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STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

NOTICE TO CONTRACTORS

AND

SPECIAL PROVISIONS

FOR CONSTRUCTION ON STATE HIGHWAY IN

THE CITY AND COUNTY OF SAN FRANCISCO AND ALAMEDA COUNTY IN SAN FRANCISCO AND OAKLAND FROM 1.3 km EAST OF THE YERBA BUENA ISLAND TUNNEL EAST PORTAL

DISTRICT 04, ROUTE 80

For Use in Connection with Standard Specifications Dated JULY 1999, Standard Plans Dated JULY 1999, and Labor Surcharge and Equipment Rental Rates.

CONTRACT NO. 04-012024

04-SF,Ala-80-13.9/14.3,0.0/1.6

Federal Aid Project

***ACIM-080-1(085)8N**

Bids Open: November 14, 2001
Dated: July 16, 2001

OSD

****

IMPORTANT SPECIAL NOTICES

PROJECT FUNDING AND OPENING OF PROPOSALS

Funding available for this project is insufficient at this time to award and construct the project. Bids will not be opened and the contract will not be awarded until sufficient funds are made available. Bidders are advised that any and all costs incurred in preparing a bid for this project are at bidder's sole risk, cost and expense. If funds are subsequently made available to permit full project funding, prospective bidders who have obtained project plans, special provisions and proposal forms from the Department's Plans and Bid Documents Room will be notified by contract addendum. If this notification is within 6 weeks of the date set forth in the "Notice to Contractors" for the opening of bids, the addendum will also postpone the bid opening date to allow additional time for preparation of bids.

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PRE-AWARD MEETING SPECIAL NOTICE

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The bidder's attention is directed to Section 2-1.03, "Bridge Construction Information/Questionnaire," and Section 3, "Pre-Award Meeting and Award and Execution of Contract," in the Special Provisions.

Responses to the **"Bridge Construction Information/Questionnaire"** included in the Proposal must be **submitted with the bid**.

A pre-award **qualifications review meeting** will be conducted with the apparent low bidder on **November 16, 2001 at 10:00 a.m. in the third floor conference room, 1727 - 30th Street, Sacramento, CA 95816.** The purpose of the meeting will be to determine the bidder's qualifications and ability to complete the construction work on this project. The second and third apparent low bidders may also be requested to participate in pre-award qualifications review meetings.

Establishing to the satisfaction of the Department the bidder's qualifications and ability to complete the bridge construction work in a safe and timely manner is a condition for being eligible for award of the contract.

****

- The bidder's attention is directed to Section 5, containing specifications for \"Disputes Review Board,\" of the Special Provisions, regarding establishing a Disputes Review Board (DRB) for the project.

- The Special Provisions for Federal-aid projects (with and without DBE goals) have been revised to incorporate changes made by new regulations governing the DBE Program (49 CFR Part 26).

  Sections 2 and 5 incorporate the changes. Bidders should read these sections to become familiar with them. Attention is directed to the following significant changes:

Section 2, "Disadvantaged Business Enterprise (DBE)" revises the counting of participation by DBE primes, and the counting of trucking performed by DBE firms. The section also revises the information that must be submitted to the Department in order to receive credit for trucking.

Section 2, "Submission of DBE Information" revises the information required to be submitted to the Department to receive credit toward the DBE goal. It also revises the criteria to demonstrate good faith efforts.

Section 5, "Subcontractor and DBE Records" revises the information required to be reported at the end of the project, and information related to trucking that must be submitted throughout the project.

Section 5, "DBE Certification Status" adds new reporting requirements related to DBE certification.

Section 5, "Subcontracting" describes the efforts that must be made in the event a DBE subcontractor is terminated or fails to complete its work for any reason.

Section 5, "Prompt Progress Payment to Subcontractors" requires prompt payment to all subcontractors.

Section 5, "Prompt Payment of Withheld Funds to Subcontractors" requires the prompt payment of retention to all subcontractors.

- **Payment Bonds**
  Attention is directed to Section 5 of the Special Provisions, regarding contract bonds. The payment bond shall be in a sum not less than one hundred percent of the total amount payable by the terms of the contract.

- Attention is directed to Section 11-2, "Portland Cement Concrete," of these Special Provisions which contains Section 90, "Portland Cement Concrete," of the Standard Specifications.

- Attention is directed to "Miscellaneous Metal," in Section 8-1, "Miscellaneous," of these Special Provisions for new requirements for miscellaneous metal.

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STANDARD PLANS LIST

The Standard Plan sheets applicable to this contract include, but are not limited to those indicated below. The Revised Standard Plans (RSP) and New Standard Plans (NSP) which apply to this contract are included as individual sheets of the project plans.

A10A	Abbreviations
A10B	Symbols
A20A	Pavement Markers and Traffic Lines, Typical Details
A20B	Pavement Markers and Traffic Lines, Typical Details
A62B	Limits of Payment for Excavation and Backfill – Bridge Surcharge and Wall
A62C	Limits of Payment for Excavation and Backfill – Bridge
T10	Traffic Control System for Lane Closure On Freeways and Expressways
B0-1	Bridge Details
B0-5	Bridge Details
B0-13	Bridge Details
B6-21	Joint Seals (Maximum Movement Rating = 50 mm)
B7-1	Box Girder Details
B7-6	Deck Drains - Types D-1 and D-2
B7-10	Utility Opening - Box Girder
B7-11	Utility Details
B8-5	Cast-in-Place Prestressed Girder Details
B11-51	Tubular Hand Railing
RS1	Roadside Signs, Typical Installation Details No. 1
RS4	Roadside Signs, Typical Installation Details No. 4
S8A	Overhead Signs - Steel Frame - Removable Sign Panel Frames
S8B	Overhead Signs - Removable Sign Panel Frames - Overhead Formed Panel Mounting Details
S8D	Overhead Signs - Truss, Removable Sign Panel Frames - 2794 mm and 3048 mm Sign Panels
S9	Overhead Signs - Walkway Details No. 1
S10	Overhead Signs - Walkway Details No. 2
RSP S11	Overhead Signs - Walkway Safety Railing Details
S40N	Overhead Signs- Tubular, Instructions and Examples
S40R	Overhead Signs - Tubular, Structural Frame Details No. 1
RSP S40S	Overhead Signs - Tubular, Structural Frame Details No. 2
RSP S40T	Overhead Signs - Tubular, Base Plate and Anchorage Details
RSP S40U	Overhead Signs - Tubular, Foundation Details
ES-1A	Signal, Lighting and Electrical Systems - Symbols and Abbreviations
ES-1B	Signal, Lighting and Electrical Systems - Symbols and Abbreviations
ES-3A	Signal, Lighting and Electrical Systems - Controller Cabinet Details
ES-5A	Signal, Lighting and Electrical Systems - Detectors
ES-5B	Signal, Lighting and Electrical Systems - Detectors
RSP ES-6B	Lighting Standards - Types 15 AND 21, Barrier Rail Mounted Details
ES-9B	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9C	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9D	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9E	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-13A	Signal, Lighting and Electrical Systems - Splicing Details
ES-15C	Sign Illumination - Sign Illumination Equipment
ES-15D	Sign Illumination - Sign Illumination Control
ES-16A	Closed Circuit Television Pole Details

DEPARTMENT OF TRANSPORTATION

NOTICE TO CONTRACTORS

CONTRACT NO. 04-012024

04-SF,Ala-80-13.9/14.3,0.0/1.6

Sealed proposals for the work shown on the plans entitled:

STATE OF CALIFORNIA; DEPARTMENT OF TRANSPORTATION; PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY IN THE CITY AND COUNTY OF SAN FRANCISCO AND ALAMEDA COUNTY IN SAN FRANCISCO AND OAKLAND FROM 1.3 km EAST OF THE YERBA BUENA ISLAND TUNNEL EAST PORTAL

will be received at the Department of Transportation, 1120 N Street, Room 0200, MS #26, Sacramento, CA 95814, until 2 o'clock p.m. on November 14, 2001, at which time they will be publicly opened and read in Room 0100 at the same address.

Proposal forms for this work are included in a separate book entitled:

STATE OF CALIFORNIA; DEPARTMENT OF TRANSPORTATION; PROPOSAL AND CONTRACT FOR CONSTRUCTION ON STATE HIGHWAY IN THE CITY AND COUNTY OF SAN FRANCISCO AND ALAMEDA COUNTY IN SAN FRANCISCO AND OAKLAND FROM 1.3 km EAST OF THE YERBA BUENA ISLAND TUNNEL EAST PORTAL

General work description: Construct center portion (4 frames) of new bridge to replace existing bridge.

This project has a goal of 20 percent disadvantaged business enterprise (DBE) participation.
No prebid meeting is scheduled for this project.
Bidder inquiries may be made as follows:

For all inquiries: Toll Bridge Duty Senior at the District 04 Office, 111 Grand Avenue, Oakland, California 94612, fax number (510) 286-4563, email address duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Bidders will be requested to submit their inquiries in writing to the Oakland address, accompanied by an electronic copy where feasible, in order to avoid any misunderstandings. Written inquiries shall include the bidder's name, address and phone number. Written inquiries will be investigated and an addendum to the contract will be issued to the extent feasible and at the discretion of the Department. A copy of each addendum will also be posted on the Internet at "http://www.dot.ca.gov/hq/esc/tollbridge/Index.html"."

Contractors' will be requested to submit their inquiries in writing to the Oakland address, accompanied by an electronic copy where feasible, in order to avoid any misunderstandings, Written inquiries shall include the contractor's name, address and phone number.

The responses to contractors' inquiries, unless incorporated into a formal addendum to the contract, are not a part of the contract and are provided for the contractor's convenience only. In some instances, the question and answer may represent a summary of the matters discussed rather than a word-for-word recitation. The responses may be considered along with all other information furnished to prospective bidders for the purpose of bidding on the project. The availability or use of information provided in the responses to contractors' inquiries is not to be construed in any way as a waiver of the provisions of section 2-1.03 of the Standard Specifications or any other provision of the contract, the plans, Standard Specifications or special provisions, nor to excuse the contractor from full compliance with those contract requirements. Bidders are cautioned that subsequent responses or contract addenda may affect or vary a response previously given, and any such subsequent response or addenda should be taken into consideration when submitting a bid for the project. Inquiries that are submitted within seventy-two (72) hours of the bid opening date might not be addressed.

THIS PROJECT IS SUBJECT TO THE "BUY AMERICA" PROVISIONS OF THE SURFACE TRANSPORTATION ASSISTANCE ACT OF 1982 AS AMENDED BY THE INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT OF 1991.

Bids are required for the entire work described herein.

At the time this contract is awarded, the Contractor shall possess either a Class A license or a combination of Class C licenses which constitutes a majority of the work.

This contract is subject to state contract nondiscrimination and compliance requirements pursuant to Government Code, Section 12990.

Project plans, special provisions, and proposal forms for bidding this project can only be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, MS #26, Transportation Building, 1120 N Street, Sacramento, California 95814, FAX No. (916) 654-7028, Telephone No. (916) 654-4490. Use FAX orders to expedite orders for project plans, special provisions and proposal forms. FAX orders must include credit card charge number, card expiration date and authorizing signature. Project plans, special provisions, and proposal forms may be seen at the above Department of Transportation office and at the offices of the District Directors of Transportation at Irvine, Oakland, and the district in which the work is situated. Standard Specifications and Standard Plans are available through the State of California, Department of Transportation, Publications Unit, 1900 Royal Oaks Drive, Sacramento, CA 95815, Telephone No. (916) 445-3520.

Cross sections for this project are not available.

The successful bidder shall furnish a payment bond and a performance bond.

The Department of Transportation hereby notifies all bidders that it will affirmatively insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full opportunity to submit bids in response to this invitation.

The U.S. Department of Transportation (DOT) provides a toll-free "hotline" service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., eastern time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county, or counties, in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at the Labor Compliance Office at the offices of the District Director of Transportation for the district in which the work is situated, and available from the California Department of Industrial Relations' Internet Web Site at: http://www.dir.ca.gov. The Federal minimum wage rates for this project as predetermined by the United States Secretary of Labor are set forth in the books issued for bidding purposes entitled "Proposal and Contract," and in copies of this book that may be examined at the offices described above where project plans, special provisions, and proposal forms may be seen. Addenda to modify the Federal minimum wage rates, if necessary, will be issued to holders of "Proposal and Contract" books. Future effective general prevailing wage rates which have been predetermined and are on file with the California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

Attention is directed to the Federal minimum wage rate requirements in the books entitled "Proposal and Contract." If there is a difference between the minimum wage rates predetermined by the Secretary of Labor and the general prevailing wage rates determined by the Director of the California Department of Industrial Relations for similar classifications of labor, the Contractor and subcontractors shall pay not less than the higher wage rate. The Department will not accept lower State wage rates not specifically included in the Federal minimum wage determinations. This includes "helper" (or other classifications based on hours of experience) or any other classification not appearing in the Federal wage determinations. Where Federal wage determinations do not contain the State wage rate determination otherwise available for use by the Contractor and subcontractors, the Contractor and subcontractors shall pay not less than the Federal minimum wage rate which most closely approximates the duties of the employees in question.

DEPARTMENT OF TRANSPORTATION

Deputy Director Transportation Engineering

Dated July 16, 2001

RRF/SAN

COPY OF ENGINEER'S ESTIMATE

(NOT TO BE USED FOR BIDDING PURPOSES)

04-012024

Item	Item Code	Item	Unit of Measure	Estimated Quantity
1	021678	TRANSPORTATION FOR THE ENGINEER	LS	LUMP SUM
2	021679	ENGINEER'S FIELD OFFICE	LS	LUMP SUM
3	021680	ELECTRONIC MOBILE DAILY DIARY COMPUTER SYSTEM DATA DELIVERY	LS	LUMP SUM
4	021681	TEMPORARY FENCE (TYPE ESA)	M	200
5	021682	PHOTOGRAPHY OF BUILDING	LS	LUMP SUM
6	070010	PROGRESS SCHEDULE (CRITICAL PATH)	LS	LUMP SUM
7	070018	TIME-RELATED OVERHEAD	WDAY	900
8	048536	TEMPORARY TOWER (LOCATION AE)	LS	LUMP SUM
9	048537	TEMPORARY TOWER (LOCATION BE)	LS	LUMP SUM
10	048538	TEMPORARY TOWER (LOCATION CE)	LS	LUMP SUM
11	048539	TEMPORARY TOWER (LOCATION AW)	LS	LUMP SUM
12	048540	TEMPORARY TOWER (LOCATION BW)	LS	LUMP SUM
13	048541	TEMPORARY TOWER (LOCATION CW)	LS	LUMP SUM
14	120090	CONSTRUCTION ARE SIGNS	LS	LUMP SUM
15	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM
16	074020	WATER POLLUTION CONTROL	LS	LUMP SUM
17	021683	TEMPORARY CONCRETE WASHOUT FACILITY	LS	LUMP SUM
18	021684	TURBIDITY CONTROL	LS	LUMP SUM
19 (S)	153225	PREPARE CONCRETE BRIDGE DECK SURFACE	M2	97 600
20	048542	JACK SUPERSTRUCTURE (FRAME E1)	LS	LUMP SUM

Item	Item Code	Item	Unit of Measure	Estimated Quantity
21	048543	JACK SUPERSTRUCTURE (FRAME E2)	LS	LUMP SUM
22	048544	JACK SUPERSTRUCTURE (FRAME E3)	LS	LUMP SUM
23	048545	JACK SUPERSTRUCTURE (FRAME W1)	LS	LUMP SUM
24	048546	JACK SUPERSTRUCTURE (FRAME W2)	LS	LUMP SUM
25	048547	JACK SUPERSTRUCTURE (FRAME W3)	LS	LUMP SUM
26 (F)	048548	STRUCTURE EXCAVATION (BRIDGE, UNDERWATER)	M3	65 000
27	048549	FURNISH 2.5 M CAST-IN-STEEL SHELL CONCRETE PILING	M	15 260
28 (S)	048550	DRIVE 2.5 M CAST-IN-STEEL SHELL CONCRETE PILE	EA	160
29 (S-F)	048551	REDRIVE EXIST 2.438 M STEEL PIPE PILE	EA	3
30 (S)	048552	PRESTRESSING, LONGITUDINAL (FRAME 1)	LS	LUMP SUM
31` (S)	048553	PRESTRESSING, LONGITUDINAL (FRAME 2)	LS	LUMP SUM
32 (S)	048554	PRESTRESSING, LONGITUDINAL (FRAME 3)	LS	LUMP SUM
33 (S)	048555	PRESTRESSING, LONGITUDINAL (FRAME 4)	LS	LUMP SUM
34 (S)	048556	PRESTRESSING, TRANSVERSE	LS	LUMP SUM
35 (S)	048557	PRESTRESSING, HIGH STRENGTH BARS	LS	LUMP SUM
36 (F)	510051	STRUCTURAL CONCRETE, BRIDGE FOOTING	M3	31 000
37 (F)	048558	STRUCTURAL CONCRETE, BRIDGE FOOTING (LIGHTWEIGHT)	M3	23 000
38 (F)	510053	STRUCTURAL CONCRETE, BRIDGE	M3	31 400
39 (F)	048559	STRUCTURAL CONCRETE, BRIDGE PIER	M3	28 350
40 (F)	048560	FURNISH PRECAST CONCRETE PANEL (PRECAST SEGMENT, LIGHTWEIGHT)	M3	13 900

Item	Item Code	Item	Unit of Measure	Estimated Quantity
41 (F)	048561	FURNISH PRECAST CONCRETE PANEL (PIER TABLE, LIGHTWEIGHT)	M3	2350
42 (S-F)	048562	ERECT PRECAST CONCRETE PANEL (PIER TABLE, LIGHTWEIGHT)	M3	2350
43 (F)	048563	FURNISH PRECAST CONCRETE WALL (BRIDGE FOOTING)	M3	3510
44 (S-F)	048564	ERECT PRECAST CONCRETE WALL (BRIDGE FOOTING)	M3	3510
45 (F)	048565	FURNISH PRECAST CONCRETE FENDER MODULES	M3	1820
46 (S-F)	048566	ERECT PRECAST CONCRETE FENDER MODULES	M3	1820
47 (F)	048567	FURNISH PRECAST CONCRETE SEGMENT	M3	85 000
48 (S-F)	048568	ERECT PRECAST CONCRETE SEGMENT	M3	98 900
49 (S-F)	048569	FURNISH POLYESTER CONCRETE OVERLAY (20 MM)	M3	1950
50 (S-F)	048570	PLACE POLYESTER CONCRETE OVERLAY (20 MM)	M2	97 600
51 (S-F)	048571	FURNISH POLYESTER CONCRETE OVERLAY (13 MM)	M3	138
52 (S-F)	048572	PLACE POLYESTER CONCRETE OVERLAY (13 MM)	M2	10 580
53 (S-F)	048573	CIRCULAR SEGMENTED BEARING	EA	80
54 (S-F)	048574	NEOPRENE BUMPER	EA	12
55 (S)	519121	JOINT SEAL (TYPE B - MR 30 MM)	M	790
56 (S)	048575	MODULAR JOINT SEAL ASSEMBLY (HINGE BW)	M	25
57 (S)	048576	MODULAR JOINT SEAL ASSEMBLY (HINGE BE)	M	25
58 (S)	048577	MODULAR JOINT SEAL ASSEMBLY (HINGE CW)	M	25
59 (S)	048578	MODULAR JOINT SEAL ASSEMBLY (HINGE CE)	M	25
60 (S)	048579	MODULAR JOINT SEAL ASSEMBLY (HINGE DW)	M	25

Item	Item Code	Item	Unit of Measure	Estimated Quantity
61 (S)	048580	MODULAR JOINT SEAL ASSEMBLY (HINGE DE)	M	25
62 (S-F)	520102	BAR REINFORCING STEEL (BRIDGE)	KG	16 490 000
63 (S-F)	520110	BAR REINFORCING STEEL (EPOXY COATED) (BRIDGE)	KG	9 110 000
64 (S-F)	048581	WELDED HEADED BAR REINFORCEMENT	EA	140 500
65 (F)	048582	FURNISH STRUCTURAL STEEL (ORTHOTROPIC BOX GIRDER)	KG	2 600 000
66 (S-F)	048583	ERECT STRUCTURAL STEEL (ORTHOTROPIC BOX GIRDER)	KG	2 600 000
67 (F)	048584	FURNISH STRUCTURAL STEEL (BRIDGE FOOTING)	KG	25 000 000
68 (S)	048585	ERECT STRUCTURAL STEEL (BRIDGE FOOTING)	KG	25 000 000
69 (F)	048586	FURNISH STRUCTURAL STEEL (PIPE BEAM)	KG	1 347 000
70 (S-F)	048587	ERECT STRUCTURAL STEEL (PIPE BEAM)	KG	1 347 000
71 (S-F)	048588	FURNISH STRUCTURAL STEEL (PIPE BEAM FUSE)	EA	40
72 (F)	048589	FURNISH STRUCTURAL STEEL (BRIDGE BIKEPATH)	KG	3 290 000
73 (S-F)	048590	ERECT STRUCTURAL STEEL (BRIDGE BIKEPATH)	KG	3 290 000
74 (S-F)	048591	TRAVELER SUPPORT RAILS	KG	192 000
75 (S)	048592	TRAVELER SCAFFOLD	LS	LUMP SUM
76 (S)	048593	TRAVELER SCAFFOLD MECHANICAL	LS	LUMP SUM
77	021685	SERVICE PLATFORMS	EA	26
78	560218	FURNISH SIGN STRUCTURE (TRUSS)	KG	29 000
79	560219	INSTALL SIGN STRUCTURE (TRUSS)	KG	29 000
80	562004	METAL (RAIL MOUNTED SIGN)	KG	1900

Item	Item Code	Item	Unit of Measure	Estimated Quantity
81 (S-F)	048594	FURNISH AND INSTALL REINFORCED, RECYCLED PLASTIC OR COMPOSITE PLASTIC LUMBER	M3	390
82 (S-F)	048595	ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE PANEL (5O MM)	M2	2400
83 (S)	048596	CLEAN AND PAINT STRUCTURAL STEEL (ORTHOTROPIC BOX GIRDER)	LS	LUMP SUM
84 (S)	048597	CLEAN AND PAINT STRUCTURAL STEEL (PIPE BEAM)	LS	LUMP SUM
85 (S)	048598	CLEAN AND PAINT STRUCTURAL STEEL (BRIDGE BIKEPATH)	LS	LUMP SUM
86 (S-F)	750501	MISCELLANEOUS METAL (BRIDGE)	KG	260 000
87	021286	WALKWAYS	LS	LUMP SUM
88 (S)	750505	BRIDGE DECK DRAINAGE SYSTEM	LS	LUMP SUM
89	021687	CONSTRUCTION SURVEYING	LS	LUMP SUM
90 (F)	048599	CONCRETE BARRIER (TYPE 732 MODIFIED)	M	8121
91 (S-F)	048600	STEEL BARRIER (TYPE 732 MODIFIED)	M	238
92 (S-F)	048601	BIKEPATH RAILING	M	4161
93	840561	100 MM THERMOPLASTIC TRAFFIC STRIPE	M	25 150
94	021688	75MM PAINT TRAFFIC STRIPE (BLACK, 1-COAT)	M	8400
95	840656	PAINT TRAFFIC STRIPE (2-COAT)	M	2030
96	840666	PAINT PAVEMENT MARKING (2-COAT)	M2	26
97	850101	PAVEMENT MARKER (NON-REFLECTIVE)	EA	4600
98	850111	PAVEMENT MARKER (RETROREFLECTIVE)	EA	1450
99	021689	PILE CORROSION MONITORING SYSTEM	LS	LUMP SUM
100	021690	STRONG MOTION DETECTION SYSTEM	LS	LUMP SUM

Item	Item Code	Item	Unit of Measure	Estimated Quantity
101 (S)	021691	TRAFFIC OPERATION SYSTEM	LS	LUMP SUM
102 (S)	021692	CAMERA WITH HOUSING	EA	2
103 (S)	021693	PAN AND TILT UNIT	EA	2
104 (S)	021694	CAMERA CONTROL UNIT	EA	2
105 (S)	021695	TRANSMITTER DUPLEX DATA	EA	2
106 (S)	021696	PREFORMED LOOP DETECTOR STATION	EA	12
107 (S)	021697	MICROWAVE VEHICLE DETECTION SENSOR SYSTEM	EA	10
108 (S)	021698	FIBER OPTIC DATA MODEM	EA	25
109 (S)	021699	FIBER OPTIC CABLE (72-FIBERS)	M	6900
110 (S)	021700	FIBER OPTIC CABLE (12-FIBERS)	M	1200
111 (S)	021701	FIBER OPTIC SPLICE CLOSURE	EA	28
112 (S)	021702	SUBSTATION WESTBOUND	LS	LUMP SUM
113 (S)	021703	SUBSTATION EASTBOUND	LS	LUMP SUM
114 (S)	021704	ROADWAY LEVEL WESTBOUND	LS	LUMP SUM
115 (S)	021705	GIRDER LEVEL WESTBOUND	LS	LUMP SUM
116 (S)	021706	ROADWAY LEVEL EASTBOUND	LS	LUMP SUM
117 (S)	021707	GIRDER LEVEL EASTBOUND	LS	LUMP SUM
118 (S)	021708	NAVIGATION LIGHTING SYSTEM	LS	LUMP SUM
119 (S)	021709	SUPERVISORY CONTROL AND DATA ACQUISITION REMOTE TERMINAL UNIT SYSTEM	LS	LUMP SUM
120	021710	CCSF WATER MAIN (12 NPS)	M	2130

Item	Item Code	Item	Unit of Measure	Estimated Quantity
121	021711	CCSF SEWER FORCE MAIN (10 NPS)	M	2130
122	021712	CCSF SEWER CASING PIPE (18 NPS)	M	2040
123	021713	CCSF SEWER CASING PIPE (20 NPS)	M	12
124	021714	DOMESTIC WATER (2 1/2 NPS)	M	2110
125	021715	COMPRESSED AIR (4 NPS)	M	2110
126	021716	CCSF RECLAIMED WATER (6 NPS)	M	2130
127	021717	CCSF RECLAIMED WATER CASING PIPE (10 NPS)	M	12
128	021718	SUBSTATION ARCHITECTURAL EASTBOUND	LS	LUMP SUM
129	021719	SUBSTATION ARCHITECTURAL WESTBOUND	LS	LUMP SUM
130	999990	MOBILIZATION	LS	LUMP SUM

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISIONS

Annexed to Contract No. 04-012024

SECTION 1. SPECIFICATIONS AND PLANS

The work embraced herein shall conform to the provisions in the Standard Specifications dated July 1999, and the Standard Plans dated July 1999, of the Department of Transportation insofar as the same may apply, and these special provisions.

Amendments to the Standard Specifications set forth in these special provisions shall be considered as part of the Standard Specifications for the purposes set forth in Section 5-1.04, "Coordination and Interpretation of Plans, Standard Specifications and Special Provisions," of the Standard Specifications. Whenever either the term "Standard Specifications is amended" or the term "Standard Specifications are amended" is used in the special provisions, the indented text or table following the term shall be considered an amendment to the Standard Specifications. In case of conflict between such amendments and the Standard Specifications, the amendments shall take precedence over and be used in lieu of the conflicting portions.

In case of conflict between the Standard Specifications and these special provisions, the special provisions shall take precedence over and shall be used in lieu of the conflicting portions.

SECTION 2. PROPOSAL REQUIREMENTS AND CONDITIONS

2-1.01 GENERAL

The bidder's attention is directed to the provisions in Section 2, "Proposal Requirements and Conditions," of the Standard Specifications and these special provisions for the requirements and conditions which the bidder must observe in the preparation of the Proposal form and the submission of the bid.

In addition to the subcontractors required to be listed in conformance with Section 2-1.054, "Required Listing of Proposed Subcontractors," of the Standard Specifications, each proposal shall have listed therein the portion of work that will be performed by each subcontractor listed.

The Bidder's Bond form mentioned in the last paragraph in Section 2-1.07, "Proposal Guaranty," of the Standard Specifications will be found following the signature page of the Proposal.

Submit request for substitution of an "or equal" item, and the data substantiating the request to the Department of Transportation, Division Of Construction - Duty Senior, Mail Station: 3 - B, 111 Grand Avenue / P. O. Box 23660, Oakland, CA 94623-0660, so that the request is received by the Department by close of business on the fourth day, not including Saturdays, Sundays and legal holidays, following bid opening.

In conformance with Public Contract Code Section 7106, a Noncollusion Affidavit is included in the Proposal. Signing the Proposal shall also constitute signature of the Noncollusion Affidavit.

The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate. Each subcontract signed by the bidder must include this assurance.

2-1.015 FEDERAL LOBBYING RESTRICTIONS

Section 1352, Title 31, United States Code prohibits Federal funds from being expended by the recipient or any lower tier subrecipient of a Federal-aid contract to pay for any person for influencing or attempting to influence a Federal agency or Congress in connection with the awarding of any Federal-aid contract, the making of any Federal grant or loan, or the entering into of any cooperative agreement.

If any funds other than Federal funds have been paid for the same purposes in connection with this Federal-aid contract, the recipient shall submit an executed certification and, if required, submit a completed disclosure form as part of the bid documents.

A certification for Federal-aid contracts regarding payment of funds to lobby Congress or a Federal agency is included in the Proposal. Standard Form - LLL, \"Disclosure of Lobbying Activities,\" with instructions for completion of the Standard Form is also included in the Proposal. Signing the Proposal shall constitute signature of the Certification.

The above-referenced certification and disclosure of lobbying activities shall be included in each subcontract and any lower-tier contracts exceeding $100,000. All disclosure forms, but not certifications, shall be forwarded from tier to tier until received by the Engineer.

The Contractor, subcontractors and any lower-tier contractors shall file a disclosure form at the end of each calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed by the Contractor, subcontractors and any lower-tier contractors. An event that materially affects the accuracy of the information reported includes:

A. A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or
B. A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or,
C. A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

2-1.02 DISADVANTAGED BUSINESS ENTERPRISE (DBE)

This project is subject to Part 26, Title 49, Code of Federal Regulations entitled "Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs." The Regulations in their entirety are incorporated herein by this reference.

Bidders shall be fully informed respecting the requirements of the Regulations and the Department's Disadvantaged Business Enterprise (DBE) program developed pursuant to the Regulations; particular attention is directed to the following matters:

A. A DBE must be a small business concern as defined pursuant to Section 3 of U.S. Small Business Act and relevant regulations promulgated pursuant thereto.
B. A DBE may participate as a prime contractor, subcontractor, joint venture partner with a prime or subcontractor, vendor of material or supplies, or as a trucking company.
C. A DBE bidder, not bidding as a joint venture with a non-DBE, will be required to document one or a combination of the following:

    1. The bidder will meet the goal by performing work with its own forces.
    2. The bidder will meet the goal through work performed by DBE subcontractors, suppliers or trucking companies.
    3. The bidder, prior to bidding, made adequate good faith efforts to meet the goal.

D. A DBE joint venture partner must be responsible for specific contract items of work, or portions thereof. Responsibility means actually performing, managing and supervising the work with its own forces. The DBE joint venture partner must share in the capital contribution, control, management, risks and profits of the joint venture. The DBE joint venturer must submit the joint venture agreement with the proposal or the DBE Information form required in the Section entitled "Submission of DBE Information" of these special provisions.
E. A DBE must perform a commercially useful function, i.e., must be responsible for the execution of a distinct element of the work and must carry out its responsibility by actually performing, managing and supervising the work.
F. DBEs must be certified by either the California Department of Transportation, or by a participating State of California or local agency which certifies in conformance with Title 49, Code of Federal Regulations, Part 26, as of the date of bid opening. It is the Contractor's responsibility to verify that DBEs are certified. Listings of DBEs certified by the Department are available from the following sources:

    1. The Department's DBE Directory, which is published quarterly. This Directory may be obtained from the Department of Transportation, Materiel Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone: (916) 445-3520.

2. The Department's Electronic Information Bulletin Board Service, which is accessible by modem and is updated weekly. The Bulletin Board may be accessed by first contacting the Department's Business Enterprise Program at Telephone: (916) 227-8937 and obtaining a user identification and password.
3. The Department's web site at http://www.dot.ca.gov/hq/bep/index.htm.
4. The organizations listed in the Section entitled "DBE Goal for this Project" of these special provisions.

G. Credit for materials or supplies purchased from DBEs will be as follows:

1. If the materials or supplies are obtained from a DBE manufacturer, 100 percent of the cost of the materials or supplies will count toward the DBE goal. A DBE manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications.
2. If the materials or supplies are purchased from a DBE regular dealer, 60 percent of the cost of the materials or supplies will count toward the DBE goal. A DBE regular dealer is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a DBE regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question. A person may be a DBE regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business as provided in this paragraph G.2. if the person both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment shall be by a long-term lease agreement and not on an ad hoc or contract-by-contract basis. Packagers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not DBE regular dealers within the meaning of this paragraph G.2.
3. Credit for materials or supplies purchased from a DBE which is neither a manufacturer nor a regular dealer will be limited to the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site, provided the fees are reasonable and not excessive as compared with fees charged for similar services.

H. Credit for DBE trucking companies will be as follows:

1. The DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there cannot be a contrived arrangement for the purpose of meeting the DBE goal.
2. The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
3. The DBE receives credit for the total value of the transportation services it provides on the contract using trucks its owns, insures, and operates using drivers it employs.
4. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.
5. The DBE may also lease trucks from a non-DBE firm, including an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement. The DBE does not receive credit for the total value of the transportation services provided by the lessee, since these services are not provided by a DBE.
6. For the purposes of this paragraph H, a lease must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE.

I. Noncompliance by the Contractor with the requirements of the regulations constitutes a breach of this contract and may result in termination of the contract or other appropriate remedy for a breach of this contract.
J. Bidders are encouraged to use services offered by financial institutions owned and controlled by DBEs.

2-1.02A DBE GOAL FOR THIS PROJECT

The Department has established the following goal for Disadvantaged Business Enterprise (DBE) participation for this project:

Disadvantaged Business Enterprise (DBE): 20 percent

Bidders may use the services of the following firms to contact interested DBEs. These firms are available to assist DBEs in preparing bids for subcontracting or supplying materials.

The following firms may be contacted for projects in the following locations:

Districts 04, 05 (except San Luis Obispo and Santa Barbara Counties), 06 (except Kern County) and 10:	Districts 08, 11 and 12:
Triaxial Management Services, Inc. - Oakland 1545 Willow Street, 1st Floor Oakland, CA 94607 Telephone - (510) 286-1313 FAX No. - (510) 286-6792	Triaxial Management Services, Inc. - San Diego 2725 Congress Street, Suite 1-D San Diego, CA 92110 Telephone - (619) 543-5109 FAX No. - (619) 543-5108

Districts 07 and 08; in San Luis Obispo and Santa Barbara Counties in District 05; and in Kern County in District 06:	Districts 01, 02, 03 and 09:
Triaxial Management Services, Inc. - Los Angeles 2594 Industry Way, Suite 101 Lynwood, CA 90262 Telephone - (310) 537-6677 FAX No. - (310) 637-0128	Triaxial Management Services, Inc. - Sacramento 930 Alhambra Blvd., #205 Sacramento, CA 95816 Telephone - (916) 553-4172 FAX No. - (916) 553-4173

2-1.02B SUBMISSION OF DBE INFORMATION

The required DBE information shall be submitted on the "CALTRANS BIDDER - DBE INFORMATION" form included in the Proposal. If the DBE information is not submitted with the bid, the DBE Information form shall be removed from the documents prior to submitting the bid.

It is the bidder's responsibility to make enough work available to DBEs and to select those portions of the work or material needs consistent with the available DBEs to meet the goal for DBE participation or to provide information to establish that, prior to bidding, the bidder made adequate good faith efforts to do so.

If DBE information is not submitted with the bid, the apparent successful bidder (low bidder), the second low bidder and the third low bidder shall submit DBE information to the Department of Transportation, 1120 N Street, Room 0200, MS #26, Sacramento, California 95814 so the information is received by the Department no later than 4:00 p.m. on the fourth day, not including Saturdays, Sundays and legal holidays, following bid opening. DBE information sent by U.S. Postal Service certified mail with return receipt and certificate of mailing and mailed on or before the third day, not including Saturdays, Sundays and legal holidays, following bid opening will be accepted even if it is received after the fourth day following bid opening. Failure to submit the required DBE information by the time specified will be grounds for finding the bid or proposal nonresponsive. Other bidders need not submit DBE information unless requested to do so by the Department.

The bidder's DBE information shall establish that good faith efforts to meet the DBE goal have been made. To establish good faith efforts, the bidder shall demonstrate that the goal will be met or that, prior to bidding, adequate good faith efforts to meet the goal were made.

Bidders are cautioned that even though their submittal indicates they will meet the stated DBE goal, their submittal should also include their adequate good faith efforts information along with their DBE goal information to protect their eligibility for award of the contract in the event the Department, in its review, finds that the goal has not been met.

The bidder's DBE information shall include the names, addresses and phone numbers of DBE firms that will participate, with a complete description of work or supplies to be provided by each, the dollar value of each DBE transaction, and a written confirmation from the DBE that it is participating in the contract. A copy of the DBE's quote will serve as written confirmation that the DBE is participating in the contract. When 100 percent of a contract item of work is not to be performed or furnished by a DBE, a description of the exact portion of that work to be performed or furnished by that DBE shall be included in the DBE information, including the planned location of that work. The work that a DBE prime contractor has committed to performing with its own forces as well as the work that it has committed to be performed by DBE subcontractors, suppliers and trucking companies will count toward the goal.

The information necessary to establish the bidder's adequate good faith efforts to meet the DBE goal should include:

A. The names and dates of each publication in which a request for DBE participation for this project was placed by the bidder.
B. The names and dates of written notices sent to certified DBEs soliciting bids for this project and the dates and methods used for following up initial solicitations to determine with certainty whether the DBEs were interested.
C. The items of work which the bidder made available to DBE firms, including, where appropriate, any breaking down of the contract work items (including those items normally performed by the bidder with its own forces) into economically feasible units to facilitate DBE participation. It is the bidder's responsibility to demonstrate that sufficient work to meet the DBE goal was made available to DBE firms.
D. The names, addresses and phone numbers of rejected DBE firms, the firms selected for that work, and the reasons for the bidder's choice.
E. Efforts made to assist interested DBEs in obtaining bonding, lines of credit or insurance, and any technical assistance or information related to the plans, specifications and requirements for the work which was provided to DBEs.
F. Efforts made to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services, excluding supplies and equipment the DBE subcontractor purchases or leases from the prime contractor or its affiliate.
G. The names of agencies contacted to provide assistance in contacting, recruiting and using DBE firms.
H. Any additional data to support a demonstration of good faith efforts.

2-1.03 BRIDGE CONSTRUCTION INFORMATION/QUESTIONNAIRE

The Department has established the need to obtain information regarding each bidder's qualifications for performing bridge construction work contracts.

Bidders shall submit responses to the "Bridge Construction Information/Questionnaire" included in the Proposal. The responses to the Questionnaire shall be submitted with the bid.

In signing the signature page of the Proposal, the bidder certifies that the information and answers on the "Bridge Construction Information/Questionnaire" are complete and accurate.

2-1.04 ESCROW OF BID DOCUMENTATION

Bid documentation shall consist of all documentary and calculated information generated by the Contractor in preparation of the bid. The bid documentation shall conform to the requirements in these special provisions, and shall be submitted to the Department and held in escrow for the duration of the contract.

In the resolution of disputes involving the project, the escrowed bid documents will be the only documents accepted from the Contractor regarding preparation of the bid.

In signing the proposal, the bidder certifies that the material submitted for escrow constitutes all the documentary information used in preparation of the bid and that he has personally examined the contents of the container and that they are complete.

Nothing in the bid documentation shall be construed to change or modify the terms or conditions of the contract.

Escrowed bid documentation will not be used for pre-award evaluation of the Contractor's anticipated methods of construction, nor to assess the Contractor's qualifications for performing the work.

Bid documentation shall clearly itemize the Contractor's estimated costs of performing the work. The documentation submitted shall be complete and so detailed as to allow for an in-depth analysis of the Contractor's estimate.

The bid documentation shall include, but not be limited to: quantity takeoffs; rate schedules for the direct costs and the time- and nontime-related indirect costs for labor (by craft), plant and equipment ownership and operation, permanent and expendable materials, insurance and subcontracted work; estimated construction schedules, including sequence and duration and development of production rates; quotations from subcontractors and suppliers; estimates of field and home office overhead; contingency and margin for each contract item of work; names of the persons responsible for preparing the bidder's estimate, and other reports, calculations, assumptions and information used by the bidder to arrive at the estimate submitted with the proposal.

The Contractor shall also submit bid documentation for each subcontractor and supplier whose total subcontract exceeds $250,000. Subcontractor or supplier bid documentation shall be enclosed with the Contractor's submittal. The examination of subcontractors' and suppliers' bid documentation will be accomplished in the same manner as for the Contractor's bid documentation. If a subcontractor or supplier is replaced, bid documentation for the new subcontractor or supplier shall be submitted for review and escrow before authorization for the substitution will be granted. Upon request of a subcontractor or supplier, the bid documentation from that subcontractor or supplier shall be reviewed only by the subcontractor or supplier and the Department.

If the bidder is a joint venture, the bid documentation shall include the joint venture agreement, the joint venture estimate comparison and final reconciliation of the joint venture estimate.

Copies of the proposals submitted by the first, second and third low bidders will be provided to the respective bidders for inclusion in the bid documentation to be escrowed.

The first, second, and third apparent low bidders shall present the bid documentation for escrow at the District 04 Office, 111 Grand Avenue, Room 12-820, Oakland, California, on the first Monday, at 1:00 p.m.., following the time indicated in the "Notice to Contractors" for the opening of bids.

Bid documentation shall be submitted in a sealed container, clearly marked with the bidder's name, date of submittal, project contract number and the words, "Bid Documentation for Escrow."

Failure to submit the actual and complete bid documentation as specified herein within the time specified shall be cause for rejection of the proposal.

Upon submittal, the bid documentation of the apparent low bidder will be examined and inventoried by the duly designated representatives of the Contractor and the Department to ensure that the bid documentation is authentic, legible, and in accordance with the terms of this section "Escrow of Bid Documentation." The examination will not include review of, nor will it constitute approval of, proposed construction methods, estimating assumptions or interpretation of the contract. The examination will not alter any conditions or terms of the contract. The acceptance or rejection by the Department that the submitted bid documents are in compliance with this section "Escrow of Bid Documentation" shall be completed within 48 hours of the time the bid documentation is submitted by the Contractor.

At the completion of the examination, the bid documents will be sealed and jointly deposited at an agreed commercial bank.

Bid documentation submitted by the second and third apparent low bidders will be jointly deposited at agreed commercial banks. If the apparent low bid is withdrawn or rejected, the bid documentation of the second low bidder will be examined and inventoried in the manner specified above, then sealed and deposited again in escrow. If the second low bid is withdrawn or rejected, the bid documentation of the third low bidder will be examined and inventoried in the manner specified above, then sealed and deposited again in escrow. Upon execution and final approval of the contract or rejection of all bids, the bid documentation will be returned to any remaining unsuccessful bidders.

The escrowed bid documentation may be examined by the designated representatives of both the Department and the Contractor, at any time deemed necessary by either the Department or the Contractor to assist in the negotiation of price adjustments and change orders, or to assist in the potential resolution or in the settlement of claims or disputes.

If requested by a Disputes Review Board, the escrowed bid documentation may be utilized to assist the Board in its recommendations.

The bid documentation submitted by the Contractor will be held in escrow until the contract has been completed, the ultimate resolution of all disputes and claims has been achieved and receipt of final payment has been accepted by the Contractor. The escrowed bid documentation will then be released from escrow to the Contractor.

The bid documentation submitted by the bidder is, and shall remain, the property of the bidder, and is subject to only joint review by the Department and the bidder. The Department stipulates and expressly acknowledges that the submitted bid documentation constitutes trade secrets and will not be deemed public records. This acknowledgment is based on the Department's express understanding that the information contained in the bid documentation is not known outside the bidder's business, is known only to a limited extent and only by a limited number of employees of the bidder, is safeguarded while in the bidder's possession, is extremely valuable to the bidder and could be extremely valuable to the bidder's competitors by virtue of it reflecting the bidder's contemplated techniques of construction. The Department acknowledges that the bid documentation includes a compilation of information used in the bidder's business, intended to give the bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. The Department agrees to safeguard the bid documentation, and all information contained therein, against disclosure, including disclosure of subcontractor bid documentation to the Contractor and other subcontractors to the fullest extent permitted by law. However, in the event of arbitration or litigation, the bid documentation shall be subject to discovery, and the Department assumes no responsibility for safeguarding the bid documentation unless the Contractor has obtained an appropriate protective order issued by the arbitrator or the court.

Full compensation for preparing the bid documentation, presenting it for escrow and reviewing it for escrow and upon request of the Engineer shall be considered as included in the contract prices paid for the various items of work, and no additional compensation will be allowed therefor.

The direct cost of depositing the bid documentation in escrow at the agreed commercial bank will be paid by the State.

SECTION 3. PRE-AWARD MEETING AND AWARD AND EXECUTION OF CONTRACT

3-1.01 GENERAL

The bidder's attention is directed to the provisions in Section 3, "Award and Execution of Contract," of the Standard Specifications, and these special provisions for the requirements and conditions concerning the pre-award meeting and the award and execution of contract.

3-1.01A PRE-AWARD MEETING.--Bidders are advised that on **October 25, 2001** at 10:00 a.m., in the third floor conference room, 1727 - 30th Street, Sacramento, CA 95816, the apparent low bidder shall participate in a pre-award qualifications review meeting conducted by an agent of the Director. Non-attendance to the qualifications review meeting by the apparent low bidder shall be just cause for rejection of the bid and forfeiture of the proposal guaranty. At the qualifications review meeting, the low bidder shall be prepared to discuss and answer questions relative to the responses to the "Bridge Construction Information/Questionnaire" submitted with the bid. The Director's agent will prepare written findings and recommendations to the Engineer regarding award of the contract to the apparent low bidder based on the bridge construction information and responses submitted with the bid, and on the information provided at the qualifications review meeting. The Engineer's determination on the bidder's qualifications for performing bridge construction work, in a manner that is safe for the workers and the public, will be based on the bidder's experience, qualifications of on-site supervisory personnel, equipment, conceptual approach to the bridge construction work and safety history of the bidder and its supervisory personnel. The decision of the Engineer regarding the bidder's qualifications shall be final.

The second and third apparent low bidders shall participate in pre-award qualifications review meetings if requested to do so by the Department. Notification by the Department will be within 7 days after the bid opening, and will be provided at least 12 hours prior to the qualifications review meeting. Non-attendance by the second or third apparent low bidder at any such requested meeting shall be just cause for rejection of bid and forfeiture of the proposal guaranty.

3-1.01B AWARD AND EXECUTION OF CONTRACT.--The award of contract, if it be awarded, will be to the lowest responsible bidder whose proposal complies with all the requirements prescribed and who has met the goal for DVBE participation or has demonstrated, to the satisfaction of the Department, good faith effort to do so and who has established to the satisfaction of the Engineer, the qualifications and ability to complete the construction work on this project in a safe and timely manner. Meeting the goal for DVBE participation or demonstrating, to the satisfaction of the Department, good faith efforts to do so and establishing the qualifications and ability to complete the construction work are conditions for being eligible for award of contract.

It is anticipated that this contract will be awarded within 10 days after the bid opening.

The contract shall be signed by the successful bidder and shall be received with contract bonds by the Department within **4 days**, including Saturdays, Sundays and legal holidays, after the bidder has received notice that the contract has been awarded. Failure to do so shall be just cause for forfeiture of the proposal guaranty. The executed contract documents shall be delivered to the following address: Department of Transportation, P.O. Box 942874, Sacramento, CA 94274-0001, Attn: Office Engineer (MS 43)- Contracts.

Within 2 days, not including Saturdays, Sundays and legal holidays, of return of the executed contract and bonds, the Department will notify the successful bidder of either approval of the contract by the Attorney General or the attorney appointed and authorized to represent the Department of Transportation, or disapproval of the submittal. Should the Department fail to provide notification within said 2 days, the delay will be considered a right of way delay as specified in Section 8-1.09, \"Right of Way Delays,\" of the Standard Specifications.

A "Payee Data Record" form will be included in the contract documents to be executed by the successful bidder. The purpose of the form is to facilitate the collection of taxpayer identification data. The form shall be completed and returned to the Department by the successful bidder with the executed contract and contract bonds. For the purposes of the form, payee shall be deemed to mean the successful bidder. The form is not to be completed for subcontractors or suppliers. Failure to complete and return the "Payee Data Record" form to the Department as provided herein will result in the retention of 31 percent of payments due the contractor and penalties of up to $20,000. This retention of payments for failure to complete the "Payee Data Record" form is in addition to any other retention of payments due the Contractor.

SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION AND LIQUIDATED DAMAGES

Attention is directed to the provisions in Section 8-1.03, "Beginning of Work," in Section 8-1.06, "Time of Completion," and in Section 8-1.07, "Liquidated Damages," of the Standard Specifications and these special provisions.

The 72 hours advance notice before beginning work as referred to in Section 8-1.03, "Beginning of Work," is changed to 24 hours advance notice for this project.

The work shall be diligently prosecuted to completion before the expiration of **900 WORKING DAYS** beginning at 12:01 a.m. on the day after the day of contract award.

The Contractor shall pay to the State of California the sum of **$70,000** per day, for each and every calendar day's delay in finishing the work in excess of the number of working days perscribed above.

Attention is directed to "Order of Work" of these special provisions. The Contractor shall not have the exclusive right to use the marine access areas for the Contract 04-012044 (Oakland Touchdown), as shown on the plans, and shall evacuate these areas after **410 Working Days** beginning at 12:01 a.m. on the day after the day of contract award.

The Contractor shall pay the State of California liquidated damages the sum of **$17,500** per day, for each and every calendar day's delay in vacating the marine access areas for Contract 04-012044 in excess of 410 working days, beginning at 12:01 a.m. on the day after the day of contract award.

No incentive payments will be paid nor will disincentive deductions be charged on this project.

SECTION 5. GENERAL

SECTION 5-1. MISCELLANEOUS

5-1.01 WORKING DRAWINGS

Working drawings shall conform to the requirements in Section 5-1.02 " Plans and Working Drawings," of the Standard Specifications and these special provisions. Working drawings shall include supplements and calculations that are in addition to drawings.

Working drawings shall be submitted to the following location:

Office of the Resident Engineer, Contract 04-012024
SFOBB Toll Plaza Administration Building
Room 1261
Oakland , CA 94608

Working drawings shall conform to the following:

A. For initial review, 6 sets of the working drawings, shall be submitted. After the Engineer has determined that a submittal is complete, 12 additional sets shall be submitted.
B. Drawings shall be 559 mm x 864 mm or 279 mm x 432 mm in size. Supplements and calculations shall 22 mm x 28 mm in size.
C. For drawings, text size shall be nominally 2.8 mm high, minimum. For supplement and calculations, font size shall be 12, minimum.
D. Each working drawing sheet and each page of supplement or calculation, shall include the jobsite name of the structure as shown on the contract plans, District-County-Route-Kilometer Post, bridge number and contract number.
E. Text and details shall be legible and suitable for photocopying and reduction.
F. In addition to the paper copies of the working drawings, electronic files shall be submitted. Electronic files shall be portable document format (PDF) and shall be submitted on compact disk (CD) media. Each plan sheet shall be a separate PDF file on the CD. The electronic copy of the calculations and supplement shall be made into separate PDF files so that no more than 50 pages are included in a single file on the CD. The CD shall contain an index consisting of the file names and a description of the corresponding file contents. The files shall be listed in the sequence of: 1) index, 2) drawings, 3) supplement, and 4) calculations. If more than one CD is used for a given working drawing submittal, the index shall be included on each CD.
G. Microfilms are required for approved shop drawings and shall be only a 24x reduction. The edge of the corrected original tracing image shall be clearly visible and visually parallel with the edges of the page. A clear, legible symbol shall be provided on the upper left side of each page to show the amount of reduction, and a horizontal and vertical scale shall be provided on each reduced print to facilitate enlargement to original scale.
H. At the completion of the contract, one compiled set of all approved working drawings (in electronic form and including all corrections and revisions) shall be furnished to the Engineer. The index shall be the first file on the CD.
I. At the completion of the contract, one set of reduced prints on 75-g/m2 (minimum) bond paper, 279 mm x 432 mm in size, of the corrected original tracings of all approved working drawings, including all corrections and revisions shall be furnished to the Engineer. Reduced prints that are common to more than one structure shall be submitted

for each structure. An index prepared specifically for the drawings for each structure containing sheet numbers and titles shall be included on the first reduced print in the set for each structure. Reduced prints for each structure shall be arranged in the order of drawing numbers shown in the index

Working drawings shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California. When independently checked calculations are required, these calculations shall be stamped and signed by another engineer who is registered as a Civil Engineer in the State of California.

Working drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work. The time shall be proportional to the complexity of the work, but in no case shall the time be less than the review time as specified for the type of working drawings as required elsewhere in these special provisions.

The Engineer will review a working drawing submittal for completeness. The Engineer will notify the Contractor in writing when a given working drawing submittal is determined to be complete, and the review period shall begin on that day.

Should the Engineer fail to review the complete working drawing submittal within the time specified, and the Contractor's controlling operation on the critical path is delayed (as determined by the Engineer) by the Engineer's failure to review within the time specified, an extension of time will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

5-1.011 EXAMINATION OF PLANS, SPECIFICATIONS, CONTRACT, AND SITE OF WORK

The second paragraph of Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications is amended to read:

- Where the Department has made investigations of site conditions, including subsurface conditions in areas where work is to be performed under the contract, or in other areas, some of which may constitute possible local material sources, bidders or Contractors may, upon written request, inspect the records of the Department as to those investigations subject to and upon the conditions hereinafter set forth.

Attention is directed to "Differing Site Conditions" of these special provisions regarding physical conditions at the site which may differ from those indicated in "Materials Information," log of test borings or other geotechnical information obtained by the Department's investigation of site conditions.

5-1.012 DIFFERING SITE CONDITIONS

Attention is directed to Section 5-1.116, "Differing Site Conditions," of the Standard Specifications.

During the progress of the work, if subsurface or latent conditions are encountered at the site differing materially from those indicated in the "Materials Information," log of test borings, other geotechnical data obtained by the Department's investigation of subsurface conditions, or an examination of the conditions above ground at the site, the party discovering those conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

The Contractor will be allowed 15 days from the notification of the Engineer's determination of whether or not an adjustment of the contract is warranted, in which to file a notice of potential claim in conformance with the provisions of Section 9-1.04, "Notice of Potential Claim," of the Standard Specifications and as specified herein; otherwise the decision of the Engineer shall be deemed to have been accepted by the Contractor as correct. The notice of potential claim shall set forth in what respects the Contractor's position differs from the Engineer's determination and provide any additional information obtained by the Contractor, including but not limited to additional geotechnical data. The notice of potential claim shall be accompanied by the Contractor's certification that the following were made in preparation of the bid: a review of the contract, a review of the "Materials Information," a review of the log of test borings and other records of geotechnical data to the extent they were made available to bidders prior to the opening of bids, and an examination of the conditions above ground at the site. Supplementary information, obtained by the Contractor subsequent to the filing of the notice of potential claim, shall be submitted to the Engineer in an expeditious manner.

5-1.015 LABORATORY

When a reference is made in the specifications to the "Laboratory," the reference shall mean the Division of Materials Engineering and Testing Services and the Division of Structural Foundations of the Department of Transportation, or established laboratories of the various Districts of the Department, or other laboratories authorized by the Department to test materials and work involved in the contract. When a reference is made in the specifications to the "Transportation Laboratory," the reference shall mean the Division of Materials Engineering and Testing Services and the Division of Structural Foundations, located at 5900 Folsom Boulevard, Sacramento, CA 95819, Telephone (916) 227-7000.

5-1.017 CONTRACT BONDS

Attention is directed to Section 3-1.02, "Contract Bonds," of the Standard Specifications and these special provisions.

Each of the two bonds specified in Section 3-1.02, "Contract Bonds," of the Standard Specifications shall be the sum equal to 100 percent of the contract set forth on the proposal form.

5-1.018 EXCAVATION SAFETY PLANS

Section 5-1.02A, "Trench Excavation Safety Plans," of the Standard Specifications is amended to read:

5-1.02A Excavation Safety Plans

- The Construction Safety Orders of the Division of Occupational Safety and Health shall apply to all excavations. For all excavations 1.5 m or more in depth, the Contractor shall submit to the Engineer a detailed plan showing the design and details of the protective systems to be provided for worker protection from the hazard of caving ground during excavation. The detailed plan shall include any tabulated data and any design calculations used in the preparation of the plan. Excavation shall not begin until the detailed plan has been reviewed and approved by the Engineer.
- Detailed plans of protective systems for which the Construction Safety Orders require design by a registered professional engineer shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California, and shall include the soil classification, soil properties, soil design calculations that demonstrate adequate stability of the protective system, and any other design calculations used in the preparation of the plan.
- No plan shall allow the use of a protective system less effective than that required by the Construction Safety Orders.
- If the detailed plan includes designs of protective systems developed only from the allowable configurations and slopes, or Appendices, contained in the Construction Safety Orders, the plan shall be submitted at least 5 days before the Contractor intends to begin excavation. If the detailed plan includes designs of protective systems developed from tabulated data, or designs for which design by a registered professional engineer is required, the plan shall be submitted at least 3 weeks before the Contractor intends to begin excavation.
- Attention is directed to Section 7-1.01E, "Trench Safety."

The third paragraph of Section 19-1.02, "Preservation of Property," of the Standard Specifications is amended to read:

- In addition to the provisions in Sections 5-1.02, "Plans and Working Drawings," and 5-1.02A, "Excavation Safety Plans," detailed plans of the protective systems for excavations on or affecting railroad property will be reviewed for adequacy of protection provided for railroad facilities, property, and traffic. These plans shall be submitted at least 9 weeks before the Contractor intends to begin excavation requiring the protective systems. Approval by the Engineer of the detailed plans for the protective systems will be contingent upon the plans being satisfactory to the railroad company involved.

5-1.02 LABOR NONDISCRIMINATION

Attention is directed to the following Notice that is required by Chapter 5 of Division 4 of Title 2, California Code of Regulations.

NOTICE OF REQUIREMENT FOR NONDISCRIMINATION PROGRAM

(GOV. CODE, SECTION 12990)

Your attention is called to the "Nondiscrimination Clause", set forth in Section 7-1.01A(4), "Labor Nondiscrimination," of the Standard Specifications, which is applicable to all nonexempt State contracts and subcontracts, and to the "Standard California Nondiscrimination Construction Contract Specifications" set forth therein. The specifications are applicable to all nonexempt State construction contracts and subcontracts of $5000 or more.

5-1.03 INTEREST ON PAYMENTS

Interest shall be payable on progress payments, payments after acceptance, final payments, extra work payments, and claim payments as follows:

A. Unpaid progress payments, payment after acceptance, and final payments shall begin to accrue interest 30 days after the Engineer prepares the payment estimate.

B. Unpaid extra work bills shall begin to accrue interest 30 days after preparation of the first pay estimate following receipt of a properly submitted and undisputed extra work bill. To be properly submitted, the bill must be submitted within 7 days of the performance of the extra work and in conformance with the provisions in Section 9-1.03C, "Records," and Section 9-1.06, "Partial Payments," of the Standard Specifications. An undisputed extra work bill not submitted within 7 days of performance of the extra work will begin to accrue interest 30 days after the preparation of the second pay estimate following submittal of the bill.
C. The rate of interest payable for unpaid progress payments, payments after acceptance, final payments, and extra work payments shall be 10 percent per annum.
D. The rate of interest payable on a claim, protest or dispute ultimately allowed under this contract shall be 6 percent per annum. Interest shall begin to accrue 61 days after the Contractor submits to the Engineer information in sufficient detail to enable the Engineer to ascertain the basis and amount of said claim, protest or dispute.

The rate of interest payable on any award in arbitration shall be 6 percent per annum if allowed under the provisions of Civil Code Section 3289.

5-1.031 FINAL PAYMENT AND CLAIMS

Attention is directed to Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications.

If the Contractor files a timely written statement of claims in response to the proposed final estimate, the District that administers the contract will submit a claim position letter to the Contractor by hand delivery or deposit in the U.S. mail within 135 days of acceptance of the contract. The claim position letter will delineate the District's position on the Contractor's claims. If the Contractor disagrees with the claim position letter, the Contractor shall submit a written notification of its disagreement to be received by the District not later than 15 days after the Contractor's receipt of the claim position letter. The written notification of disagreement shall set forth the basis for the Contractor's disagreement and be submitted to the office designated in the claim position letter. The Contractor's failure to provide a timely, written notification of disagreement shall constitute the Contractor's acceptance and agreement with the determinations provided in the claim position letter and with final payment pursuant to the claim position letter.

If the Contractor files a timely notification of disagreement with the District claim position letter, the board of review designated by the District Director to review claims that remain in dispute will meet with the Contractor within 45 days after receipt by the District of the notification of disagreement. Attendance by the Contractor at the board of review meeting shall be mandatory.

If the District fails to submit a claim position letter to the Contractor within 135 days after the acceptance of the contract and the Contractor has claims that remain in dispute, the Contractor may request a meeting with the board of review designated by the District Director to review claims that remain in dispute. The Contractor's request for a meeting shall identify the claims that remain in dispute. If the Contractor files a request for a meeting, the board of review will meet with the Contractor within 45 days after the District receives the request for the meeting. Attendance by the Contractor at the District Director's board of review meeting shall be mandatory.

Failure of the Contractor to file a timely written statement of claims in response to the proposed final estimate, or to file a timely notification of disagreement with the District claim position letter, or to attend the District Director's board of review meeting shall constitute a failure to pursue diligently and exhaust the administrative procedures in the contract and shall be a bar to arbitration in conformance with the requirements in Section 10240.2 of the California Public Contract Code.

5-1.04 PUBLIC SAFETY

The Contractor shall provide for the safety of traffic and the public in conformance with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications and these special provisions.

The Contractor shall install temporary railing (Type K) between a lane open to public traffic and an excavation, obstacle or storage area when the following conditions exist:

A. Excavations**.—**The near edge of the excavation is 3.6 m or less from the edge of the lane, except:

1. Excavations covered with sheet steel or concrete covers of adequate thickness to prevent accidental entry by traffic or the public.
2. Excavations less than 0.3-m deep.
3. Trenches less than 0.3-m wide for irrigation pipe or electrical conduit, or excavations less than 0.3-m in diameter.
4. Excavations parallel to the lane for the purpose of pavement widening or reconstruction.
5. Excavations in side slopes, where the slope is steeper than 1:4 (vertical:horizontal).
6. Excavations protected by existing barrier or railing.

B. Temporarily Unprotected Permanent Obstacles.—The work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and the Contractor elects to install the obstacle prior to installing the protective system; or the Contractor, for the Contractor's convenience and with permission of the Engineer, removes a portion of an existing protective railing at an obstacle and does not replace such railing complete in place during the same day.

C. Storage Areas.—Material or equipment is stored within 3.6 m of the lane and the storage is not otherwise prohibited by the provisions of the Standard Specifications and these special provisions.

The approach end of temporary railing (Type K), installed in conformance with the provisions in this section "Public Safety" and in Section 7-1.09, "Public Safety," of the Standard Specifications, shall be offset a minimum of 4.6 m from the edge of the traffic lane open to public traffic. The temporary railing shall be installed on a skew toward the edge of the traffic lane of not more than 0.3-m transversely to 3 m longitudinally with respect to the edge of the traffic lane. If the 4.6-m minimum offset cannot be achieved, the temporary railing shall be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules shall be installed at the approach end of the temporary railing.

Temporary railing (Type K) shall conform to the provisions in Section 12-3.08, "Temporary Railing (Type K)," of the Standard Specifications. Temporary railing (Type K), conforming to the details shown on 1999 Standard Plan T3, may be used. Temporary railing (Type K) fabricated prior to January 1, 1993, and conforming to 1988 Standard Plan B11-30 may be used, provided the fabrication date is printed on the required Certificate of Compliance.

Temporary crash cushion modules shall conform to the provisions in "Temporary Crash Cushion Module" of these special provisions.

Except for installing, maintaining and removing traffic control devices, whenever work is performed or equipment is operated in the following work areas, the Contractor shall close the adjacent traffic lane unless otherwise provided in the Standard Specifications and these special provisions:

Approach Speed of Public Traffic (Posted Limit) (Kilometers Per Hour)	Work Areas
Over 72 (45 Miles Per Hour)	Within 1.8 m of a traffic lane but not on a traffic lane
56 to 72 (35 to 45 Miles Per Hour)	Within 0.9-m of a traffic lane but not on a traffic lane

The lane closure provisions of this section shall not apply if the work area is protected by permanent or temporary railing or barrier.

When traffic cones or delineators are used to delineate a temporary edge of a traffic lane, the line of cones or delineators shall be considered to be the edge of the traffic lane, however, the Contractor shall not reduce the width of an existing lane to less than 3 m without written approval from the Engineer.

When work is not in progress on a trench or other excavation that required closure of an adjacent lane, the traffic cones or portable delineators used for the lane closure shall be placed off of and adjacent to the edge of the traveled way. The spacing of the cones or delineators shall be not more than the spacing used for the lane closure.

Suspended loads or equipment shall not be moved nor positioned over public traffic or pedestrians.

Full compensation for conforming to the provisions in this section "Public Safety," including furnishing and installing temporary railing (Type K) and temporary crash cushion modules, shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

5-1.05 SURFACE MINING AND RECLAMATION ACT

Attention is directed to the Surface Mining and Reclamation Act of 1975, commencing in Public Resources Code, Mining and Geology, Section 2710, which establishes regulations pertinent to surface mining operations, and to California Public Contract Code Section 10295.5.

Material from mining operations furnished for this project shall only come from permitted sites in compliance with California Public Contract Code Section 10295.5.

The requirements of this section shall apply to materials furnished for the project, except for acquisition of materials in conformance with the provisions in Section 4-1.05, "Use of Materials Found on the Work," of the Standard Specifications.

5-1.06 REMOVAL OF ASBESTOS AND HAZARDOUS SUBSTANCES

When the presence of asbestos or hazardous substances are not shown on the plans or indicated in the specifications and the Contractor encounters materials which the Contractor reasonably believes to be asbestos or a hazardous substance as defined in Section 25914.1 of the Health and Safety Code, and the asbestos or hazardous substance has not been rendered harmless, the Contractor may continue work in unaffected areas reasonably believed to be safe. The Contractor shall immediately cease work in the affected area and report the condition to the Engineer in writing.

In conformance with Section 25914.1 of the Health and Safety Code, removal of asbestos or hazardous substances including exploratory work to identify and determine the extent of the asbestos or hazardous substance will be performed by separate contract.

If delay of work in the area delays the current controlling operation, the delay will be considered a right of way delay and the Contractor will be compensated for the delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

5-1.07 YEAR 2000 COMPLIANCE

This contract is subject to Year 2000 Compliance for automated devices in the State of California.

Year 2000 compliance for automated devices in the State of California is achieved when embedded functions have or create no logical or mathematical inconsistencies when dealing with dates prior to and beyond 1999. The year 2000 is recognized and processed as a leap year. The product shall operate accurately in the manner in which the product was intended for date operation without requiring manual intervention.

The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for all automated devices furnished for the project.

5-1.075 BUY AMERICA REQUIREMENTS

Attention is directed to the "Buy America" requirements of the Surface Transportation Assistance Act of 1982 (Section 165) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) Sections 1041(a) and 1048(a), and the regulations adopted pursuant thereto. In conformance with the law and regulations, all manufacturing processes for steel and iron materials furnished for incorporation into the work on this project shall occur in the United States; with the exception that pig iron and processed, pelletized and reduced iron ore manufactured outside of the United States may be used in the domestic manufacturing process for such steel and iron materials. The application of coatings, such as epoxy coating, galvanizing, painting, and other coatings that protect or enhance the value of steel or iron materials shall be considered a manufacturing process subject to the "Buy America" requirements.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for steel and iron materials. The certificates, in addition to certifying that the materials comply with the specifications, shall specifically certify that all manufacturing processes for the materials occurred in the United States, except for the above exceptions.

The requirements imposed by the law and regulations do not prevent a minimal use of foreign steel and iron materials if the total combined cost of the materials used does not exceed one-tenth of one percent (0.1 percent) of the total contract cost or $2500, whichever is greater. The Contractor shall furnish the Engineer acceptable documentation of the quantity and value of the foreign steel and iron prior to incorporating the materials into the work.

5-1.08 SUBCONTRACTOR AND DBE RECORDS

The Contractor shall maintain records showing the name and business address of each first-tier subcontractor. The records shall also show the name and business address of every DBE subcontractor, DBE vendor of materials and DBE trucking company, regardless of tier. The records shall show the date of payment and the total dollar figure paid to all of these firms. DBE prime contractors shall also show the date of work performed by their own forces along with the corresponding dollar value of the work.

Upon completion of the contract, a summary of these records shall be prepared on Form CEM-2402 (F) and certified correct by the Contractor or the Contractor's authorized representative, and shall be furnished to the Engineer. The form shall be furnished to the Engineer within 90 days from the date of contract acceptance. $10,000 will be withheld from payment until the Form CEM-2402 (F) is submitted. The amount will be returned to the Contractor when a satisfactory Form CEM-2402 (F) is submitted.

Prior to the fifteenth of each month, the Contractor shall submit documentation to the Engineer showing the amount paid to DBE trucking companies listed in the Contractor's DBE information. This monthly documentation shall indicate the portion of the revenue paid to DBE trucking companies which is claimed toward DBE participation. The Contractor shall also obtain and submit documentation to the Engineer showing the amount paid by DBE trucking companies to all firms, including owner-operators, for the leasing of trucks. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement. The records must confirm that the amount of credit claimed toward DBE participation conforms with Section 2-1.02, \"Disadvantaged Business Enterprise,\" of these special provisions.

The Contractor shall also obtain and submit documentation to the Engineer showing the truck number, owner's name, California Highway Patrol CA number, and if applicable, the DBE certification number of the owner of the truck for all trucks used during that month for which DBE participation will be claimed. This documentation shall be submitted on Form CEM-2404 (F).

5-1.083 DBE CERTIFICATION STATUS

If a DBE subcontractor is decertified during the life of the project, the decertified subcontractor shall notify the Contractor in writing with the date of decertification. If a subcontractor becomes a certified DBE during the life of the project, the subcontractor shall notify the Contractor in writing with the date of certification. The Contractor shall furnish the written documentation to the Engineer.

Upon completion of the contract, Form CEM-2403 (F) indicating the DBE's existing certification status shall be signed and certified correct by the Contractor. The certified form shall be furnished to the Engineer within 90 days from the date of contract acceptance.

5-1.086 PERFORMANCE OF DBE SUBCONTRACTORS AND SUPPLIERS

The DBEs listed by the Contractor in response to the provisions in Section 2-1.02B, "Submission of DBE Information," and Section 3, "Award and Execution of Contract," of these special provisions, which are determined by the Department to be certified DBEs, shall perform the work and supply the materials for which they are listed, unless the Contractor has received prior written authorization to perform the work with other forces or to obtain the materials from other sources.

Authorization to use other forces or sources of materials may be requested for the following reasons:

A. The listed DBE, after having had a reasonable opportunity to do so, fails or refuses to execute a written contract, when such written contract, based upon the general terms, conditions, plans and specifications for the project, or on the terms of such subcontractor's or supplier's written bid, is presented by the Contractor.
B. The listed DBE becomes bankrupt or insolvent.
C. The listed DBE fails or refuses to perform the subcontract or furnish the listed materials.
D. The Contractor stipulated that a bond was a condition of executing a subcontract and the listed DBE subcontractor fails or refuses to meet the bond requirements of the Contractor.
E. The work performed by the listed subcontractor is substantially unsatisfactory and is not in substantial conformance with the plans and specifications, or the subcontractor is substantially delaying or disrupting the progress of the work.
F. It would be in the best interest of the State.

The Contractor shall not be entitled to any payment for such work or material unless it is performed or supplied by the listed DBE or by other forces (including those of the Contractor) pursuant to prior written authorization of the Engineer.

5-1.09 SUBCONTRACTING

Attention is directed to the provisions in Section 8-1.01, "Subcontracting," of the Standard Specifications, and Section 2, "Proposal Requirements and Conditions," and Section 3, "Award and Execution of Contract," of these special provisions.

Pursuant to the provisions of Section 1777.1 of the Labor Code, the Labor Commissioner publishes and distributes a list of contractors ineligible to perform work as a subcontractor on a public works project. This list of debarred contractors is available from the Department of Industrial Relations web site at:

http://www.dir.ca.gov/DLSE/Debar.html.

The provisions in the third paragraph of Section 8-1.01, "Subcontracting," of the Standard Specifications, that the Contractor shall perform with the Contractor's own organization contract work amounting to not less than 50 percent of the original contract price, is not changed by the Federal Aid requirement specified under "Required Contract Provisions Federal-Aid Construction Contracts" in Section 14 of these special provisions that the Contractor perform not less than 30 percent of the original contract work with the Contractor's own organization.

Each subcontract and any lower tier subcontract that may in turn be made shall include the "Required Contract Provisions Federal-Aid Construction Contracts" in Section 14 of these special provisions. This requirement shall be enforced as follows:

A. Noncompliance shall be corrected. Payment for subcontracted work involved will be withheld from progress payments due, or to become due, until correction is made. Failure to comply may result in termination of the contract.

In conformance with the Federal DBE regulations Sections 26.53(f)(1) and 26.53(f)(2) Part 26, Title 49 CFR:

A. The Contractor shall not terminate for convenience a DBE subcontractor listed in response to Section 2-1.02B, "Submission of DBE Information," and then perform that work with its own forces, or those of an affiliate without the written consent of the Department, and

B. If a DBE subcontractor is terminated or fails to complete its work for any reason, the Contractor will be required to make good faith efforts to substitute another DBE subcontractor for the original DBE subcontractor, to the extent needed to meet the contract goal.

The requirement in Section 2-1.02, "Disadvantaged Business Enterprise (DBE)," of these special provisions that DBEs must be certified on the date bids are opened does not apply to DBE substitutions after award of the contract.

5-1.10 PROMPT PROGRESS PAYMENT TO SUBCONTRACTORS

Attention is directed to the provisions in Sections 10262 and 10262.5 of the Public Contract Code and Section 7108.5 of the Business and Professions Code concerning prompt payment to subcontractors.

5-1.102 PROMPT PAYMENT OF WITHHELD FUNDS TO SUBCONTRACTORS

The Contractor shall return all moneys withheld in retention from the subcontractor within 30 days after receiving payment for work satisfactorily completed, even if the other contract work is not completed and has not been accepted in conformance with Section 7-1.17, "Acceptance of Contract," of the Standard Specifications. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or noncompliance by a subcontractor.

5-1.11 PARTNERING

The State will promote the formation of a "Partnering" relationship with the Contractor in order to effectively complete the contract to the benefit of both parties. The purpose of this relationship is to maintain a cooperative communication and to mutually resolve conflicts at the lowest responsible management level.

The Contractor may request the formation of a "Partnering" relationship by submitting a request in writing to the Engineer after approval of the contract. If the Contractor's request for "Partnering" is approved by the Engineer, scheduling of a "Partnering Workshop," selecting the "Partnering" facilitator and workshop site, and other administrative details shall be as agreed to by both parties. If agreed to by the parties, additional "Partnering Workshops" will be conducted as needed throughout the life of the contract.

A one-day \"Training in Partnering Concepts\" session will be conducted regardless of whether the Contractor requests the formation of a \"Partnering\" relationship. The \"Training in Partnering Concepts\" session will be conducted locally for the Contractor's and the Engineer's project representatives. The Contractor shall be represented by a minimum of 2 representatives, one being the Contractor's authorized representative pursuant to Section 5-1.06, \"Superintendence,\" of the Standard Specifications. Scheduling of the \"Training in Partnering Concepts\" session and selection of the trainer and training site shall be determined cooperatively by the Contractor and the Engineer. If, upon the Contractor's request, \"Partnering\" is approved by the Engineer, the \"Training in Partnering Concepts\" session shall be conducted prior to the initial \"Partnering Workshop.\"

The costs involved in providing the \"Training in Partnering Concepts\" trainer and training site will be borne entirely by the State. The costs will be determined in conformance with the provisions in Section 9-1.03B, \"Work Performed by Special Forces or Other Special Services,\" of the Standard Specifications, and paying to the Contractor the sum of that cost, except no markups will be allowed.

The costs involved in providing the "Partnering Workshop" facilitator and workshop site will be borne equally by the State and the Contractor. The division of cost will be made by determining the cost in providing the "Partnering Workshop" facilitator and workshop site in conformance with the provisions in Section 9-1.03B, "Work Performed by Special Forces or Other Special Services," of the Standard Specifications, and paying to the Contractor one-half of that cost, except no markups will be allowed.

All other costs associated with "Training in Partnering Concepts\" and "Partnering Workshops" will be borne separately by the party incurring the costs, such as wages and travel expenses, and no additional compensation will be allowed therefor.

The establishment of a "Partnering" relationship will not change or modify the terms and conditions of the contract and will not relieve either party of the legal requirements of the contract.

5-1.114 VALUE ANALYSIS

The Contractor may submit to the Engineer, in writing, a request for a "Value Analysis" workshop. The purpose for having a workshop is to identify value enhancing opportunities and to consider modifications to the plans and specifications that will reduce either the total cost, time of construction or traffic congestion, without impairing, in any manner, the essential

functions or characteristics of the project including, but not limited to, service life, economy of operation, ease of maintenance, benefits to the travelling public, desired appearance, or design and safety standards.

To maximize the potential benefits of a workshop, the request should be submitted to the Engineer early in the project after approval of the contract. If the Contractor's request for a "Value Analysis" workshop is approved by the Engineer, scheduling of a workshop, selecting the facilitator and workshop site, and other administrative details shall be determined cooperatively by the Contractor and the Engineer.

The workshop shall be conducted in conformance with the methodology described in the Department's "Value Analysis Team Guide" available at the Department's web site at:

http://www.dot.ca.gov/hq/oppd/value/

The facilitator shall be a Certified Value Specialist (CVS) as recognized by the Society of American Value Engineers (SAVE) International, which may be contacted as follows:

SAVE International, 60 Revere Drive, Northbrook, IL 60062
Telephone 1-847-480-1730, FAX 1-847-480-9282

The Contractor may submit recommendations resulting from a "Value Analysis" workshop for approval by the Engineer as cost reduction incentive proposals in conformance with the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications.

The costs involved in providing the "Value Analysis" facilitator and workshop site will be borne equally by the State and the Contractor. The division of cost will be made by determining the cost in providing the "Value Analysis" facilitator and workshop site in conformance with the provisions in Section 9-1.03B, "Work Performed by Special Forces or Other Special Services," of the Standard Specifications, and paying to the Contractor one-half of that cost, except no markups will be allowed.

All other costs associated with the "Value Analysis" workshop will be borne separately by the party incurring the costs, such as wages and travel expenses, and no additional compensation will be allowed therefor.

5-1.12 DISPUTE REVIEW BOARD

To assist in the resolution of disputes or potential claims arising out of the work of this project, a Dispute Review Board, hereinafter referred to as the "DRB," shall be established by the Engineer and Contractor cooperatively upon approval of the contract. The DRB is intended to assist the contract administrative claims resolution process as specified in the provisions in Section 9-1.04, "Notice of Potential Claim," and Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications. The DRB shall not serve as a substitute for provisions in the specifications in regard to filing potential claims. The requirements and procedures established in this special provision shall be considered as an essential prerequisite to filing a claim, for arbitration or for litigation prior or subsequent to project completion.

The DRB shall be utilized when dispute or potential claim resolution at the project level is unsuccessful. The DRB shall function until the day of acceptance of the contract, at which time the work of the DRB will cease except for completion of unfinished dispute hearings and reports. After acceptance of the contract, disputes or potential claims that the Contractor wants to pursue that have not been settled, shall be stated or restated, by the Contractor, in response to the Proposed Final Estimate within the time limits provided in Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications. The State will review those claims in conformance with the provisions in Section 9-1.07B of the Standard Specifications. Following the completion of the State's administrative claims procedure, the Contractor may resort to arbitration in conformance with the provisions in Section 9-1.10, "Arbitration," of the Standard Specifications.

Disputes, as used in this section, shall include differences of opinion, properly noticed as provided hereinafter, between the State and Contractor on matters related to the work and other subjects considered by the State or Contractor, or by both, to be of concern to the DRB on this project, except matters relating to Contractor, subcontractor or supplier claims not actionable against the State as specified in these special provisions. Whenever the term "dispute" or "disputes" is used herein, it shall be deemed to include potential claims as well as disputes.

The DRB shall serve as an advisory body to assist in the resolution of disputes between the State and the Contractor, hereinafter referred to as the "parties." The DRB shall consider disputes referred to it, and furnish written reports containing findings and recommendations pertaining to those disputes, to the parties to aid in resolution of the differences between them. DRB findings and recommendations are not binding on the parties.

The DRB shall consist of one member selected by the State, one member selected by the Contractor, and a third member selected by the first 2 members and approved by both the State and the Contractor. The third member shall act as DRB Chairperson.

The first 2 DRB members shall select a third DRB member subject to mutual approval of the parties or may mutually concur on a list of potentially acceptable third DRB members and submit the list to the parties for final selection and approval of the third member. The goal in selection of the third member is to complement the professional experience of the first 2 members and to provide leadership for the DRB's activities.

No DRB member shall have prior direct involvement in this contract. No member shall have a financial interest in this contract or the parties thereto, within a period of 6 months prior to award of this contract or during the contract, except as follows:

A. Compensation for services on this DRB.
B. Ownership interest in a party or parties, documented by the prospective DRB member, that has been reviewed and determined in writing by the State to be sufficiently insignificant to render the prospective member acceptable to the State.
C. Service as a member of other Dispute Review Boards on other contracts.
D. Retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.
E. The above provisions apply to parties having a financial interest in this contract, including but not limited to contractors, subcontractors, suppliers, consultants, and legal and business services.

DRB members shall be especially knowledgeable in the type of construction and contract documents potentially anticipated by the contract. The members shall discharge their responsibilities impartially and as an independent body considering the facts and circumstances related to the matters under consideration, applicable laws and regulations, and the pertinent provisions of the contract.

The State and the Contractor shall select their respective DRB members, in conformance with the terms and conditions of the Dispute Review Board Agreement and these special provisions, within 45 days of the approval of the contract. Each party shall provide written notification to the other of the name of their selected DRB member along with the prospective member's written disclosure statement.

Before their appointments are final, the first 2 prospective DRB members shall submit complete disclosure statements to both the State and the Contractor. The statement shall include a resume of the prospective member's experience, together with a declaration describing past, present, and anticipated or planned future relationships, including indirect relationships through the prospective member's primary or full-time employer, to this project and with the parties involved in this construction contract, including, but not limited to, relevant subcontractors or suppliers to the parties, the parties' principals or the parties' counsel. The DRB members shall also include a full disclosure of close professional or personal relationships with all key members of the parties to the contract. Either the Contractor or the State may object to the others nominee and that person will not be selected for the DRB. No reason need be given for the first objection. Objections to subsequent nominees must be based on a specific breech or violation of nominee responsibilities under this specification. A different person shall then be nominated within 14 Days. The third DRB member shall supply a full disclosure statement to the first 2 DRB members and to the parties prior to appointment. Either party may reject any of the 3 prospective DRB members who fail to fully comply with all required employment and financial disclosure conditions of DRB membership as described in the Dispute Review Board Agreement and herein. A copy of the Dispute Review Board Agreement is included in this special provision.

The first duty of the State and Contractor selected members of the DRB is to select and recommend prospective third member(s) to the parties for final selection and approval. The first 2 DRB members shall proceed with the selection of the third DRB member immediately upon receiving written notification from the State of their selection, and shall provide their recommendation simultaneously to the parties within 14 days of the notification.

An impasse shall be considered to have been reached if the parties are unable to approve a third member within 14 days of receipt of the recommendation of the first 2 DRB members, or if the first 2 members are unable to agree upon a recommendation within the 14 day time limit allowed in the preceding paragraph. In the event of an impasse in selection of the third DRB member, the State and the Contractor shall each propose 3 candidates for the third position. The parties shall select the candidates proposed under this paragraph from the current list of arbitrators certified by the Public Works Contract Arbitration Committee created by Article 7.2 (commencing with Section 10245) of the State Contract Act. The first 2 DRB members shall then select one of the 6 proposed candidates in a blind draw.

The Contractor, the State, and the 3 members of the DRB shall complete and adhere to the Dispute Review Board Agreement in administration of this DRB within 14 days of the parties' concurrence in the selection of the third member. The State authorizes the Engineer to execute and administer the terms of the Agreement. The person(s) designated by the Contractor as authorized to execute Contract Change Orders shall be authorized to execute and administer the terms of this agreement, or to delegate the authority in writing. The operation of the DRB shall be in conformance with the terms of the Dispute Review Board Agreement.

The State and the Contractor shall bear the costs and expenses of the DRB equally. Each DRB board member shall be compensated at an agreed rate of $1,000 per day if time spent per meeting, including on-site time plus one hour of travel time, is greater than 4 hours. Each DRB board member shall be compensated at an agreed rate of $600 per day if time spent per meeting, including on-site time plus one hour of travel time, is less than or equal to 4 hours. The agreed rates shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof, that the DRB member is at an authorized DRB meeting. No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time, (such as time spent evaluating and preparing recommendations on specific issues presented to the DRB), has been specifically agreed to in advance by the State and Contractor. Time away from the project, that has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of $100 per hour. The agreed amount of $100 per hour shall include all incidentals including expenses for telephone, fax, and computer services. Members serving on more than one DRB, regardless of the number of meetings per day, shall not be paid more than the all inclusive rate per day or rate per hour for an individual project. The State will provide, at no cost to the Contractor, administrative services such as conference facilities and secretarial services to the DRB. These special provisions and the Dispute Review Board Agreement state provisions for compensation and expenses of the DRB. DRB members shall be compensated at the same daily and hourly rate. The Contractor shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges from invoices submitted by each DRB member. The State will reimburse the Contractor for its share of the costs. There will be no markups applied to expenses connected with the DRB, either by the DRB members or by the Contractor when requesting payment of the State's share of DRB expenses.

Service of a DRB member may be terminated at any time with not less than 14 days notice as follows:

A. The State may terminate service of the State appointed member.
B. The Contractor may terminate service of the Contractor appointed member.
C. Upon the written recommendation of the State and Contractor members for the removal of the third member.
D. Upon resignation of a member.

When a member of the DRB is replaced, the replacement member shall be appointed in the same manner as the replaced member was appointed. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement and shall be completed within 14 days. Changes in either of the DRB members chosen by the two parties will not require re-selection of the third member, unless both parties agree to such re-selection in writing. The Dispute Review Board Agreement shall be amended to reflect the change of a DRB member.

The following procedure shall be used for dispute resolution:

A. If the Contractor objects to any decision, act or order of the Engineer, the Contractor shall give written notice of potential claim in conformance with the provisions in Section 9-1.04, "Notice of Potential Claim," of the Standard Specifications, including provision of applicable cost documentation; or file written protests or notices in conformance with the provisions in the Standard Specifications and these special provisions.
B. The Engineer will respond, in writing, to the Contractor's written protest or notice within 14 days of receipt of the written protest or notice.
C. Within 14 days after receipt of the Engineer's written response, the Contractor shall, if the Contractor still objects, file a written reply with the Engineer, stating clearly and in detail the basis of the objection.
D. Following the Contractor's objection to the Engineer's decision, the Contractor shall refer the dispute to the DRB if the Contractor wishes to further pursue the objection to the Engineer's decision. The Contractor shall make the referral in writing to the DRB, simultaneously copied to the State, within 21 days after receipt of the written reply from the Engineer. The written dispute referral shall describe the disputed matter in individual discrete segments so that it will be clear to both parties and the DRB what discrete elements of the dispute have been resolved, and which remain unresolved and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.
E. The Contractor, by failing to submit the written notice of referral of the matter to the DRB, within 21 days after receipt of the State's written reply, waives future claims on the matter in contention.
F. The Contractor and the State shall each be afforded an opportunity to be present and to be heard by the DRB, and to offer evidence. Either party furnishing written evidence or documentation to the DRB must furnish copies of such information to the other party a minimum of 14 days prior to the date the DRB is scheduled to convene the hearing for the dispute. Either party shall produce such additional evidence as the DRB may deem necessary to reach an understanding and determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party at the same time the evidence is provided to the DRB. The DRB will not consider evidence not furnished in conformance with the terms specified herein.

G. The DRB shall furnish a report, containing findings and recommendations as described in the Dispute Review Board Agreement, in writing to both the State and the Contractor. The DRB shall complete its reports, including minority opinion, if any, and submit them to the parties within 30 days of the DRB hearing, except that time extensions may be granted at the request of the DRB with the written concurrence of both parties. The report shall include the facts and circumstances related to the matters under consideration, applicable laws and regulations, the pertinent provisions of the Contract and the actual costs and time incurred as shown on the Contractor's cost accounting records. The DRB shall make recommendations on the merit of the dispute, and if appropriate, recommend guidelines for determining compensation.

H. Within 30 days after receiving the DRB's report, both the State and the Contractor shall respond to the DRB in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRB's recommendation presented in the report by either party, shall conclusively indicate that the party(s) failing to respond accepts the DRB recommendation. Immediately after responses have been received by both parties, the DRB will provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRB's report from the DRB prior to responding to the report. The DRB will consider any clarification request only if submitted within 10 days of receipt of the DRB's report, and if submitted simultaneously in writing to both the DRB and the other party. Each party may submit only one request for clarification for any individual DRB report. The DRB shall respond, in writing, to requests for clarification within 10 days of receipt of such requests.

I. The DRB's recommendations, stated in the DRB's reports, are not binding on either party. Either party may seek a reconsideration of a recommendation of the DRB. The DRB shall only grant a reconsideration based upon submission of new evidence and if the request is submitted within the 30-day time limit specified for response to the DRB's written report. Each party may submit only one request for reconsideration regarding an individual DRB recommendation.

J. If the State and the Contractor are able to resolve their dispute with the aid of the DRB's report, the State and Contractor shall promptly accept and implement the recommendations of the DRB. If the parties cannot agree on compensation within 60 days of the acceptance by both parties of the DRB's recommendation, either party may request the DRB to make a recommendation regarding compensation.

K. The State or the Contractor shall not call members who served on the DRB for this contract as witnesses in arbitration proceedings which may arise from this contract, and all documents created by the DRB shall be inadmissible as evidence in subsequent arbitration proceedings, except the DRB's final written reports on each issue brought before it.

L. The State and Contractor shall jointly indemnify and hold harmless the DRB members from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRB.

M. The DRB members shall have no claim against the State or the Contractor, or both, from claimed harm arising out of the parties' evaluations of the DRB's report.

DISPUTES INVOLVING SUBCONTRACTOR CLAIMS

For purposes of this section, a "subcontractor claim" shall include any claim by a subcontractor (including also any pass through claims by a lower tier subcontractor or supplier) against the Contractor that is actionable by the Contractor against the Department which arises from the work, services, or materials provided or to be provided in connection with the contract. If the Contractor determines to pursue a dispute against the Department that includes a subcontractor claim, the dispute shall be processed and resolved in conformance with these special provisions and in conformance with the following:

A. The Contractor shall identify clearly in submissions pursuant to this section, that portion of the dispute that involves a subcontractor claim or claims.

B. The Contractor shall include, as part of its submission pursuant to Step 4 above, a certification (False Claims Act Certification) by the subcontractor's or supplier's officer, partner, or authorized representative with authority to bind the subcontractor and with direct knowledge of the facts underlying the subcontractor claim. The Contractor shall submit a certification that the subcontractor claim is acknowledged and forwarded by the Contractor. The form for these certifications are available from the Engineer.

C. At any DRB meeting on a dispute that includes one or more subcontractor claims, the Contractor shall require that each subcontractor that is involved in the dispute have present an authorized representative with actual knowledge of the facts underlying the subcontractor claim to assist in presenting the subcontractor claim and to answer questions raised by the DRB members or the Department's representatives.

D. Failure by the Contractor to declare a subcontractor claim on behalf of its subcontractor (including lower tier subcontractors' and suppliers' pass through claims) at the time of submission of the Contractor's claims, as provided hereunder, shall constitute a release of the Department by the Contractor on account of such subcontractor claim.

E. The Contractor shall include in all subcontracts under this contract that subcontractors and suppliers of any tier (a) agree to submit subcontractor claims to the Contractor in a proper form and in sufficient time to allow processing by the Contractor in conformance with the Dispute Review Board resolution specifications; (b) agree to be bound by the terms of the Dispute Review Board provisions to the extent applicable to subcontractor claims; (c) agree that, to the extent a subcontractor claim is involved, completion of all steps required under these Dispute Review Board special provisions shall be a condition precedent to pursuit by the subcontractor of other remedies permitted by law, including without limitation of a lawsuit against the Contractor; and (d) agree that the existence of a dispute resolution process for disputes involving subcontractor claims shall not be deemed to create any claim, right, or cause of action by any subcontractor or supplier against the Department.

Notwithstanding the foregoing, this Dispute Review Board special provision shall not apply to, and the DRB shall not have the authority to consider, subcontractor claims between the subcontractor(s) or supplier(s) and the Contractor that is not actionable by the Contractor against the Department.

A copy of the "Dispute Review Board Agreement" to be executed by the Contractor, State and the 3 DRB members after approval of the contract follows:

Form 6202 Rev (01-05-98)

DISPUTE REVIEW BOARD AGREEMENT

_____
(Contract Identification)

Contract No. _____

THIS DISPUTE REVIEW BOARD AGREEMENT, hereinafter called "AGREEMENT", made and entered into this _____ day of _____, _____, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," _____ _____ hereinafter called the "CONTRACTOR," and the Dispute Review Board, hereinafter called the "DRB" consisting of the following members:

_____ ,
(Contractor Appointee)

_____ ,
(State Appointee)

and _____
(Third Person)

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the special provisions for the above referenced contract provides for the establishment and operation of the DRB to assist in resolving disputes; and

WHEREAS, the DRB is composed of three members, one selected by the STATE, one selected by the CONTRACTOR, and the third member selected by the other two members and approved by the parties;

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRB members hereto agree as follows:

SECTION I DESCRIPTION OF WORK

To assist in the resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRB. The intent of the DRB is to fairly and impartially consider disputes placed before it and provide written recommendations for resolution of these disputes to both parties. The members of this DRB shall perform the services necessary to participate in the DRB's actions as designated in Section II, Scope of Work.

SECTION II SCOPE OF WORK

The scope of work of the DRB includes, but is not limited to, the following:

A. OBJECTIVE

The principal objective of the DRB is to assist in the timely resolution of disputes between the parties arising from performance of this contract. It is not intended for either party to default on their normal responsibility to amicably and fairly settle their differences by indiscriminately assigning them to the DRB. It is intended that the mere existence of the DRB will encourage the parties to resolve disputes without resorting to this review procedure. But when a dispute which is serious enough to warrant the DRB's review does develop, the process for prompt and efficient action will be in place.

B. PROCEDURES

The DRB shall render written reports on disputes between the parties arising from the construction contract. Prior to consideration of a dispute, the DRB shall establish rules and regulations that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. DRB recommendations, resulting from its consideration of a dispute, shall be furnished in writing to both parties. The recommendations shall be based on the pertinent contract provisions, and the facts and circumstances involved in the dispute. The recommendations shall find one responsible party in a dispute; shared or "jury" determinations shall not be rendered. The DRB shall make recommendations on the merit of the dispute, and if appropriate, recommend guidelines for determining compensation. If the parties cannot agree on compensation within 60 days of the acceptance by both parties of the DRB's recommendation, either party may request the DRB to make a recommendation regarding compensation.

The DRB shall refrain from officially giving advice or consulting services to anyone involved in the contract. The individual members shall act in a completely independent manner and while serving as members of the DRB shall have no consulting business connections with either party or its principals or attorneys or other affiliates (subcontractors, suppliers, etc.) who have a beneficial interest in the contract.

During scheduled meetings of the DRB as well as during dispute hearings, DRB members shall refrain from expressing opinions on the merits of statements on matters under dispute or potential dispute. Opinions of DRB members expressed in private sessions shall be kept strictly confidential. Individual DRB members shall not meet with, or discuss contract issues with individual parties, except as directed by the DRB Chairperson. Such discussions or meetings shall be disclosed to both parties. Other discussions regarding the project between the DRB members and the parties shall be in the presence of all three members and both parties. Individual DRB members shall not undertake independent investigations of any kind pertaining to disputes or potential disputes, except with the knowledge of both parties and as expressly directed by the DRB Chairperson.

C. CONSTRUCTION SITE VISITS, PROGRESS MEETINGS AND FIELD INSPECTIONS

The DRB members shall visit the project site and meet with representatives of the parties to keep abreast of construction activities and to develop familiarity with the work in progress. Scheduled progress meetings shall be held at or near the project site. The DRB shall meet at least once at the start of the project, and at least once every 6 months thereafter. The frequency, exact time, and duration of additional site visits and progress meetings shall be as recommended by the DRB and approved by the parties consistent with the construction activities or matters under consideration and dispute. Each meeting shall consist of a round table discussion and a field inspection of the work being performed on the contract, if necessary. Each meeting shall be attended by representatives of both parties. The agenda shall generally be as follows:

1. Meeting opened by the DRB Chairperson.
2. Remarks by the STATE's representative.
3. A description by the CONTRACTOR's representative of work accomplished since the last meeting; the current schedule status of the work; and a forecast for the coming period.
4. An outline by the CONTRACTOR's representative of potential problems and a description of proposed solutions.
5. An outline by the STATE's representative of the status of the work as the STATE views it.
6. A brief description by the CONTRACTOR's or STATE's representative of potential claims or disputes which have surfaced since the last meeting.
7. A summary by the STATE's representative, the CONTRACTOR's representative, or the DRB of the status of past disputes and claims.

The STATE's representative will prepare minutes of all regular meetings and circulate them for revision and approval by all concerned.

The field inspection shall cover all active segments of the work, the DRB being accompanied by both parties' representatives. The field inspection may be waived upon mutual agreement of the parties.

D. DRB CONSIDERATION AND HANDLING OF DISPUTES

Upon receipt by the DRB of a written referral of a dispute, the DRB shall convene to review and consider the dispute. The DRB shall determine the time and location of DRB hearings, with due consideration for the needs and preferences of the parties while recognizing the paramount importance of speedy resolution of issues. If the matter is not urgent, it may be scheduled for the time of the next scheduled DRB visit to the project. For an urgent matter, and upon the request of either party, the DRB shall meet at its earliest convenience.

Normally, hearings shall be conducted at or near the project site. However, any location which would be more convenient and still provide required facilities and access to necessary documentation shall be satisfactory.

Both parties shall be given the opportunity to present their evidence at these hearings. It is expressly understood that the DRB members are to act impartially and independently in the consideration of the contract provisions, and the facts and conditions surrounding any dispute presented by either party, and that the recommendations concerning any such dispute are advisory and nonbinding on the parties.

The DRB may request that written documentation and arguments from both parties be sent to each DRB member, through the DRB Chairperson, for review before the hearing begins. A party furnishing written documentation to the DRB shall furnish copies of such information to the other party at the same time that such information is supplied to the DRB.

DRB hearings shall be informal. There shall be no testimony under oath or cross-examination. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRB in conformance with acceptance standards established by the DRB. These standards need not comply with prescribed legal laws of evidence.

The third DRB member shall act as Chairperson for dispute hearings and all other DRB activities. The parties shall have a representative at all hearings. Failure to attend a duly noticed meeting by either of the parties shall be conclusively considered by the DRB as indication that the non-attending party considers written submittals as their entire and complete argument. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals until all aspects of the dispute are thoroughly covered. DRB members may ask questions, seek clarification, or request further data from either of the parties. The DRB may request from either party documents or information that would assist the DRB in making its findings and recommendations including, but not limited to, documents used by the CONTRACTOR in preparing the bid for the project. A refusal by a party to provide information requested by the DRB may be considered by the DRB as an indication that the requested material would tend to disprove that party's position. Claims shall not necessarily be computed by merely subtracting bid price from the total cost of the affected work. However, if claims are based on the "total cost method," then, to be considered by the DRB, they shall be supported by evidence furnished by the CONTRACTOR that (1) the nature of the dispute(s) makes it impossible or impracticable to determine costs with a reasonable degree of accuracy, (2) the CONTRACTOR's bid estimate was realistic, (3) the CONTRACTOR's actual costs were reasonable, and (4) the CONTRACTOR was not responsible for the added expenses. As to claims based on the CONTRACTOR's field or home office accounting records, those claims shall be supported by an audit report of an independent Certified Public Accountant unless the contract includes special provisions that provide for an alternative method to calculate unabsorbed home office overhead. Any of those claims shall also be subject to audit by the DRB with the concurrence of the parties. In large or complex cases, additional hearings may be necessary in order to consider all the evidence presented by both parties. All involved parties shall maintain the confidentiality of all documents and information, as provided in this AGREEMENT.

During dispute hearings, no DRB member shall express an opinion concerning the merit of any facet of the case. DRB deliberations shall be conducted in private, with interim individual views kept strictly confidential.

After hearings are concluded, the DRB shall meet in private and reach a conclusion supported by 2 or more members. Private sessions of the DRB may be held at a location other than the job site or by electronic conferencing as deemed appropriate, in order to expedite the process.

The DRB's findings and recommendations, along with discussion of reasons therefor, shall then be submitted as a written report to both parties. Recommendations shall be based on the pertinent contract provisions, applicable laws and regulations, and facts and circumstances related to the dispute. The report shall be thorough in discussing the facts considered, the contract language, law or regulation viewed by the DRB as pertinent to the issues, and the DRB's interpretation and philosophy in arriving at its conclusions and recommendations. The DRB's report shall stand on its own, without attachments or appendices. The DRB chairman shall complete and furnish a summary report to the DRB Program Manager, Construction Program, MS 44, P.O. Box 942874, Sacramento, CA 94274.

With prior written approval of both parties, the DRB may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the 2 parties as specified in an approved contract change order. The CONTRACTOR will not be entitled to markups for the payments made for these services.

The DRB shall resist submittal of incremental portions of information by either party, in the interest of making a fully-informed decision and recommendation.

The DRB shall make every effort to reach a unanimous decision. If this proves impossible, the dissenting member shall prepare a minority opinion, which shall be included in the DRB's report.

Although both parties should place weight upon the DRB's recommendations, they are not binding. Either party may appeal a recommendation to the DRB for reconsideration. However, reconsideration shall only be allowed when there is new evidence to present, and the DRB shall accept only one appeal from each party pertaining to an individual DRB recommendation. The DRB shall hear appeals in conformance with the terms described in the Section entitled "Dispute Review Board" in the special provisions.

E. DRB MEMBER REPLACEMENT

Should the need arise to appoint a replacement DRB member, the replacement DRB member shall be appointed in the same manner as the original DRB members were appointed. The selection of a replacement DRB member shall begin promptly upon notification of the necessity for a replacement and shall be completed within 14 days. This AGREEMENT will be amended to indicate change in DRB membership.

SECTION III CONTRACTOR RESPONSIBILITIES

The CONTRACTOR shall furnish to each DRB member one copy of pertinent documents which are or may become necessary for the DRB to perform their function. Pertinent documents are drawings or sketches, calculations, procedures, schedules, estimates, or other documents which are used in the performance of the work or in justifying or substantiating the CONTRACTOR's position. The CONTRACTOR shall also furnish a copy of such pertinent documents to the STATE, in conformance with the terms outlined in the special provisions.

SECTION IV STATE RESPONSIBILITIES

The STATE will furnish the following services and items:

A. CONTRACT RELATED DOCUMENTS

The STATE will furnish to each DRB member one copy of Notice to Contractors and Special Provisions, Proposal and Contract, Plans, Standard Specifications, and Standard Plans, change orders, written instructions issued by the STATE to the CONTRACTOR, or other documents pertinent to any dispute that has been referred to the DRB and necessary for the DRB to perform its function.

B. COORDINATION AND SERVICES

The STATE, through the Engineer, will, in cooperation with the CONTRACTOR, coordinate the operations of the DRB. The Engineer will arrange or provide conference facilities at or near the project site and provide secretarial and copying services to the DRB without charge to the CONTRACTOR.

SECTION V TIME FOR BEGINNING AND COMPLETION

Once established, the DRB shall be in operation until the day of acceptance of the contract. The DRB members shall not begin work under the terms of this AGREEMENT until authorized in writing by the STATE.

SECTION VI PAYMENT

A. ALL INCLUSIVE RATE PAYMENT

The STATE and the CONTRACTOR shall bear the costs and expenses of the DRB equally. Each DRB board member shall be compensated at an agreed rate of $1,000 per day if time spent per meeting, including on-site time plus one hour of travel time, is greater than 4 hours. Each DRB board member shall be compensated at an agreed rate of $600 per day if time spent per meeting, including on-site time plus one hour of travel time, is less than or equal to 4 hours. The agreed rates shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof, that the DRB member is at an authorized DRB meeting. No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time has been specifically agreed to in advance by the STATE and CONTRACTOR. Time away from the project, that has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of $100 per hour. The agreed amount of $100 per hour shall include all incidentals including expenses for telephone, fax, and computer services. Members serving on more than one DRB, regardless of the number of meetings per day, shall not be paid more than the all inclusive rate per day or rate per hour for an individual project. The STATE will provide, at no cost to the CONTRACTOR, administrative services such as conference facilities and secretarial services to the DRB.

B. PAYMENTS

DRB members shall be compensated at the same rate. The CONTRACTOR shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges from invoices submitted by each DRB member. The STATE will reimburse the CONTRACTOR for its share of the costs of the DRB.

The DRB members may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to a DRB member until the amount and extent of those fees are approved by the STATE and CONTRACTOR.

Invoices shall be accompanied by original supporting documents, which the CONTRACTOR shall include with the extra work billing when submitting for reimbursement of the STATE's share of cost from the STATE. The CONTRACTOR will be reimbursed for one-half of approved costs of the DRB. No markups will be added to the CONTRACTOR's payment.

C. INSPECTION OF COSTS RECORDS

The DRB members and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

SECTION VII ASSIGNMENT OF TASKS OF WORK

The DRB members shall not assign the work of this AGREEMENT.

SECTION VIII TERMINATION OF AGREEMENT, THE DRB, AND DRB MEMBERS

DRB members may resign from the DRB by providing not less than 14 days written notice of the resignation to the STATE and CONTRACTOR. DRB members may be terminated by their original appointing power, in conformance with the terms of the contract.

SECTION IX LEGAL RELATIONS

The parties hereto mutually understand and agree that the DRB member in the performance of duties on the DRB, is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRB members from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRB.

SECTION X CONFIDENTIALITY

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRB, which documents and records are marked "Confidential - for use by the DRB only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRB findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of the DRB. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRB. However, the parties understand that such documents shall be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION XI DISPUTES

Disputes between the parties hereto, including disputes between the DRB members and either party or both parties, arising out of the work or other terms of this AGREEMENT, which cannot be resolved by negotiation and mutual concurrence between the parties, or through the administrative process provided in the contract, shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications.

SECTION XII VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party, including an individual member of the DRB, deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

SECTION XIII FEDERAL REVIEW AND REQUIREMENTS

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRB in progress, except for private meetings or deliberations of the DRB.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIV CERTIFICATION OF THE CONTRACTOR, THE DRB MEMBERS, AND THE STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRB MEMBER	DRB MEMBER
By: _____	By: _____
Title: _____	Title :_____
DRB MEMBER	
By :_____	
Title :_____	
CONTRACTOR	CALIFORNIA STATE DEPARTMENT OF TRANSPORTATION
By: _____	By: _____
Title: _____	Title: _____

5-1.13 TIDAL CONDITIONS AND ELEVATION DATUM

Attention is directed to Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

Tidal conditions may present significant problems in constructing the work as depicted in the contract plans. Tidal fluctuations may be severe and different from those shown in published tidal and current data due to differences in datum, winter runoff and other causes. Strong currents exist over portions of the project site. Limited time periods of slack water may restrict diving and other underwater activities.

The Contractor is responsible for being knowledgeable of such tidal difficulties, and no payment will be made by the State for any costs incurred by the Contractor in connection with the variations in actual tidal or current conditions during the course of this contract. Any reference to Mean Higher High and Mean Lower Low tides shall be understood to be an estimate used for permit purposes, actual mean tide data shall be determined by the Contractor.

All vertical control data are based on the National Geodetic Vertical Datum NGVD of 1929.

5-1.14 COST REDUCTION INCENTIVE PROPOSALS

Cost Reduction Incentive Proposals (CRIP) shall conform to the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications and these special provisions.

Attention is directed to "Description of Bridge Work" of these special provisions for the definition of basic design of the bridge.

Attention is directed to "Cost Reduction Incentive Proposals for Precast Concrete Segments" of these special provisions regarding additional CRIP requirements for precast concrete segments.

The sixth paragraph of Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications shall not apply.

The Contractor shall reimburse the Department's costs for investigating and reviewing a CRIP including the preliminary concept of a CRIP regardless of whether it is approved or rejected. The Contractor shall indicate acceptance thereof in writing, and that acceptance shall constitute full authority for the Department to deduct amounts payable to the Department from any moneys due or that may become due to the Contractor under the contract.

No proposals will be permitted in the following:

A. Structure Type
B. Monolithic Superstructure to Pier Connections
C. Number and Location of Hinges
D. Span Lengths
E. Pier Cross-Sections
F. Pile Dimensions and Layout

G. Footing Type and Dimensions
H. Specified Pile Tip Elevations
I. Minimum Hammer Energy
J. Pile Installation Methods
K. Welding Requirements and Procedures
L. Lighting System
M. Bikepath Structure
N. Railing
O. Temporary Tower Locations

The Contractor shall submit the preliminary concept of proposed CRIP in writing to the Engineer for approval prior to proceeding with the complete CRIP. After submitting the preliminary concept of proposed CRIP, the Contractor shall request a meeting with the Engineer to discuss the proposal in concept and to determine whether the cost reduction proposal will be considered by the Department. Items of discussion will include permit issues, impact on other projects, impact on the project schedule, traffic considerations, safety and health issues, design criteria, and review times required by the Department and other agencies. Determination by the Engineer that a cost reduction proposal will not be considered further will be deemed rejection of the proposal. The Contractor shall allow 15 working days after the meeting for the Engineer to review the conceptual submittal. Acceptance of a conceptual submittal in no way constitutes approval nor guarantees future approval of the Contractor's CRIP.

No extension of time and no delay will be granted for the development, submittal, investigation, and review of CRIPs.

5-1.15 AREAS FOR CONTRACTOR'S USE

Attention is directed to the requirements specified in Section 7-1.19, "Rights in Land and Improvements," of the Standard Specifications and these special provisions.

The highway right of way shall be used only for purposes that are necessary to perform the required work. The Contractor shall not occupy the right of way, or allow others to occupy the right of way, for purposes which are not necessary to perform the required work.

No area is available within the contract limits and no State-owned parcels adjacent to the right of way for the exclusive use of the Contractor. However, temporary storage of equipment and materials on State property may be arranged with the Engineer, subject to the prior demands of State maintenance forces and to other contract requirements. Use of the Contractor's work areas and other State-owned property shall be at the Contractor's own risk. The State shall not be held liable for damage to or loss of materials or equipment located within these areas.

Toll plaza parking lots shall not be used for the Contractor's employees private vehicles and the Contractor's equipment and vehicles.

The Contractor shall remove the equipment, materials, and rubbish from the work areas and other State-owned property which the Contractor occupies and shall leave the areas in a presentable condition, in conformance with the provisions in Section 4-1.02, "Final Cleaning Up," of the Standard Specifications.

The Contractor shall secure, at the Contractor's own expense, areas required for storage of plant, equipment, and materials, or for other purposes if sufficient area is not available to the Contractor within the contract limits.

5-1.16 UTILITIES

The Contractor shall make arrangements to obtain electrical power, water or compressed air or other utilities required for the Contractor's operations and shall make and maintain the necessary service connections at the Contractor's own expense.

5-1.17 SANITARY PROVISIONS

State sanitary facilities will not be available for use by the Contractor's employees.

5-1.18 BRIDGE TOLLS

Toll-free passage on the San Francisco-Oakland Bay Bridge will be granted only for cars, trucks and special construction equipment which are clearly marked on the exterior with the Contractor's identification and which are being operated by the Contractor exclusively for the project, and which are used for the purpose of transporting materials and workers directly to and from the project site.

The Contractor shall make application to the Engineer in advance for toll-free passage. The Contractor will be held accountable for the proper use of passes issued, and upon completion of the work, shall return unused passes to the Engineer.

Attention is directed to Section 23302, "Evasion of Toll," of the Vehicle Code.

5-1.19 ACCESS TO PROJECT SITE

Prospective bidders may make arrangements to visit the project site by contacting the Toll Bridge Program Duty Senior , District 04 Office, 111 Grand Avenue, Oakland, CA 94612, email: duty senior tollbridge district04@dot.ca.gov, at telephone 510-286-5549.

5-1.20 PERMITS AND LICENSES

Attention is directed to Section 7-1.04, "Permits and Licenses," of the Standard Specifications and these special provisions.

The Department has obtained the following permits for this project:

A. California Regional Water Quality Control Board
B. U.S. Army Corps of Engineers
C. San Francisco Bay Conservation Development Commission
D. United States Coast Guard

Copies of these permits can be obtained at the Department of Transportation, Plans and Bid Documents Section, MS 26, 1120 N Street, Room 200, Sacramento, CA 95814, Telephone 916-654-4490 or may be seen and are available for inspection at the office of the Toll Bridge Duty Senior, District 04 Office, 111 Grand Avenue, Oakland, CA 94612, email: duty senior tollbridge district04@dot.ca.gov, telephone number (510) 286-5549.

Full compensation for conforming to the requirements in these permits shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefor.

5-1.21 FORCE ACCOUNT PAYMENT

The second, third and fourth paragraphs of Section 9-1.03A, "Work Performed by Contractor," in the Standard Specifications, shall not apply.

Attention is directed to "Overhead" of these special provisions.

To the total of the direct costs for work performed on a force account basis, computed as provided in Sections 9-1.03A(1), "Labor," 9-1.03A(2), "Materials," and 9-1.03A(3), "Equipment Rental," of the Standard Specifications, there will be added the following markups:

Cost	Percent Markup
Labor	28
Materials	10
Equipment Rental	10

The above markups shall be applied to all work performed on a force account basis, regardless of whether the work revises the current contract completion date.

The above markups, together with payments made for time-related overhead pursuant to "Overhead" of these special provisions, shall constitute full compensation for all overhead costs for work performed on a force account basis. These overhead costs shall be deemed to include all items of expense not specifically designated as cost or equipment rental in conformance with the provisions in Sections 9-1.03A(1), "Labor," 9-1.03A(2), "Materials," and 9-1.03A(3), "Equipment Rental," of the Standard Specifications. The total payment made as provided above and in the first paragraph of Section 9-1.03A, "Work Performed by Contractor," of the Standard Specifications shall be deemed to be the actual cost of the work performed on a force account basis, and shall constitute full compensation therefor. Full compensation for all overhead costs for work performed on a force account basis, and for which no adjustment is made to the quantity of time-related overhead pursuant to "Overhead" of these special provisions, shall be considered as included in the markups specified above, and no additional compensation will be allowed therefor.

When extra work to be paid for on a force account basis is performed by a subcontractor, approved in conformance with the provisions in Section 8-1.01, "Subcontracting," of the Standard Specifications, an additional markup of 7 percent will be added to the total cost of that extra work including all markups specified in this section "Force Account Payment". The additional 7 percent markup shall reimburse the Contractor for additional administrative costs, and no other additional payment will be made by reason of performance of the extra work by a subcontractor.

5-1.22 END USE OF DREDGED MATERIALS

If clay, silt, sand, gravel, aggregate, imported borrow or other minerals are dredged from San Francisco Bay, the Contractor shall provide documentation that a permit from the Bay Conservation and Development Commission has been

obtained. The documentation shall include the permit number, parcel number and specific location of the source of the material. The Contractor must also include this information on the HC-30 "Notice of Materials to be Used".

5-1.23 PAYMENTS

Attention is directed to Sections 9-1.06, "Partial Payments," and 9-1.07, "Payment After Acceptance," of the Standard Specifications and these special provisions.

For the purpose of making partial payments pursuant to Section 9-1.06, "Partial Payments," of the Standard Specifications, the amount set forth for the contract items of work hereinafter listed shall be deemed to be the maximum value of the contract item of work which will be recognized for progress payment purposes:

A. Electronic Mobile Daily Diary Computer System Data Delivery $82,500

After acceptance of the contract pursuant to the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount, if any, payable for a contract item of work in excess of the maximum value for progress payment purposes hereinabove listed for the item, will be included for payment in the first estimate made after acceptance of the contract.

In determining the partial payments to be made to the Contractor, only the following listed materials will be considered for inclusion in the payment as materials furnished but not incorporated in the work:

A. Steel Shells for Cast-In-Steel Shell Piling
B. Prestressing Steel in Sealed Containers
C. Prestressing Ducts and Anchorages
D. Precast Concrete Panel (Lightweight)
E. Precast Concrete Wall
F. Precast Concrete Fender Modules
G. Precast Concrete Segments
H. Circular Segmented Bearings
I. Joint Seal (Type B)
J. Modular Joint Seal Assemblies
K. Bar Reinforcing Steel
L. Bar Reinforcing Steel (Epoxy Coated)
M. Welded Headed Bar Reinforcement
N. Structural Steel
O. Miscellaneous Metal
P. Bridge Deck Drainage System
Q. Steel Barrier
R. Bikepath Railing
S. Equipment for Substation Eastbound and Substation Westbound
T. Service Platforms
U. Walkways

5-1.24 SOUND CONTROL REQUIREMENTS

Sound control shall conform to the provisions in Section 7-1.01I, "Sound Control Requirements," of the Standard Specifications and these special provisions.

The noise level from all of the Contractor's operations, between the hours of 9:00 p.m. and 6:00 a.m., shall not exceed 86 dbA at a distance of 15 meters. No pile driving activities are to be conducted between the hours of 8:00 p.m. and 7:00 a.m. This requirement shall not relieve the Contractor from responsibility for complying with local ordinances regulating noise levels.

The noise level requirement shall apply to all equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by the Contractor. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety laws for the protection of personnel.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.25 ENVIRONMENTAL WORK RESTRICTIONS

The project is located within the jurisdictions of the U.S. Army Corp of Engineers, the San Francisco Bay Conservation and Development Commission, the California Department of Fish and Game, the San Francisco Bay Regional Water Control

Board, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. The Department of Transportation has entered into an agreement regarding mitigation of the potential impact of this project with these entities.

The Contractor's attention is directed to the existence of environmental work restrictions that require special precautions be taken by the Contractor to protect the species listed below. It is the Contractor's responsibility to keep informed of all State and Federal Laws.

The Contractor shall comply with the California Endangered Species Act and the Federal Migratory Bird Treaty Act, which govern the protection of the peregrine falcon, double-crested cormorant and western gull. Seabird colonies and nests which become established on new construction will be monitored by the Caltrans staff and qualified seabird experts during the breeding season.

The Contractor shall notify the Engineer immediately if any dead or injured species of concern listed below are encountered.

The provisions in this section shall be made part of every subcontract executed pursuant to this contract.

The Contractor shall fully inform himself of the requirements of these agreements as well as all rules, regulations and conditions that may govern his operation in the following species of concern:

SPECIES OF CONCERN

PEREGRINE FALCON.--Peregrine falcon movements and behavior will be monitored by the U.S. Fish and Wildlife Service authorized personnel from the Santa Cruz Predatory Bird Research Group during construction between February 1st and July 31st of each year of construction. If peregrine falcon nesting occurs, the Contractor shall provide access to the nesting site as directed by the authorized biologist to monitor the nest site and to remove the falcon eggs and/or chicks.

Full compensation for providing access to U.S. Fish and Wildlife Service authorized personnel shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor

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PACIFIC HERRING.--Open water hydraulic dredging in areas 6 meters below Mean Lower Low Water (NGVD1929) or shallower will not be allowed between January 1 through May 31 of any year, except in areas confined within cofferdams or pile casings. At the Contractor's option, dredging by clam shell method may be used to perform the work without any time restriction. The Contractor's operations within cofferdams or during pile installations which will not place debris into the water or increase water turbidity will not be restricted. In-water construction or other operations that can generate debris into the water or increase water turbidity during spawn will not be allowed.

Surveys and monitoring of Pacific herring spawning locations will be conducted by the State. The Engineer will notify the Contractor whenever a spawning event is observed. If construction operations within the open water is within 200 meters of a spawn, the Contractor shall cease the portion of the contract work in this area within 8 hours of notification by the Engineer. Work shall not resume until notified by the Engineer which is expected to be approximately 14 days from the time of spawning. It is anticipated that Pacific herring spawning could occur from November 15 through March 31 of any year.

Full compensation for conforming to the above requirements shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

DOUBLE-CRESTED CORMORANT, WESTERN GULLS AND OTHER BIRD SPECIES.--Where Double-Crested Cormorant or other bird species nests are present, the Contractor shall not perform any activity within the nesting area during the breeding season defined as March 15 to August 31 of any year unless the Contractor implements the following:

A. Remove existing nests from the work areas prior to the breeding season.
B. Prevent the birds from constructing nests in the work area by installing temporary netting and wood sheeting or by continually washing off nest material beginning March 1 through July 1.

CALIFORNIA SEA LION AND HARBOR SEAL.--Prior to conduction pile driving activities, a 500 meter safety zone will be established around the location of the pile to be driven. If a marine mammal is observed within the safety zone during the driving of the pile, all pile driving will cease and the Contractor shall wait a minimum of 15 minutes for the marine mammal to move out of the safety zone. If, after 15 minutes, the marine mammal does not evacuate the safety zone, pile driving will be permitted to commence.

If floating marine mammal carcasses are observed within the construction right-of-way prior to the commencement of construction activities, said carcasses shall be tagged so they are not confused as project-related casualties. The tags shall be of waterproof material and shall be secured in such a manner that they are attached to the carcass for the full duration of the contract. After tagging, the Contractor shall leave all carcasses as they are found.

Full compensation for conforming to the above requirements shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.26 ENVIRONMENTALLY SENSITIVE AREAS (GENERAL)

The Contractor's attention is directed to the designated Environmentally Sensitive Areas (ESA), shown on the plans. The exact location of the boundaries of ESAs shall be established by the Engineer. Land based ESA boundaries shall be established in the field with temporary high visibility fencing. Water based ESA boundaries will be by others.

No construction activities in water within 200 meters of the ESA boundaries shall be allowed until a high visibility coast guard approved delineator has been installed.

Within the boundaries of an ESA, no project related activities shall take place. This specifically prohibits barge and vehicle access, storage or transport of any materials, including hydrocarbon and lead contaminated material, or any other project related activities.

The Contractor shall comply with the requirements below for the following ESAs:

NON-TIDAL WETLANDS.--Non-tidal wetlands are located near the east bay approach. The non-tidal wetland boundary shall be clearly marked by the installation of Temporary Fence (Type ESA) as specified elsewhere in these special provisions. The boundaries shall be checked periodically and the markings repaired or replaced as necessary during constriction.

Full compensation for checking, repairing or replacing the ESA marking shall be considered as included in the contract price paid per meter for Temporary Fence (Type ESA) and no separate payment will be made therefor.

5-1.27 RELATIONS WITH CALIFORNIA DEPARTMENT OF FISH AND GAME

This project is located within the jurisdiction of the California Department of Fish and Game (CDFG). CDFG has concurred with the measures developed by the Department of Transportation regarding the Peregrine Falcon colony that nests on the existing San Francisco/Oakland Bay Bridge during their breeding season and which may nest on new construction, and to protect the pacific herring if a spawn occurs in the vicinity of the construction activities. The Contractor shall be fully informed of the requirements associated with these measures as well as all rules regulations, and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's operations accordingly. The Department of Transportation has entered into an agreement with the CDFG with regard to species protection measures. This agreement will become part of the Information Handout.

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and are available for inspection at the office of the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Attention is directed to Section "Environmental Work Restrictions" of these special provisions relating to specific protection measures required under this contract.

Any modifications to any agreement between the Department of Transportation and the CDFG shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Full compensation for conforming to the requirements of this section shall be considered as included in the contract prices paid for the various contract items of work and no additional compensation will be allowed therefor.

5-1.28 RELATIONS WITH REGIONAL WATER QUALITY CONTROL BOARD

This project is located within an area controlled by the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). A RWQCB Order has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly.

Copies of the Order, may be obtained at the Department of Transportation, Plans and Bid Documents, Room 200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and will be available for inspection at the office of the Toll Bridge Program Duty Senior at 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Attention is directed to Sections 7-1.11, "Preservation of Property," and 7-1.12, "Responsibility for Damage," of the Standard Specifications.

Attention is directed to Section 8-1.06, "Time of Completion," of the Standard Specifications. Days during which the Contractor's operations are restricted in the floodway by the requirements of this section, shall be considered to be nonworking days if these restrictions cause a delay in the current controlling operation or operations.

Any modifications to the Order which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the RWQCB for their consideration.

When the Contractor is notified by the Engineer that a modification to the Order is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification.

Any modifications to any agreement between the Department of Transportation and the RWQCB shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.29 RELATIONS WITH BAY AREA AIR QUALITY MANAGEMENT DISTRICT (PENDING, TB SPEC BAAQMD)

Portions of the work being performed under this contract are subject to the provisions of Regulation _____, Rule ___ of the Bay Area Air Quality Management District (BAAQMD). The Contractor shall be fully informed of the provisions of that Rule and shall conduct the work accordingly.

The BAAQMD has issued a permit to allow the Department to conduct the work necessary for new construction. Copies of this permit may be obtained at the Department of Transportation, Plans and Bid Documents Section (MS 26), 1120 N Street, Room 200, Sacramento, CA 95814, telephone no. (916) 654-4490, and are available for inspection at the office of the Toll Bridge Duty Senior at the District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549. Notify the Duty Senior at least 24 hours in advance to reserve a copy for review.

Attention is directed to Sections 7-1.01, "Laws to be Observed," 7-1.04, "Permits and Licenses," and 7-1.09, "Public Safety," of the Standard Specifications.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items involved and no additional compensation will be allowed therefor.

5-1.30 RELATIONS WITH U.S. ARMY CORPS OF ENGINEERS

This project is located within the jurisdiction of the United States Army Corps of Engineers (USACE). A permit has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions of the permit that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly. Said document shall be considered a part of, and shall become, an integral part of the special provisions and contract for this project.

Copies of the permit may be obtained at the Department of Transportation, Plans and Bid Documents, Room 200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, telephone number (916) 654-4490, and will be available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Any modifications to the permit which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the USACE for their consideration.

When the Contractor is notified by the Engineer that a modification to the permit is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification. Any modifications to any agreement between the Department of Transportation and the USACE shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.31 RELATIONS WITH SAN FRANCISCO BAY CONSERVATION DEVELOPMENT COMMISSION

This project is located within the jurisdiction of the San Francisco Bay Conservation and Development Commission (BCDC). A permit has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions of the permit that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly. Said document shall be considered a part of, and shall become, an integral part of the special provisions and contract for this project.

Copies of the permit may be obtained at the Department of Transportation, Plans and Bid Documents, Room 200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, telephone number (916) 654-4490, and will be available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Any modifications to the permit which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the BCDC for their consideration.

When the Contractor is notified by the Engineer that a modification to the permit is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification. Any modifications to any agreement between the Department of Transportation and BCDC shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

The Contractor shall submit to the Engineer a plan for in-Bay temporary falsework, temporary structures, trestles and other temporary in-Bay constructed facilities within 15 days following notice of award. The plan shall include the area and volume of material to be placed between the mean-high-water-line and the mudline. The Engineer will submit to BCDC for plan review; the Engineer and BCDC will review and the Engineer will provide comments to the Contractor within 30 days. The Contractor will have 15 days to revise and resubmit.

Full compensation for conforming to the above requirements shall be considered as included in the contract prices paid for the various contract items of work and no additional compensation will be allowed therefor.

5-1.32 RELATIONS WITH UNITED STATES COAST GUARD

This project is located adjacent to and across a navigable channel which is under the jurisdiction of the United States Coast Guard (USCG), Eleventh District, Coast Guard Island, Alameda, California 94501-5100.

A USCG Preconstruction Checklist has been issued covering work to be performed under this contract and will be part of the Informational Handout. The Contractor shall be fully informed of all rules, regulations and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly.

Copies of the Preconstruction Checklist may be obtained at the Department of Transportation, Plans and Bid Documents, Room 200, Transportation Building, P.O. Box 942874, Sacramento, California 94274-0001, telephone number (916) 654-4490, and will be available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Attention is directed to Sections 7-1.01, "Laws to be Observed," 7-1.11, "Preservation of Property," and 7-1.12, "Responsibility for Damage," of the Standard Specifications.

The Contractor's attention is directed to the following conditions which are among those established by the USCG in the Preconstruction Checklist and the work authorization for this project:

Navigation.--The Contractor's operations shall conform to the USCG Commandant Instruction M16672.2C. Work shall be such that the free navigation of the waterway, navigable depths and channel widths are not impaired, except otherwise directed by the USCG.

Within 30 calendar days of award of the contract, or as directed by the Engineer, the Contractor shall notify the Engineer, in writing, along with drawings, of their proposed method for anchoring barges and of the location of trestles, falsework and temporary towers. The Engineer will transmit the Contractor's proposal to the USCG for approval. The Contractor shall not anchor any barges until their procedure has been approved by the USCG. In the event that the required USCG approval, in the opinion of the Engineer, delays the Contractor's operations, the Contractor will be granted a time extension commensurate with the delays.

Aids to Navigation.--The Contractor, acting on behalf of the Department, shall coordinate with the USCG Commander, Telephone (510) 437-2983 for written authorization at least 60 days prior to any relocation or temporary removal of any aids to navigation within or near any areas involved with dredging or construction. In addition, the Contractor shall not obstruct, willfully damage, make fast to, or interfere with any aid to navigation.

Navigational Obstructions.--Any debris, material, plant or machinery that are incidentally dropped into the waters of the Bay during the progress of work, which may present a hazard or which may obstruct navigation shall be promptly recovered or removed. Floating objects shall be immediately recovered or tied down and marked, so that they do not present hazards to navigation. The Contractor shall give immediate notice of in-place obstructions to the proper authorities and shall mark or buoy such obstructions until they are removed. Should the Contractor neglect or delay compliance with the above requirements, such obstructions shall be removed by the State and the cost of such removal will be deducted from the moneys due to the Contractor or may be recovered from their bond.

Navigational Lighting.--The Contractor shall keep proper warning lights each night between the hours of sunset and sunrise upon all floating equipment, falsework connected with the work and all buoys which are of a size and location as to endanger or obstruct navigation. The Contractor shall provide suitable navigational lighting at any time that construction operations obstruct the waterways. All floating equipment shall be marked in accordance with USCG Regulation CG-169.

Falsework, Trestles and Temporary Towers.--Following the completion of construction, the Contractor shall removed all temporary falsework, trestles and towers in their entirety.

The Contractor shall be aware of the USCG facility on the southeast side of Yerba Buena Island. The Contractor's activities will not interfere with the twenty-four hour a day operations at the USCG facility. The Contractor shall not restrict land or sea access to that facility.

Attention is directed to Section 8-1.06, "Time of Completion," of the Standard Specifications. Days during which the Contractor's operations are restricted in the navigation channel by others shall be considered to be nonworking days if, in the opinion of the Engineer, these restrictions cause a delay in the current controlling operation or operations.

Full compensation for conforming to the above requirements shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.33 RELATIONS WITH UNITED STATES FISH AND WILDLIFE SERVICE

This project is located within the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). The USFWS has issued a Biological Opinion regarding several species which are protected under both the Federal Endangered Species Act and the California Endangered Species Act. The specifics of this opinion are part of an agreement which the Department of Transportation has entered into with the USFWS. This agreement is part of the Information Handout. The Contractor shall be fully informed of the requirements of this agreement as well as of all rules, regulations, and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's operations accordingly.

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and will be available for inspection at the office of the Toll Bridge Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Attention is directed to "Environmental Work Restrictions" of these special provisions relating to specific measures required under this contract.

Any modifications to any agreement between the Department of Transportation and the USFWS shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.34 RELATIONS WITH NATIONAL MARINE FISHERIES SERVICES

This project is located within the jurisdiction of the National Marine Fisheries Service (NMFS). The NMFS has concurred with measures developed by the Department of Transportation regarding the protection of winter-run Chinook salmon habitat and critical habitat for steelhead trout, and for protection of the local California Sea Lion and Harbor Seal populations. The Contractor shall be fully informed of the requirements associated with these measures as well as all rules, regulations and conditions that may govern the Contractor's operations in said area and shall conduct their operations accordingly. Attention is directed to Section "Environmental Work Restrictions" of these special provisions relating to specific measures required under this contract.

The Contractor shall restrict contract vessels from entering a no entry buffer zone of 500 meters radius measured from the harbor seal haul-out site to the southwest of Yerba Buena Island.

The NMFS has prepared advisory letters to the Department of Transportation, in response to the Department's request for consultation regarding species of fish and marine mammals that may be affected by construction activities on the new San Francisco/Oakland Bay Bridge, Skyway project. These letters are part of the Information Handout. The Contractor shall be fully informed of and abide by the recommendations of the NMFS in performing the Contractor's operations on this project.

Copies of these consultation letters may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and will be available for inspection at the office of the Toll Bridge Retrofit Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549.

Any modifications to any agreement between the Department of Transportation and the NMFS shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

SECTION 6. (BLANK)

SECTION 7. (BLANK)

SECTION 8. MATERIALS

SECTION 8-1. MISCELLANEOUS

8-1.01 SUBSTITUTION OF NON-METRIC MATERIALS AND PRODUCTS

Only materials and products conforming to the requirements of the specifications shall be incorporated in the work. When metric materials and products are not available, and when approved by the Engineer, and at no cost to the State, materials and products in the United States Standard Measures which are of equal quality and of the required properties and characteristics for the purpose intended, may be substituted for the equivalent metric materials and products, subject to the following provisions:

A. Materials and products shown on the plans or in the special provisions as being equivalent may be substituted for the metric materials and products specified or detailed on the plans.
B. Before other non-metric materials and products will be considered for use, the Contractor shall furnish, at the Contractor's expense, evidence satisfactory to the Engineer that the materials and products proposed for use are equal to or better than the materials and products specified or detailed on the plans. The burden of proof as to the quality and suitability of substitutions shall be upon the Contractor and the Contractor shall furnish necessary information as required by the Engineer. The Engineer will be the sole judge as to the quality and suitability of the substituted materials and products and the Engineer's decision will be final.
C. When the Contractor elects to substitute non-metric materials and products, including materials and products shown on the plans or in the special provisions as being equivalent, the list of sources of material specified in Section 6-1.01, "Source of Supply and Quality of Materials," of the Standard Specification shall include a list of substitutions to be made and contract items involved. In addition, for a change in design or details, the Contractor shall submit plans and working drawings in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The plans and working drawings shall be submitted at least 7 days before the Contractor intends to begin the work involved.

Unless otherwise specified, the following substitutions of materials and products will be allowed:

SUBSTITUTION TABLE FOR SIZES OF HIGH STRENGTH STEEL FASTENERS
ASTM Designation: A 325M

METRIC SIZE SHOWN ON THE PLANS mm x thread pitch	SIZE TO BE SUBSTITUTED inch
M16 x 2	5/8
M20 x 2.5	3/4
M22 x 2.5	7/8
M24 x 3	1
M27 x 3	1-1/8
M30 x 3.5	1-1/4
M36 x 4	1-1/2

SUBSTITUTION TABLE FOR PLAIN WIRE REINFORCEMENT
ASTM Designation: A 82

METRIC SIZE SHOWN ON THE PLANS mm^2	SIZE TO BE SUBSTITUTED $inch^2$ x 100
MW9	W1.4
MW10	W1.6
MW13	W2.0
MW15	W2.3
MW19	W2.9
MW20	W3.1
MW22	W3.5
MW25	W3.9, except W3.5 in piles only
MW26	W4.0
MW30	W4.7
MW32	W5.0
MW35	W5.4
MW40	W6.2
MW45	W6.5
MW50	W7.8
MW55	W8.5, except W8.0 in piles only
MW60	W9.3
MW70	W10.9, except W11.0 in piles only
MW80	W12.4
MW90	W14.0
MW100	W15.5

SUBSTITUTION TABLE FOR BAR REINFORCEMENT

METRIC BAR DESIGNATION NUMBER[1] SHOWN ON THE PLANS	BAR DESIGNATION NUMBER[2] TO BE SUBSTITUTED
10	3
13	4
16	5
19	6
22	7
25	8
29	9
32	10
36	11
43	14
57	18

[1]Bar designation numbers approximate the number of millimeters of the nominal diameter of the bars.
[2]Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars.
No adjustment will be required in spacing or total number of reinforcing bars due to a difference in minimum yield strength between metric and non-metric bars.

SUBSTITUTION TABLE FOR SIZES OF:

(1) STEEL FASTENERS FOR GENERAL APPLICATIONS (ASTM Designation: A 307 or AASHTO Designation: M 314, Grade 36 or 55), and

(2) HIGH STRENGTH STEEL FASTENERS (ASTM Designation: A 325 or A 449)

METRIC SIZE SHOWN ON THE PLANS mm	SIZE TO BE SUBSTITUTED inch
6 or 6.35	1/4
8 or 7.94	5/16
10 or 9.52	3/8
11 or 11.11	7/16
13 or 12.70	1/2
14 or 14.29	9/16
16 or 15.88	5/8
19 or 19.05	3/4
22 or 22.22	7/8
24, 25, or 25.40	1
29 or 28.58	1-1/8
32 or 31.75	1-1/4
35 or 34.93	1-3/8
38 or 38.10	1-1/2
44 or 44.45	1-3/4
51 or 50.80	2
57 or 57.15	2-1/4
64 or 63.50	2-1/2
70 or 69.85	2-3/4
76 or 76.20	3
83 or 82.55	3-1/4
89 or 88.90	3-1/2
95 or 95.25	3-3/4
102 or 101.60	4

SUBSTITUTION TABLE FOR NOMINAL THICKNESS OF SHEET METAL

UNCOATED HOT AND COLD ROLLED SHEETS		HOT-DIPPED ZINC COATED SHEETS (GALVANIZED)	
METRIC THICKNESS SHOWN ON THE PLANS mm	GAGE TO BE SUBSTITUTED inch	METRIC THICKNESS SHOWN ON THE PLANS mm	GAGE TO BE SUBSTITUTED inch
7.94	0.3125	4.270	0.1681
6.07	0.2391	3.891	0.1532
5.69	0.2242	3.510	0.1382
5.31	0.2092	3.132	0.1233
4.94	0.1943	2.753	0.1084
4.55	0.1793	2.372	0.0934
4.18	0.1644	1.994	0.0785
3.80	0.1495	1.803	0.0710
3.42	0.1345	1.613	0.0635
3.04	0.1196	1.461	0.0575
2.66	0.1046	1.311	0.0516
2.28	0.0897	1.158	0.0456
1.90	0.0747	1.006 or 1.016	0.0396
1.71	0.0673	0.930	0.0366
1.52	0.0598	0.853	0.0336
1.37	0.0538	0.777	0.0306
1.21	0.0478	0.701	0.0276
1.06	0.0418	0.627	0.0247
0.91	0.0359	0.551	0.0217
0.84	0.0329	0.513	0.0202
0.76	0.0299	0.475	0.0187
0.68	0.0269	--------	--------
0.61	0.0239	--------	--------
0.53	0.0209	--------	--------
0.45	0.0179	--------	--------
0.42	0.0164	--------	--------
0.38	0.0149	--------	--------

SUBSTITUTION TABLE FOR WIRE

METRIC THICKNESS SHOWN ON THE PLANS mm	WIRE THICKNESS TO BE SUBSTITUTED inch	GAGE NO.
6.20	0.244	3
5.72	0.225	4
5.26	0.207	5
4.88	0.192	6
4.50	0.177	7
4.11	0.162	8
3.76	0.148	9
3.43	0.135	10
3.05	0.120	11
2.69	0.106	12
2.34	0.092	13
2.03	0.080	14
1.83	0.072	15
1.57	0.062	16
1.37	0.054	17
1.22	0.048	18
1.04	0.041	19
0.89	0.035	20

SUBSTITUTION TABLE FOR PIPE PILES

METRIC SIZE SHOWN ON THE PLANS mm x mm	SIZE TO BE SUBSTITUTED inch x inch
PP 360 x 4.55	NPS 14 x 0.179
PP 360 x 6.35	NPS 14 x 0.250
PP 360 x 9.53	NPS 14 x 0.375
PP 360 x 11.12	NPS 14 x 0.438
PP 406 x 12.70	NPS 16 x 0.500
PP 460 x T	NPS 18 x T"
PP 508 x T	NPS 20 x T"
PP 559 x T	NPS 22 x T"
PP 610 x T	NPS 24 x T"
PP 660 x T	NPS 26 x T"
PP 711 x T	NPS 28 x T"
PP 762 x T	NPS 30 x T"
PP 813 x T	NPS 32 x T"
PP 864 x T	NPS 34 x T"
PP 914 x T	NPS 36 x T"
PP 965 x T	NPS 38 x T"
PP 1016 x T	NPS 40 x T"
PP 1067 x T	NPS 42 x T"
PP 1118 x T	NPS 44 x T"
PP 1219 x T	NPS 48 x T"
PP 1524 x T	NPS 60 x T"

The thickness in millimeters (T) represents an exact conversion of the thickness in inches (T").

SUBSTITUTION TABLE FOR STRUCTURAL TIMBER AND LUMBER

METRIC MINIMUM DRESSED DRY, SHOWN ON THE PLANS mm x mm	METRIC MINIMUM DRESSED GREEN, SHOWN ON THE PLANS mm x mm	NOMINAL SIZE TO BE SUBSTITUTED inch x inch
19x89	20x90	1x4
38x89	40x90	2x4
64x89	65x90	3x4
89x89	90x90	4x4
140x140	143x143	6x6
140x184	143x190	6x8
184x184	190x190	8x8
235x235	241x241	10x10
286x286	292x292	12x12

SUBSTITUTION TABLE FOR NAILS AND SPIKES

METRIC COMMON NAIL, SHOWN ON THE PLANS Length, mm Diameter, mm	METRIC BOX NAIL, SHOWN ON THE PLANS Length, mm Diameter, mm	METRIC SPIKE, SHOWN ON THE PLANS Length, mm Diameter, mm	SIZE TO BE SUBSTITUTED Penny-weight
50.80 2.87	50.80 2.51	_____	6d
63.50 3.33	63.50 2.87	_____	8d
76.20 3.76	76.20 3.25	76.20 4.88	10d
82.55 3.76	82.55 3.25	82.55 4.88	12d
88.90 4.11	88.90 3.43	88.90 5.26	16d
101.60 4.88	101.60 3.76	101.60 5.72	20d
114.30 5.26	114.30 3.76	114.30 6.20	30d
127.00 5.72	127.00 4.11	127.00 6.68	40d
_____	_____	139.70 7.19	50d
_____	_____	152.40 7.19	60d

SUBSTITUTION TABLE FOR IRRIGATION COMPONENTS

METRIC WATER METERS, TRUCK LOADING STANDPIPES, VALVES, BACKFLOW PREVENTERS, FLOW SENSORS, WYE STRAINERS, FILTER ASSEMBLY UNITS, PIPE SUPPLY LINES, AND PIPE IRRIGATION SUPPLY LINES SHOWN ON THE PLANS DIAMETER NOMINAL (DN) mm	NOMINAL SIZE TO BE SUBSTITUTED inch
15	1/2
20	3/4
25	1
32	1-1/4
40	1-1/2
50	2
65	2-1/2
75	3
100	4
150	6
200	8
250	10
300	12
350	14
400	16

Unless otherwise specified, substitutions of United States Standard Measures standard structural shapes corresponding to the metric designations shown on the plans and in conformance with the requirements in ASTM Designation: A 6/A 6M, Annex 2, will be allowed.

8-1.02 PREQUALIFIED AND TESTED SIGNING AND DELINEATION MATERIALS

The Department maintains the following list of Prequalified and Tested Signing and Delineation Materials. The Engineer shall not be precluded from sampling and testing products on the list of Prequalified and Tested Signing and Delineation Materials.

The manufacturer of products on the list of Prequalified and Tested Signing and Delineation Materials shall furnish the Engineer a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each type of traffic product supplied.

For those categories of materials included in the list of Prequalified and Tested Signing and Delineation Materials, only those products shown within the listing may be used in the work. Other categories of products, not included in the list of Prequalified and Tested Signing and Delineation Materials, may be used in the work provided they conform to the requirements of the Standard Specifications.

Materials and products may be added to the list of Prequalified and Tested Signing and Delineation Materials if the manufacturer submits a New Product Information Form to the New Product Coordinator at the Transportation Laboratory. Upon a Departmental request for samples, sufficient samples shall be submitted to permit performance of required tests. Approval of materials or products will depend upon compliance with the specifications and tests the Department may elect to perform.

PAVEMENT MARKERS, PERMANENT TYPE

Retroreflective

A. Apex, Model 921 (100 mm x 100 mm)
B. Ray-O-Lite, Models SS (100 mm x 100 mm), RS (100 mm x 100 mm) and AA (100 mm x 100 mm)
C. Stimsonite, Models 88 (100 mm x 100 mm), 911 (100 mm x 100 mm), 953 (70 mm x 114 mm)
D. 3M Series 290 (89 mm x 100 mm)

Retroreflective With Abrasion Resistant Surface (ARS)

A. Apex, Model 921AR (100 mm x 100 mm)
B. Ray-O-Lite "AA" ARS (100 mm x 100 mm)
C. Stimsonite, Models 911 (100 mm x 100 mm), 953 (70 mm x 114 mm)
D. 3M Series 290 (89 mm x 100 mm)

Retroreflective With Abrasion Resistant Surface (ARS)

(Used for recessed applications)

A. Stimsonite, Model 948 (58 mm x 119 mm)
B. Ray-O-Lite, Model 2002 (58 mm x 117 mm)
C. Stimsonite, Model 944SB (51 mm x 100 mm)*
D. Ray-O-Lite, Model 2004 ARS (51 mm x 100 mm)*

*For use only in 114 mm wide (older) recessed slots

Non-Reflective For Use With Epoxy Adhesive, 100 mm Round

A. Apex Universal (Ceramic)
B. Highway Ceramics, Inc. (Ceramic)

Non-Reflective For Use With Bitumen Adhesive, 100 mm Round

A. Alpine Products, "D-Dot" and "ANR" (ABS)
B. Apex Universal (Ceramic)
C. Apex Universal, Model 929 (ABS)
D. Elgin Molded Plastics, "Empco-Lite" Model 900 (ABS)
E. Highway Ceramics, Inc. (Ceramic)
F. Hi-Way Safety, Inc., Models P20-2000W and 2001Y (ABS)
G. Interstate Sales, "Diamond Back" (ABS) and (Polypropylene)
H. Novabrite Models Adot-w (White) Adot-y (Yellow), (ABS)
I. Road Creations, Model RCB4NR (Acrylic)
J. Zumar Industries, "Titan TM40A" (ABS)

PAVEMENT MARKERS, TEMPORARY TYPE

Temporary Markers For Long Term Day/Night Use (6 months or less)

A. Apex Universal, Model 924 (100 mm x 100 mm)
B. Elgin Molded Plastics, "Empco-Lite" Model 901 (100 mm x 100 mm)
C. Road Creations, Model R41C (100 mm x 100 mm)
D. Vega Molded Products "Temporary Road Marker" (75 mm x 100 mm)

Temporary Markers For Short Term Day/Night Use (14 days or less)

(For seal coat or chip seal applications, clear protective covers are required)

A. Apex Universal, Model 932
B. Davidson Plastics, Models T.O.M., T.R.P.M., and "HH" (High Heat)
C. Hi-Way Safety, Inc., Model 1280/1281

STRIPING AND PAVEMENT MARKING MATERIAL

Permanent Traffic Striping and Pavement Marking Tape

A. Advanced Traffic Marking, Series 300 and 400
B. Brite-Line, Series 1000
C. Brite-Line "DeltaLine XRP"
D. Swarco Industries, "Director 35" (For transverse application only)

E. Swarco Industries, "Director 60"
F. 3M, "Stamark" Series 380 and 5730
G. 3M, "Stamark" Series 420 (For transverse application only)

Temporary (Removable) Striping and Pavement Marking Tape (6 months or less)

A. Advanced Traffic Marking, Series 200
B. Brite-Line, Series 100
C. P.B. Laminations, Aztec, Grade 102
D. Swarco Industries, "Director-2"
E. 3M, "Stamark," Series 620
F. 3M Series A145 Removable Black Line Mask
(Black Tape: For use only on Asphalt Concrete Surfaces)
G. Advanced Traffic Marking Black "Hide-A-Line"
(Black Tape: For use only on Asphalt Concrete Surfaces)
H. Brite-Line "BTR" Black Removable Tape
(Black Tape: For use only on Asphalt Concrete Surfaces)

Preformed Thermoplastic (Heated in place)

A. Flint Trading, "Premark" and "Premark 20/20 Flex"
B. Pavemark, "Hotape"

Removable Traffic Paint

A. Belpro, Series 250/252 and No. 93 Remover

Ceramic Surfacing Laminate, 150 mm x 150 mm

A. Safeline Industries/Highway Ceramics, Inc.

CLASS 1 DELINEATORS

One Piece Driveable Flexible Type, 1700 mm

A. Carsonite, Curve-Flex CFRM-400
B. Carsonite, Roadmarker CRM-375
C. Davidson Plastics, "Flexi-Guide Models 400 and 566"
D. FlexStake, Model 654 TM
E. GreenLine Models HWD1-66 and CGD1-66
F. J. Miller Industries, Model JMI-375 (with soil anchor)

Special Use Flexible Type, 1700 mm

A. Carsonite, "Survivor" (with 450 mm U-Channel base)
B. FlexStake, Model 604
C. GreenLine Models HWD and CGD (with 450 mm U-Channel base)
D. Safe-Hit with 200 mm pavement anchor (SH248-GP1)
E. Safe-Hit with 380 mm soil anchor (SH248-GP2) and with 450 mm soil anchor (SH248-GP3)

Surface Mount Flexible Type, 1200 mm

A. Bent Manufacturing Company, Masterflex Model MF-180EX-48
B. Carsonite, "Super Duck II"
C. FlexStake, Surface Mount, Models 704 and 754 TM

CHANNELIZERS

Surface Mount Type, 900 mm

A. Bent Manufacturing Company, Masterflex Models MF-360-36 (Round) and MF-180-36 (Flat)
B. Carsonite, "Super Duck" (Flat SDF-436, Round SDR-336)
C. Carsonite, "Super Duck II" Model SDCF203601MB "The Channelizer"
D. Davidson Plastics, Flex-Guide Models FG300LD and FG300UR
E. FlexStake, Surface Mount, Models 703 and 753 TM
F. GreenLine, Model SMD-36

G. Hi-Way Safety, Inc. "Channel Guide Channelizer" Model CGC36
H. The Line Connection, "Dura-Post" Model DP36-3 (Permanent)
I. The Line Connection, "Dura-Post" Model DP36-3C (Temporary)
J. Repo, Models 300 and 400
K. Safe-Hit, Guide Post, Model SH236SMA

CONICAL DELINEATORS, 1070 mm
(For 700 mm Traffic Cones, see Standard Specifications)
A. Bent Manufacturing Company "T-Top"
B. Plastic Safety Systems "Navigator-42"
C. Roadmaker Company "Stacker"
D. TrafFix Devices "Grabber"

OBJECT MARKERS
Type "K", 450 mm
A. Carsonite, Model SMD-615
B. FlexStake, Model 701 KM
C. Repo, Models 300 and 400
D. Safe-Hit, Model SH718SMA
E. The Line Connection, Model DP21-4K

Type "K-4" / "Q" Object Markers, 600 mm
A. Bent Manufacturing "Masterflex" Model MF-360-24
B. Carsonite, Super Duck II
C. FlexStake, Model 701KM
D. Repo, Models 300 and 400
E. Safe-Hit, Models SH8 24SMA_WA and SH8 24GP3_WA
F. The Line Connection, Model DP21-4Q

TEMPORARY RAILING (TYPE K) REFLECTORS AND CONCRETE BARRIER MARKERS
Impactable Type
A. ARTUK, "FB"
B. Davidson Plastics, Model PCBM-12
C. Duraflex Corp., "Flexx 2020" and "Electriflexx"
D. Hi-Way Safety, Inc., Model GMKRM100

Non-Impactable Type
A. ARTUK, JD Series
B. Stimsonite, Model 967 (with 83 mm Acrylic cube corner reflector)
C. Stimsonite, Model 967LS
D. Vega Molded Products, Models GBM and JD

THRIE BEAM BARRIER MARKERS
(For use to the left of traffic)
A. Duraflex Corp., "Railrider"
B. Davidson Plastics, "Mini" (75 mm x 254 mm)

CONCRETE BARRIER DELINEATORS, 400 mm
(For use to the right of traffic. When mounted on top of barrier, places top of reflective element at 1200 mm)
A. Davidson Plastics, Model PCBM T-16
B. Safe-Hit, Model SH216RBM
C. Sun-Lab Technology, "Safety Guide Light, Model TM," 130 mm x 130 mm x 80 mm

CONCRETE BARRIER-MOUNTED MINI-DRUM (260 mm x 360 mm x 570 mm)
A. Stinson Equipment Company "SaddleMarker"

SOUND WALL DELINEATOR
(Applied vertically. Place top of 75 mm x 300 mm reflective element at 1200 mm above roadway)
A. Davidson Plastics, PCBM S-36
B. Sun-Lab Technology, "Safety Guide Light, Model SM12," 130 mm x 130 mm x 80 mm

GUARD RAILING DELINEATOR
(Top of reflective element at 1200 mm above plane of roadway)

Wood Post Type, 686 mm

A. Carsonite, Model 427
B. Davidson Plastics FG 427 and FG 527
C. FlexStake, Model 102 GR
D. GreenLine GRD 27
E. J. Miller Model JMI-375G
F. Safe-Hit, Model SH227GRD

Steel Post Type

A. Carsonite, Model CFGR-327 with CFGRBK300 Mounting Bracket

RETROREFLECTIVE SHEETING

Channelizers, Barrier Markers, and Delineators

A. 3M, High Intensity
B. Reflexite, PC-1000 Metalized Polycarbonate
C. Reflexite, AC-1000 Acrylic
D. Reflexite, AP-1000 Metalized Polyester
E. Reflexite, AR-1000 Abrasion Resistant Coating
F. Avery Dennison T-6500 Series (Formerly Stimsonite, Series 6200) (For rigid substrate devices only)

Traffic Cones, 330 mm Sleeves

A. Reflexite SB (Polyester), Vinyl or "TR" (Semi-transparent)

Traffic Cones, 100 mm and 150 mm Sleeves

A. 3M Series 3840
B. Reflexite Vinyl, "TR" (Semi-transparent) or "Conformalite"

Barrels and Drums

A. Reflexite, "Super High Intensity" or "High Impact Drum Sheeting"
B. 3M Series 3810

Barricades: Type I, Engineer Grade

A. American Decal, Adcolite
B. Avery Dennison, T-1500 and T-1600
C. 3M, Scotchlite, Series CW

Barricades: Type II, Super Engineer Grade

A. Avery Dennison, T-2500 Series
B. Kiwalite Type II
C. Nikkalite 1800 Series

Signs: Type II, Super Engineer Grade

A. Avery Dennison, T-2500 Series
B. Kiwalite, Type II
C. Nikkalite 1800 Series

Signs: Type III, High-Intensity Grade

A. 3M Series 3800
B. Nippon Carbide, Nikkalite Brand Ultralite Grade II

Signs: Type IV, High-Intensity Prismatic Grade

A. Avery Dennison T-6500 (Formerly Stimsonite Series 6200)

Signs: Type VII, High-Intensity Prismatic Grade

A. 3M Series 3900

Signs: Type VI, Roll-Up Signs

A. Reflexite, Vinyl (Orange)
B. Reflexite "SuperBright" (Fluorescent orange)
C. Reflexite "Marathon" (Fluorescent orange)
D. 3M Series RS34 (Orange) and RS20 (Fluorescent orange)

SPECIALTY SIGN (All Plastic)

A. All Sign Products, STOP Sign, 750 mm

SIGN SUBSTRATE FOR CONSTRUCTION AREA SIGNS

Aluminum

Fiberglass Reinforced Plastic (FRP)

A. Sequentia, "Polyplate"
B. Fiber-Brite

8-1.03 STATE-FURNISHED MATERIALS

Attention is directed to Section 6-1.02, "State-Furnished Materials," of the Standard Specifications and these special provisions.

The following materials will be furnished to the Contractor:

A. Sign panels for roadside signs and overhead sign structures.
B. Hardware for mounting sign panels as follows:

    1. Blind rivets for mounting overlapping legend at sign panel joints.
    2. Closure inserts.
    3. Aluminum bolts, nuts, and washers for mounting overhead formed panels.

C. Disks for survey monuments.
D. Call boxes
E. Model 170 controller assemblies, as shown on the plans, including controller unit, completely wired controller cabinet, and inductive loop detector sensor units.
F. Model 334 controller cabinets.
G. Model 500 changeable message sign panels with control cable harnesses (4 and 5) and controller interface assembly.
H. Force Balance Accelerometer (FBA) pigtails and seismic sensor mounting plates for strong motion detection system.
I. Strong motion detection sensors, recorders and steel casing and caps (for the pier sensors)
J. Steel shell sections fabricated from plate conforming to ASTM A709, Grade 50, with dimensions as shown in the following table:

Steel Shell Designation (as marked)	Outside Diameter (mm)	Wall Thickness (mm)	Length (mm)
1A	2438±	40	1525±
1B	2438±	60	1515±
1C	2438±	70	1515±
2A	2438±	40	1505±
2B	2438±	60	1510±
2C	2438±	70	1505±
3A	2438±	40	1515±
3B	2438±	60	1530±
3C	2438±	70	1490±

State-furnished steel shell sections are remnants from the previous Pile Installation Demonstration Project, Contract No. 04-012084. The ends of the steel shells have been torch-cut and have not received finish treatment, such as grinding. Steel shell sections have been deformed from pile driving and are not in conformance with the provisions in "Piling," of these special provisions. At the option of the Contractor, State-furnished steel shell sections may be used for welding qualification. If the Contractor elects to use this option, the Contractor shall be responsible for re-cutting and repairing the steel shell sections prior to welding so that they are in conformance with the requirements in "Welding" and "Piling," of these special provisions.

Controller cabinets (with auxiliary equipment but without controller unit), panels Model 500 changeable message sign, wiring harness, and controller interface assembly, including the controller unit and completely wired cabinet, will be furnished to the Contractor at the Caltrans Maintenance Station, 30 Rickard Street, San Francisco, CA 94134.

Steel shell sections will be furnished to the Contractor near the San Francisco-Oakland Bay Bridge Toll Plaza. A map showing the location of the steel shell sections is provided in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

State-furnished steel shell sections (used and un-used for welding qualification) shall become the property of the Contractor and shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

The Contractor shall notify the Engineer not less than 48 hours before State-furnished material is to be picked up by the Contractor. A full description of the material and the time the material will be picked up shall be provided.

8-1.04 MISCELLANEOUS METAL

The table in the tenth paragraph of Section 75-1.02, "Miscellaneous Iron and Steel," of the Standard Specifications is amended to read:

Material	Specification
Steel bars, plates and shapes	ASTM Designation: A 36/A 36M or A 575, A 576 (AISI or M Grades 1016 through 1030 except Grade 1017)
Steel fastener components for general applications:	
Bolts and studs	ASTM Designation: A 307
Headed anchor bolts	ASTM Designation: A 307, Grade B, including S1 supplementary requirements
Nonheaded anchor bolts	ASTM Designation: A 307, Grade C, including S1 supplementary requirements and S1.6 of AASHTO Designation: M 314 supplementary requirements or AASHTO Designation: M 314, Grade 36 or 55, including S1 supplementary requirements
High-strength bolts and studs, threaded rods, and nonheaded anchor bolts	ASTM Designation: A 449, Type 1
Nuts	ASTM Designation: A 563, including Appendix X1*
Washers	ASTM Designation: F 844
Components of high-strength steel fastener assemblies for use in structural steel joints:	
Bolts	ASTM Designation: A 325, Type 1
Tension control bolts	ASTM Designation: F 1852, Type 1
Nuts	ASTM Designation: A 563, including Appendix X1*
Hardened washers	ASTM Designation: F 436, Type 1, Circular, including S1 supplementary requirements
Direct tension indicators	ASTM Designation: F 959, Type 325, zinc-coated
Stainless steel fasteners (Alloys 304 & 316) for general applications:	
Bolts, screws, studs, threaded rods, and nonheaded anchor bolts	ASTM Designation: F 593 or F 738M
Nuts	ASTM Designation: F 594 or F 836M
Washers	ASTM Designation: A 240/A 240M and ANSI B 18.22M
Carbon-steel castings	ASTM Designation: A 27/A 27M, Grade 65-35 [450-240], Class 1
Malleable iron castings	ASTM Designation: A 47, Grade 32510 or A 47M, Grade 22010
Gray iron castings	ASTM Designation: A 48, Class 30B
Ductile iron castings	ASTM Designation: A 536, Grade 65-45-12
Cast iron pipe	Commercial quality
Steel pipe	Commercial quality, welded or extruded
Other parts for general applications	Commercial quality

* Zinc-coated nuts that will be tightened beyond snug or wrench tight shall be furnished with a dyed dry lubricant conforming to Supplementary Requirement S2 in ASTM Designation: A 563.

The table in the eighteenth paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Stud Diameter (millimeters)	Sustained Tension Test Load (kilonewtons)
29.01-33.00	137.9
23.01-29.00	79.6
21.01-23.00	64.1
* 18.01-21.00	22.2
15.01-18.00	18.2
12.01-15.00	14.2
9.01-12.00	9.34
6.00-9.00	4.23

* Maximum stud diameter permitted for mechanical expansion anchors.

The table in the nineteenth paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Stud Diameter (millimeters)	Ultimate Tensile Load (kilonewtons)
30.01-33.00	112.1
27.01-30.00	88.1
23.01-27.00	71.2
20.01-23.00	51.6
16.01-20.00	32.0
14.01-16.00	29.4
12.00-14.00	18.7

The table in the twenty-second paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Installation Torque Values, (newton meters)

Stud Diameter (millimeters)	Shell Type Mechanical Expansion Anchors	Integral Stud Type Mechanical Expansion Anchors	Resin Capsule Anchors and Cast-in-Place Inserts
29.01-33.00	—	—	540
23.01-29.00	—	—	315
21.01-23.00	—	—	235
18.01-21.00	110	235	200
15.01-18.00	45	120	100
12.01-15.00	30	65	40
9.01-12.00	15	35	24
6.00-9.00	5	10	—

8-1.05 EPOXY BONDING MATERIAL FOR PRECAST SEGMENTS

The epoxy bonding material for match-cast joint between precast segments shall conform to the provisions in Section 51-1.13, "Bonding," and Section 95, "EPOXY," of the Standard Specifications and these special provisions.

Prior to applying epoxy bonding materials, the Contractor shall submit to the Engineer for review a plan for the safe storage, mixing, and handling of the epoxy bonding agent and for applications during cold weather conditions, and sample product. The Contractor shall allow the Engineer 15 days to review and approve the plan.

Epoxy bonding agent for match-cast joint between precast segments shall be a thermosetting 100 percent solid composition that does not contain solvent or any non-reactive organic ingredient except for pigments required for coloring. Epoxy bonding agents shall be of two components, a resin and a hardener. The two components shall be distinctly pigmented, so that mixing produces a third color similar to the concrete in the segments. The components shall be packaged in pre-proportioned, labeled, ready to use containers. The labels shall designate the resin, hardener, temperature range, and shelf life date for application recommended by the Manufacturer.

Epoxy bonding agents shall be formulated to provide application temperature ranges that will permit erection of match-cast segments at substrate temperatures from 5 to 40 degrees Celsius. The formulations shall provide a fast-reacting system for erection when the substrate temperature is between 5 to 18 degrees Celsius, medium-reacting system for erection when the substrate temperature is between 13 to 32 degrees Celsius, and slow-reacting system for erection when the substrate temperature is between 22 to 40 degrees Celsius. If two surfaces to be bonded have different substrate temperatures, the adhesive applicable at the higher temperature shall be used.

The bonding agents shall be insensitive to damp conditions during application and, after curing, shall exhibit specified bonding strength to cured concrete, water resistivity, the specified creep characteristics, and tensile strength greater than the concrete. In addition, the epoxy bonding agents shall function as a lubricant during the joining of the match cast segments, and as a water-tight bond at the joint. For superstructure precast concrete segments, hardened epoxy bonding agent must provide a friction mechanism to transfer shearing stresses across the joint at the shear keys. For balance cantilever erection, this friction mechanism shall be established prior to removing the support from the in-place segments.

The two components of the epoxy resin shall be mixed in accordance with the manufacturer's instructions, using only full and undamaged containers. Containers that have been damaged or previously opened shall not be used.

A. Containers that have been previously opened shall be rejected. Mixing shall be carried out in a mechanical mixer in accordance with the recommendations of the epoxy manufacturer.
B. No mixing shall start until the new segment to be joined is within 0.5 meters of its final position.
C. Each container of epoxy material shall be thoroughly agitated before mixing, and the mixing shall continue until the uniform color is achieved. A continuous check shall be kept on the temperature of the mix.
D. A component that has exceeded its shelf life shall be rejected.

Epoxy bonding agents proportioned as designated by the manufacturer and mixed in accordance with the manufacturer's recommendations shall meet the physical requirements of ASTM C 881 Type VI except as modified below. The components of the epoxy bonding agent shall be conditioned to the temperature at which testing is to be done prior to mixing the test specimen.

A. Contact Time
   1. The contact time shall be tested in conformance with these requirements: normal-set epoxy: 60 minutes minimum, and slow-set epoxy: 8 hours minimum.
   2. Soaking of the concrete specimens prior to application of the epoxy bonding agent shall be for 24 hours in water which is at the maximum temperature of the application temperature range for the formulation being tested.
   3. Joint of the sloped surfaces shall be delayed for the period of time, measured from the time the epoxy was mixed, set out as normal–set epoxy 60 minutes, and slow–set epoxy 8 hours.
   4. During the delay period between mixing of the epoxy and joining of the sloped surfaces, the specimens shall be uncovered and maintained at the maximum temperature of the application range for the formulation being tested.
   5. The formulation of epoxy bonding agent being tested is acceptable if the specimen when tested sustains the following compressive strength: normal–set epoxy 7 MPa at 48 hours, and slow–set epoxy 7 MPa at 14 days.
   6. For slow-set epoxy, an additional test specimen shall be made and tested to failure at 24 hours. The formulation being tested is acceptable only if the epoxy bonding agent exhibits a brittle break.

B. Contact Strength
   1. 0.28 MPa compression over the cross-section of the joining segments.

C. Compressive Yield Strength
   1. Epoxy bonding agent shall be poured into the mold for forming specimens within 10 minutes after starting mixing of the components.
   2. The physical requirements for normal-set epoxy are 14 MPa at 24 hours and 50 MPa at 48 hours.
   3. The physical requirements for slow-set epoxy are 7 MPa at 36 hours and 14 MPa at 72 hours.

D. Bond Strength
   1. The test cylinder of mortar shall have a compressive strength of at least 42 MPa at 7 days.
   2. The specimens shall be conditioned by soaking in water which is at the minimum temperature of the application temperature range for the formulation being tested.
   3. The required strength of ASTM C 881 shall be modified as: normal–set epoxy 7 MPa at 48 hours and slow–set epoxy 7 MPa at 14 days.

SECTION 8-2. CONCRETE

8-2.01 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

References to Section 90-2.01, "Portland Cement," of the Standard Specifications shall mean Section 90-2.01, "Cement," of the Standard Specifications.

Mineral admixture shall be combined with cement in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures," of the Standard Specifications for the concrete materials specified in Section 56-2, "Roadside Signs," of the Standard Specifications.

The requirements of Section 90-4.08, "Required Use of Mineral Admixture," of the Standard Specifications shall not apply to Section 19-3.025C, "Soil Cement Bedding," of the Standard Specifications.

8-2.02 CORROSION CONTROL FOR PORTLAND CEMENT CONCRETE

Portland cement concrete for reinforced concrete at bridge piers, bridge footing, bridge footing (lightweight concrete), precast concrete wall (bridge footing), and precast concrete fender modules is considered to be in a corrosive environment and shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

No reduction in the cementitious material content specified or ordered, in conformance with the provisions in Section 90-4.05, "Optional Use of Chemical Admixtures," of the Standard Specifications, will be allowed for concrete in a corrosive environment.

At the Contractor's option, the cementitious material may be 20 percent by mass of mineral admixture conforming to ASTM Designation: C618 Class F or N, and 5 percent by mass of mineral admixture conforming to ASTM Designation: C1240.

At the Contractor's option, the cementitious material may be 50 percent by mass of ground granulated blast-furnace slag conforming to ASTM Designation: C 989.

When the calcium oxide content of a mineral admixture is equal to or less than 2 percent by mass, the amount of mineral admixture shall not be less than 25 percent by mass of the total amount of cementitious material to be used in the mix.

The water to cementitious material ratio shall not exceed 0.40.

Full compensation for conforming to the above requirements shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

8-2.03 OPTIONAL MARINE-BASED PORTLAND CEMENT CONCRETE BATCH PLANT

At the Contractor's option, a marine-based concrete batch plant may be used to proportion and mix portland cement concrete. The marine-based concrete batch plant shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and to these special provisions.

The Contractor shall obtaining and comply with all required permits, clearances, and approvals to operate a marine-based concrete batch plant, including transport of materials to and from the batch plant and disposal of all waste products generated by the batch plant. Permitting agencies with jurisdictional responsibilities for the marine-based concrete batch plant include, but are not limited to the U.S. Corps of Engineers, U.S. Coast Guard, San Francisco Bay Regional Water Quality Control Board , San Francisco Bay Conservation and Development Commission and the Bay Area Air Quality Management District. Delays in obtaining permits, clearances, and approvals will not be reason for granting an extension of contract time.

The requirement for providing portland cement concrete undersupports for scale bearing points as specified in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications shall not apply.

The Contractor shall submit, in writing, an operations plan for the marine-based plant to the Engineer at least 30 days prior to performing a prequalification batch test. The plan shall include:

A. a detailed description of the batch plant;
B. the navigational and operational requirements for the batch plant under all expected environmental conditions;
C. the planned movements of the batch plant, the anchoring and berthing locations of the plant, and the frequency and extent of all necessary relocations;
D. the limiting conditions for operation and the production capacity under which the batch plant can safely operate and produce portland cement concrete in compliance with these specifications;
E. the limitations of the weighing equipment to function accurately under shifting and unleveled conditions caused by wind and wave actions;
F. scale accuracy, tolerances and variations expected from shifting and tilting due to wave action; and

G. methods or devices, such as visual and/or audio signals, which will be utilized to notify plant operators that the tolerances of these specifications have been exceeded.

A prequalification batch test shall be performed at least 60 days prior to the production of the first concrete batched by the plant for use in the project. The prequalification batch test shall demonstrate the plant is capable of proportioning and mixing concrete in conformance with these special provisions and under the typical marine conditions which will be encountered during the project. This test shall include a production minimum of four batches. Each batch size shall be a minimum of eight cubic meters or otherwise as approved by the Engineer. These batches shall be produced at locations within the project limits, or as approved by the Engineer. The four batch test produced shall be transported and weighed at a land based certified scales in accordance with the requirements of Section 9-1.01, Measurement and Quantities," of the Standard Specifications. The total weight from the batch plant weigh tickets for each of the batches measured on the floating batch plant shall be within 2% of the weight measured by the land based certified scales. If the total weight varies more than 2% , the Contractor shall revise the operation plan and perform another prequalification test until the total measured weight is within 2% of the total batch plant weight tickets. Failure to comply with this requirement will be grounds for the Engineer rejecting the use of the batch plant for producing concrete for the contract.

At the discretion of the Engineer, the Contractor shall perform the prequalification batch test again if the Contractor significantly changes equipment or if problems are detected in the normal operation of the marine based portland cement concrete batch plant.

After completion of the prequalification batch test, the concrete produced during the test shall become the property of the Contractor, and all materials shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

A container, capable of holding at least 2.25 cubic meters, shall be available at the batch plant at all times. The container shall be either a cylindrical or of a rectilinear shape. It shall be mortar tight and rigid and its walls shall not deflect more than 1 millimeter (mm) during the placing of concrete. The diameter of the base of the cylinder container shall be between 1000 mm and 1250 mm. The dimensions of the width and length of the rectilinear container shall be between 900 mm and 1000 mm. During production and when ordered by the Engineer, the accuracy of the concrete batching shall be checked against this volumetric measure of two cubic meters. The Contractor, using calibrated measures on the Marine Based Portland Cement Concrete Batch Plant, shall prepare a test batch of two cubic meters. The test batch shall be poured into the measuring device, at which time, the measured volume shall be determined by multiplying the height of the concrete batch in the measuring device by the area of the base of the measuring device. The measured volume shall be within 2% of the volume calculated from the weigh batch tickets.

In addition, commercial class test masses, at least 25% of the total optional batch plant scale capacity shall be available at all times for use of testing the scales during production. The test masses shall be required by California Test 109. The plant scales shall be subjected to operation and scale tolerances testing in all weather.

Facilities on the premises of the floating batch plant shall provided to the Engineer for performing all necessary sampling and testing, including space for safe storage of test samples and testing equipment. For sampling purposes, a method of diverting the freshly mixed concrete between the mixer and the delivery system shall be provided. The sampling and testing facilities on the premises shall be approved by the Engineer.

The Aggregates shall be protected from exposure to salt waters. Coarse aggregate may be proportioned by volume. Containers, bags, or other packages of pre-weighed cementitious material if used shall be sealed and moisture proof. The Containers, bags, or packages shall be tagged showing exact weight, date and time of batching, and source of cementitious material. The tags shall be numbered serially. The tag number in addition to the weight of the material shall be included on each batch certificate used incorporating pre-weighed non-bulk material.

Full compensation for operating a floating batch plant, in accordance with the requirements of all permitting agencies, batching materials, disposing of materials, developing and submitting and operations plan, performing prequalification batch tests, periodic weight and volume checks, providing sampling and testing facilities and necessary corrective actions required, including recertification of the batch plant shall be considered as included in the contract prices paid for various items of work involved and no additional compensation will be allowed therefor.

8-2.04 PRECAST CONCRETE QUALITY CONTROL

Precast concrete quality control shall conform to the requirements in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

Attention is directed to "Construction Surveying," and "Precast Concrete Segments," for additional requirements for a survey plan and casting manual for precast facilities.

Precast concrete quality control shall apply when any concrete is precast in conformance with “Concrete Structures,” of these special provisions and for the following elements as shown on the plans:

A. Precast concrete segments

B. Precast lightweight concrete panels
C. Precast concrete walls for footings
D. Precast concrete fender modules for fender systems

Precast concrete quality control shall include the following items that are conducted in the sequence listed:

A. General precasting meeting;
B. Contractor performs precast concrete facility audit (self-audit);
C. Caltrans performs precast concrete facility audit (Caltrans-audit);
D. Contractor submits Precast Concrete Quality Control Plan (PCQCP);
E. Engineer reviews PCQCP;
F. Contractor performs ongoing quality control during all precasting and related operations.

The general precasting meeting between the Engineer and the Contractor (including precasting subcontractors, precast suppliers, or entities hired by these subcontractors and suppliers to be used in the work) shall be held to discuss the requirements for precasting quality control. This meeting shall be held in the San Francisco Bay Area.

The audit form is included in the "Information Handout," available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

The Contractor shall perform a self-audit and submit the completed precast audit form to the Engineer. The Contractor shall allow the Engineer 15 working days to review the audit. If the Engineer rejects the audit, the Contractor shall include, in the resubmittal of the self-audit, a report of how deficiencies that were noted by the Engineer have been corrected. After the Contractor has successfully completed a self-audit, as determined by the Engineer, the Contractor shall request a Caltrans' audit. The Contractor shall allow the Engineer 50 working days to complete the Caltrans-audit.

It shall be the Contractor's responsibility to ensure that the precast facility personnel provide the Engineer sufficient access and cooperation so that the Engineer can complete the audit within 50 working days . The Contractor's Quality Control Manager (QCM) and the plant quality control personnel shall be present during the Caltrans-audit. Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

Should a precast facility fail a Caltrans-audit , the Contractor shall improve the facility prior to requesting another Caltrans-audit. The Contractor shall include, in the request for another audit, a report of how deficiencies that were noted by the Engineer have been corrected. No more than 3 Caltrans-audits will be performed for a given facility. If the precast facility fails the third audit, then the Engineer will make deductions from the payment to the Contractor for furnish precast concrete. Deductions are made to compensate for the additional quality assurance inspection and testing that will be performed by the Engineer in the absence of an approved audit. If the precast facility is within 480 airline kilometers from both Sacramento and Los Angeles, the deduction from furnish precast concrete of the types shown in the Engineer's Estimate shall be $25 per cubic meter of precast concrete elements that are produced at this facility. If the precast facility is more than 480 air line kilometers from both Sacramento and Los Angeles, the deduction to furnish precast concrete concrete of the types shown in the Engineer's Estimate shall be $35 per cubic meter of precast concrete segment that is produced at this facility.

Regardless of the outcome to the audit, if given precast concrete elements are fabricated more than 480 air line kilometers from both Sacramento and Los Angeles, additional precast facility inspection expenses (for those given elements) will be sustained by the State. It is agreed that payment to the Contractor for furnishing given precast concrete elements will be reduced $5 per cubic meter of precast concrete of that type shown in the Engineer's Estimate. If a deduction is made due to a third Caltrans' audit failure for the same precast facility, then the $5 deduction will be added to the amount previously specified for audit failure.

Prior to precasting a given element, the pre-precast meeting, the self-audits, the Caltrans-audit (or the deduction), and the PCQCP shall be approved by the Engineer.–Quality Control (QC) shall be the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing prior to precasting, during precasting and after precasting and as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the details shown on the plans and these special provisions.

Quality Assurance (QA) is the prerogative of the Engineer. Regardless of the acceptance for a given precast element by the QCM, the Engineer will evaluate the precast element. The Engineer will reject any precast element that does not conform to the approved PCQCP, the details shown on the plans and these special provisions.

The Contractor shall designate in writing a precast Quality Control Manager (QCM) for each precasting facility. The QCM shall be responsible directly to the Contractor for the quality of precasting, including materials and workmanship, performed by the Contractor and all subcontractors. The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall not be employed or compensated by any subcontractor, or other persons or entities hired by subcontractors, or supplier, who will provide services or materials for the project. The QCM may be an employee of the Contractor.

The QCM shall be licensed as a Civil Engineer in the State of California and currently certified as PCI level III. QC Inspectors may assist the QCM. QC Inspectors shall be licensed as a Civil Engineers in the State of California and currently certified as PCI level II . Either the QCM or a QC Inspector shall be on site during all work required for furnishing precast items.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

The Precast facility shall have a training program so that the QCM and all staff performing precasting operations and precast QC shall have a working knowledge of the approved PCQCP.

For precast concrete, the materials testing performed by the Contractor shall inlcude the following minimum concrete testing. If precasting is done at more than one facility, then the following minimum test frequencies shall apply to each facility. Additional concrete related testing may be performed by the Engineer.

Material	**Test**	**Frequence**
Coarse Aggregate	CTM 211 Abrasion of Course Aggregate by Use of the Los Angeles Rattler Machine	1. Once, at least 10 working days prior to using a given aggregate source 2. In addition,at any time variations in the course aggregate are found (as determined by the Engnineer)
	CTM 227 Evaluating Cleanness of Coarse Aggregare	♦ Once per 250 cubic meters of course aggregate used, or each day course aggregate is used, which ever is more frequent
Fine Aggregate	CTM 213 Organic Impurities in Concrete Sand	♦ Once per 500 cubic meters of fine aggregate used
	CTM 515 Relative Mortar Strength of Portland Cement Concrete Sand	♦ Once per 500 cubic meters of fine aggregate used
	CTM 217 Sand Equivalent	♦ Once per 250 cubic meters of fine aggregate used or each day fine aggregate is used, which ever is more frequent
	CTM 229 Durability Index	♦ Once per 250 cubic meters of fine aggregate used or each day fine aggregate is used, which ever is more frequent
Combined Aggregate	CTM 214 Soundness of Aggregates by Use of Sodium Sulfate	♦ Once, at least 10 working days prior to using a given aggregate source
	CTM 202 Sieve Analysis of Fine and Coarse Aggregates	♦ Once per 250 cubic meters of aggregate used or each day aggregate is used, which ever is more frequent
	CTM 223 Surface Moisture in Concrete Aggregates by the Displacment Method (Field Method)	♦ Once per 250 cubic meters of aggregate used or each day aggregate is used, which ever is more frequent
Cement	Certificate of Compliance	♦ Once for each cement supplier or manufacturer, at least 10 working days prior to use of a given supplier or manufacturer

Concrete	CTM 533 Test for Ball Penetration in Fresh Portland Cement Concrete Or ASTM C143	♦ When a set of cylinders is fabricated and when consistency or uniformity is questionable.
	ASTM C172	♦ One set of cylinders per 100 cubic meters of concrete cast, or at every day of casting, which ever is more frequent.
Additional tests for Light Weight Concrete	CTM 504 Determining Air Concent of Freshly Mixed Concrete by the Pressure Method	♦ When a set of cylinders is fabricated
	CTM 529 Proportions of Coarse Aggregate in Fresh Concrete	♦ When a set of cylinders is fabricated

The Contractor shall submit to the Engineera separate PCQCP for: concrete segments, lightweight concrete panels, concrete walls for footings, and concrete fender modules for fender systems. A separate PCQCP shall be submitted for each facility. The PCQCP shall conform to the requirements in "Working Drawings," elsewhere in these special provisions, except that microfilms and bond copies are not required.

A given PCQCP shall include the following:

A. The name of the precasting firms, the concrete plants to be used, the concrete testing firm to be used. ;
B. A manual prepared by the precasting firm that shall include equipment, testing procedures, safety plan, and the names, qualifications and documentation of certifications for all personnel to be used;
C. The names, qualifications and documentation of certifications for the QCM and all QC Inspectors to be used;
D. An organizational chart showing all QC personnel and their assigned QC responsibilities;
E. Details and schedules for the training program for the QCM and all staff performing precasting operations and precast QC.
F. The methods and frequencies for performing all required quality control procedures, including all visual inspections, material testing, and survey procedures for all components of the precast elements including the following:

    1. Prestressing systems
    2. Concrete
    3. Grout
    4. Reinforcement
    5. Steel
    6. Miscellaneous metal
    7. Formwork

G. A system for the identification and tracking of all precast elements. A system for identifications and tracking of required precast element repairs, and a procedure for the re-inspection of any repaired precast element. The system shall have provisions for a method of reporting nonconforming precast elements to the Engineer;

3. Example forms to be used for Certificates of Compliance, daily production logs, and daily reports.

The Contractor shall allow the Engineer 20 working days to review the PCQCP for a given facility after a complete PCQCP has been received.

An amended PCQCP or addendum shall be submitted to, and approved in writing by the Engineer, for any proposed revisions to the approved PCQCP. An amended PCQCP or addendum will be required for any revisions to the PCQCP (including changes in concrete plants or source materials; changes in material testing procedures and testing lab; changes in survey procedures and equipment; changes in QC personnel; or updated systems for tracking and identifying precast elements.) The Engineer shall have 15 working days to complete the review of the amended PCQCP or addendum, once a complete submittal has been received. Work that is affected by any of the proposed revisions shall not be performed until the amended PCQCP or addendum has been approved. The Engineer's approval of the Contractor's PCQCP shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

For each precasting facility, a daily production log for precasting shall be kept by the QCM for each day that precasting or related operations (including setting forms, placing reinforcement, setting prestressing, casting, curing, post tensioning, and form release) are performed. The log shall include the facility location,description of casting or related operations, any problems or deficiencies discovered, and any testing or repair work performed. The daily report from each Quality Control Inspector shall also be included in the log. This daily log shall be available for viewing by the Engineer, at the precasting facility. Copies of the daily logs shall be submitted to the Engineer on a weekly basis.

A Precasting Report shall be submitted to the Engineer within 5 working days of the completion of a given precast segment. A Precasting Report shall be submitted within 10 working days of the completion of all other precast elements The A Precasting report r shall include the following:

A. Reports of all visual inspections
B. Material testing reports
C. Documentation that the Contractor has evaluated visual inspections, material tests and survey check reports
D. Daily production log
E. Certificates of Compliance

At the completion of a given precast element, and if the QCM determines that the element is in conformance with these special provisions, the QCM shall sign and furnish to the Engineer, a certificate of compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. This certificate of compliance shall be submitted with the Precasting Report. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans and the provisions of the Standard Specifications and these special provisions. A sample certificate of compliance form is included in the "Information Handout," available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

All reports regarding material tests and survey checks shall be signed bythe person that performed the test or check, and then submitted directly to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or typewritten next to all signatures.

The Engineer will review the Precasting Report to determine if the Contractor is in conformance with the PCQCP. The Engineer shall be allowed 10 working days to review the Precasting Report and respond in writing after a complete Precasting Report has been received. A given precast element shall not leave the precast facility until the Engineer has approved the report in writing. Any material not conforming to these requirements will be subject to rejection. Except for precast concrete segments, the Engineer shall be notified immediately (in writing) when any precasting problems or deficiencies are discovered and also of the proposed repair or process changes required to correct them. No remedial work shall begin until the Engineer approves the repair procedures in writing. .

Should the Engineer fail to review the complete a given submittal (including audits and reports) within the time specified, and the Contractor's controlling operation is delayed (as determined by the Engineer) by the Engineer's failure to review within the time specified, an extension of time will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

For precast concrete segments, the criteria for damaged or defective segments, and the process for mitigation is specified in "Furnish Precast Concrete Segments," elsewhere in these special provisions.

All required repair work or process changes required to correct precasting or related operation deficiencies, whether discovered by the QCM, QC Inspector or by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

Full compensation for conforming to the requirements of this section shall be considered as included in the contract prices paid for furnish precast concrete of the types shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

SECTION 8-3. WELDING

8-3.01 WELDING

General

Flux core welding electrodes conforming to the requirements of AWS A5.20 E6XT-4 or E7XT-4 shall not be used to perform any type of welding for this project.

Wherever reference is made to the following AWS welding codes in the Standard Specifications, on the plans, or in these special provisions, the year of adoption for these codes shall be as listed:

AWS Code	Year of Adoption
D1.1	2000
D1.4	1992
D1.5	1995
D1.5 (metric only)	1996
D1.6	1999

Requirements of the AWS welding codes shall apply unless specified otherwise in the Standard Specifications, on the plans, or in these special provisions. Wherever the abbreviation AWS is used, it shall be equivalent to the abbreviations ANSI/AWS or ANSI/AASHTO/AWS.

Sections 6.1.2 through 6.1.4.3 of AWS D 1.1, Sections 7.1.1 and 7.1.2 of AWS D 1.4, and Sections 6.1.1.1 through 6.1.3.3 of AWS D 1.5 are replaced with the following:

Quality Control (QC) shall be the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing prior to welding, during welding, and after welding as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all welding.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship, and shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard and Guide for Qualification of Welding Inspectors."

The QC Inspector may be assisted by an Assistant QC Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector (CAWI) in conformance with the requirements in AWS QC1, "Standard and Guide for Qualification of Welding Inspectors," or has equivalent qualifications. The QC Inspector shall monitor the Assistant QC Inspector's work, and shall be responsible for signing all reports.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

Section 6.14.6, "Personnel Qualification," of AWS D 1.1, Section 7.7.6, "Personnel Qualification," of AWS D 1.4, and Section 6.1.3.4, "Personnel Qualification," of AWS D 1.5 are replaced with the following:

Personnel performing NDT shall be qualified in conformance with the requirements of the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the Written Practice of the NDT firm. The Written Practice of the NDT firm shall meet or exceed the requirements of the ASNT Recommended Practice No. SNT-TC-1A, 1996 edition and current addendums. Only individuals who are 1) qualified for NDT Level II, or 2) Level III technicians who have been directly certified by the ASNT and are authorized to perform the work of Level II technicians, shall perform NDT, review the results, and prepare the written reports.

Section 6.5.4, "Scope of Examination," of AWS D 1.1 and Section 7.5.4 of AWS D 1.4 are replaced with the following:

The QC Inspector shall inspect and approve the joint preparation, joint fit-up, assembly practice, welding techniques, and performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved WPS are met.

Section 6.5.4 of AWS D 1.5 is replaced with the following:

The QC Inspector shall inspect and approve the joint preparation, joint fit-up, assembly practice, welding techniques, and performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved WPS are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Sections 3 and 9.21. The size and contour of welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities should be aided by strong light magnifiers, or such other devices as may be helpful. Acceptance criteria different from those specified in this code may be used when approved by the Engineer.

Section 6.6.5, "Nonspecified Nondestructive Testing Other Than Visual," of AWS D 1.1, Section 6.6.5 of AWS D 1.4 and Section 6.6.5 of AWS D 1.5 shall not apply.

For any welding, the Engineer may direct the Contractor to perform NDT that is in addition to the visual inspection or NDT specified in the AWS welding codes, in the Standard Specifications, or in these special provisions. Additional NDT required by the Engineer, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. Should any welding deficiencies be discovered by this additional NDT, the cost of the testing will not be paid for as extra work but shall be at the Contractor's expense.

Required repair work to correct welding deficiencies, whether discovered by the required visual inspection or NDT, or by additional NDT directed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

The Engineer shall have the authority to verify the qualifications or certifications of any welder, QC Inspector, or NDT personnel to specified levels by retests or other means.

A sufficient number of QC Inspectors shall be provided to ensure continuous inspection when any welding is being performed. Continuous inspection, as a minimum, shall include (1) having QC Inspectors continually present when any welding operation is being performed, or (2) having a QC Inspector within such close proximity of all welding operations that inspections by the QC Inspector of each operation, at each welding location, shall not lapse for a period exceeding 30 minutes.

Inspection and approval of the joint preparation, assembly practice, welding techniques, and performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day that welding is performed.

When joint details that are not prequalified by the applicable AWS codes are proposed for use in the work, welders using these details shall perform a qualification test plate using the approved WPS variables and the joint detail to be used in production. The test plate shall be the maximum thickness to be used in production. The test plate shall be mechanically or radiographically tested as directed by the Engineer. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

The period of effectiveness for a welder's or welding operator's qualification shall be a maximum of 3 years for the same weld process, welding position, and weld type. A valid qualification at the beginning of work on a contract will be acceptable for the entire period of the contract, as long as the welder's work remains satisfactory.

Welding Quality Control

Attention is directed to "Nondestructive Testing For Steel Pipe Piling," elsewhere in these special provisions regarding additional requirements for Caltrans UT certification requirements.

Welding quality control shall conform to the requirements in the AWS welding codes, the Standard Specifications, and these special provisions.

Unless otherwise specified, welding quality control shall apply when any work is welded in conformance with the provisions in Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," Section 56-1, "Overhead Sign Structures," and Section 75, "Miscellaneous Metal," of the Standard Specifications.

In addition, welding quality control shall apply when welding is performed for the following work:

A. Modular Joint Seal Assemblies
B. Circular Segmented Bearings
C. Bridge Deck Drainage System

The welding of fracture critical members (FCMs) shall conform to the provisions specified in the Fracture Control Plan (FCP) and herein.

The Contractor shall designate in writing a welding Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of welding, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, and approving all correspondence, required submittals, and reports to and from the Engineer.

The QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM shall not be employed or compensated by NDT firms to be used in the work. The QCM may be an employee of the Contractor.

The QCM shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard and Guide for Qualification of Welding Inspectors."

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project, except for the following conditions:

A. The welding is performed at a permanent fabrication facility which is certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges.
B. The welding is performed at a permanent fabrication facility that is certified under the AISC Quality Certification Program, Category Sbd, Conventional Steel Building Structures. This condition shall apply only for work welded in conformance with the provisions in Section 56-1, "Overhead Sign Structures" or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

For welding performed at such certified facilities, the inspection personnel or NDT firms may be employed or compensated by the fabrication facility performing the welding.

Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a pre-welding meeting between the Engineer, Contractor, and any entity performing welding and NDT for this project, shall be held to discuss the requirements for the WQCP. The pre-welding meeting shall be held in the San Francisco Bay Area.

Prior to performing any welding, the Contractor shall submit to the Engineera separate WQCP for each item of work for which welding is to be performed. The WQCPs shall conform to the requirements of "Working Drawings," elsewhere in these special provisions.

As a minimum, each WQCP shall include the following:

A. The name of the welding firm and any required NDT firm, should one be required;
B. A manual prepared by the NDT firm that shall include equipment, testing procedures, code of safe practices, the Written Practice of the NDT firm, and the names, qualifications, and documentation of certifications for all personnel to be used;
C. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors and Assistant QC Inspectors to be used;
D. An organizational chart showing all QC personnel and their assigned QC responsibilities;

E. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:
- all visual inspections;
- all NDT including radiographic geometry, penetrameter and shim selection, film quality, film processing, radiograph identification and marking system, and film interpretation and reports; and
- calibration procedures and calibration frequency for all NDT equipment.

F. A system for the identification and tracking of all welds, NDT, and any required repairs, and a procedure for the reinspection of repaired welds. The system shall have provisions for:
   F. permanently identifying each weld and the person who performed the weld;
   G. placing all identification and tracking information on each radiograph;
   H. a method of reporting nonconforming welds to the Engineer; and
   I. a method of documentation of repairs and reinspection of nonconforming welds.

G. Standard procedures for performing noncritical repair welds. Noncritical repair welds are–defined as welds to deposit additional weld beads or layers to compensate for insufficient weld size and to fill limited excavations that were performed to remove unacceptable edge or surface discontinuities, overlap or undercut. The depth of these excavations shall not exceed 65 percent of the specified weld size;
H. The WPS, including documentation of all supporting Procedure Qualification Record (PQR) tests performed, and the name of the testing laboratory who performed the tests, to verify the acceptability of the WPS. The submitted WPS shall be within the allowable period of effectiveness;
I. Documentation of all certifications for welders for each weld process and position that will be used. Certifications shall list the electrodes used, test position, base metal and thickness, tests performed, and the witnessing authority. All certifications shall be within the allowable period of effectiveness;
J. Ten copies each of all AWS welding codes and the FCP which are applicable to the welding to be performed. These codes and the FCP shall become the permanent property of the Department; and
K. Forms to be used for Certificates of Compliance, daily production logs, and daily reports.
L. Documentation or Caltrans' UT certification as specified in "Nondestructive Testing for Steel Pipe Piling," elsewhere in these special provisions.

The Engineer shall have 10 working days to review a WQCP submittal after a complete plan has been received.

An amended WQCP or addendum shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved WQCP. An amended WQCP or addendum will be required for revisions to the WQCP, including but not limited to a revised WPS, addition of welders, changes in NDT firms or procedures, QC, or NDT personnel, or updated systems for tracking and identifying welds. The Engineer shall have 10 working days to complete the review of the amended WQCP or addendum. Work that is affected by any of the proposed revisions shall not be performed until the amended WQCP or addendum has been approved.

It is expressly understood that the Engineer's approval of the Contractor's WQCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's approval shall not constitute a waiver of any requirement of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding approval of the WQCP.

A daily production log for welding shall be kept by the QCM for each day that welding is performed. The log shall clearly indicate the locations of all welding, except partial penetration longitudinal seam welds performed in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications. The log shall include the welders' names, amount of welding performed, any problems or deficiencies discovered, and any testing or repair work performed, at each location. The daily report from each QC Inspector shall also be included in the log.

The following items shall be included in a Welding Report that is to be submitted to the Engineer within 7 days following the performance of any welding. :

A. Reports of all visual weld inspections and NDT;
B. Radiographs and radiographic reports, and other required NDT reports;
C. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and all repaired welds have been reexamined by the required NDT and found acceptable; and
D. Daily production log.

Radiographic envelopes shall have clearly written on the outside of the envelope the following information: name of the QCM, name of the nondestructive testing firm, name of the radiographer, date, contract number, complete part description, and all included weld numbers or a report number, as detailed in the WQCP. In addition, all innerleaves shall have clearly written on them the part description and all included weld numbers, as detailed in the WQCP.

Reports regarding NDT, including radiographs, shall be signed by both the NDT technician and the person that performed the review, and then submitted directly to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or typewritten next to all signatures.

The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP. Unless otherwise specified, the Engineer shall be allowed 7 working days to review the report and respond in writing after a complete Welding Report has been received. Prior to receiving notification from the Engineer of the Contractor's conformance with the WQCP, the Contractor may encase in concrete or cover welds for which a Welding Report has been submitted. However, should the Contractor elect to encase or cover those welds prior to receiving notification from the Engineer, it is expressly understood that the Contractor shall not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase or cover welds pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in notification, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The QC Inspector shall provide reports to the QCM on a daily basis for each day that welding is performed.

Except for noncritical weld repairs, the Engineer shall be notified immediately in writing when welding problems, deficiencies, base metal repairs, or any other type of repairs not submitted in the WQCP are discovered and also of the proposed repair procedures to correct them. The Engineer shall have 5 working days to review these procedures. No remedial work shall begin until the repair procedures are approved in writing by the Engineer. Should the Engineer fail to complete the review within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the proposed repair procedures, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each item of work for which welding was performed. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans and the provisions of the Standard Specifications and these special provisions.

Payment

Full compensation for conforming to the requirements of this section shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

SECTION 8-4. STRUCTURAL STEEL

8-4.01 STEEL AUDITS

Steel audits shall apply when any structural steel is manufactured or fabricated in conformance with the provisions in Section 55, "Steel Structures, " of the Standard Specification. In addition, steel audits shall apply when any structural steel is manufactured or fabricated in conformance with "Circular Segmented Bearing," and "Modular Joint Seal Assemblies," of these special provisions.

Steel audit shall include the following items that are conducted in the sequence listed:

1. General steel meeting;
2. Contractor's steel facility audit (self-audit);
3. Engineer's steel facility audit (Caltrans-audit).

The general steel meeting shall be between the Engineer, the Contractor (including structural steel manufacture's and fabricators, steel suppliers, or entities hired by these subcontractors and suppliers to be used in the work). This meeting shall be held in the San Francisco Bay Area. At least 5 working days prior to this meeting, the Contractor shall submit a complete list of facilities that will be used for the manufacture and fabrication of structural steel items. The facility list shall include the mailing address, the physical address, the owners, the managers, and specific description(s) of the items (as shown in the Engineer's Estimate) that are to be produced at the respective facility. The list shall designate the sequence in which the facilities are to be audited. If a fabricator or manufacturer has more than one facility where work will be performed, each facility shall be listed separately.

The audit form is included in the "Information Handout," available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

The Contractor shall perform a self-audit and submit the completed steel audit form to the Engineer. The Contractor shall allow the Engineer 15 working days to review the audit.

After the Contractor has successfully completed a self-audit, as determined by the Engineer, the Contractor shall request a Caltrans' audit. The Contractor shall allow the Engineer 50 working days to complete the Caltrans-audit.

Should the Engineer fail to complete a given audit within 50 working days (of the receipt of the request for an Engineer's audit), and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in completing said audit, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

It shall be the Contractor's responsibility to ensure that the steel facility personnel provide the Engineer sufficient access and cooperation so that the Engineer can complete the audit within the time specified. The Contractor's welding Quality Control Manager (QCM) and the facility quality control personnel shall be present and cooperative during the Engineer's audit. If welding is not used for the items produced at a given facility, then the welding QCM will not be required to attend.

Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

Should a steel facility fail an self-audit or Caltrans-audit, as determined by the Engineer, the Contractor or facility owner(s) shall correct deficiencies noted by the Engineer and successfully complete a revised self-audit prior to requesting another Caltrans-audit.

At the Contractor's option, the Contractor may replace a facility that fails an audit with a new facility. All the previously specified audit requirements shall apply to replacement facilities. The time required for the audits (including the Caltrans-audit) shall be as previously specified. A new audit list with sequence designation shall be submitted with the Contractor's audit for the replacement facility.

No more than 3 Caltrans-audits will be performed for a given facility.

If a steel facility fails the third Caltrans-audit, deductions will be made for materials produced by that facility. Deductions will be made to compensate for the additional quality assurance inspection and testing that will be performed by the Engineer in the absence of an approved audit. Whereas it is and will be impractical and extremely difficult to ascertain and determine the actual increase in such expense it is agreed that payment to the Contractor for furnishing the materials will be reduced as follows. If the steel facility is within 480 airline kilometers from both Sacramento and Los Angeles, the deduction shall be $0.04 per kg of steel item produced at this facility. If the steel facility is more than 480 airline kilometers from both Sacramento and Los Angeles, the deduction shall be $0.05 per kg of steel item produced at this facility. These deductions for failure of the third audit shall be in addition to deductions for inspection by the Engineer as specified in "Circular Segmental Bearings," "Modular Joint Seals," and "Structural Steel," of these special provisions.

Prior to production of a given steel element, the pre-precast meeting, the self-audits and the Caltrans-audit (or the deduction) shall be approved by the Engineer.

Full compensation for conforming to of the requirements of "Steel Audits," shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

SECTION 9. DESCRIPTION OF BRIDGE WORK

The bridge work to be done consists, in general, of constructing the following structures as shown on the plans:

SAN FRANCISCO OAKLAND BAY BRIDGE EAST SPAN – SKYWAY STRUCTURES
(Bridge No. 34-0006 L/R)

The basic design of the bridge shall be as follows:

Superstructure consists of precast segmental concrete box girders with balanced cantilever construction and orthotropic steel box girder, a total of 4 rigid frames including a total of 14-spans. Substructure consists of the steel frames encased in the reinforced concrete shell footings which are supported by cast-in-steel shell concrete piles.

The term "Segment" in these special provisions shall be defined as a unit of the superstructure which is cast between two vertical construction joints.

SECTION 10. CONSTRUCTION DETAILS

SECTION 10-1. GENERAL

10-1.00 CONSTRUCTION PROJECT INFORMATION SIGNS

Before any major physical construction work readily visible to highway users is started on this contract, the Contractor shall furnish and erect 2 Type 2 Construction Project Information signs at the locations designated by the Engineer.

The signs and overlays shall be of a type and material consistent with the estimated time of completion of the project and shall conform to the details shown on the plans.

The sign letters, border and the Department's construction logos shall conform to the colors (non-reflective) and details shown on the plans, and shall be on a white background (non-reflective). The colors blue and orange shall conform to PR Color Number 3 and Number 6, respectively, as specified in the Federal Highway Administration's Color Tolerance Chart.

The sign message to be used for fund types shall consist of the following, in the order shown:

FEDERAL HIGHWAY TRUST FUNDS
STATE HIGHWAY FUNDS

The sign message to be used for type of work shall consist of the following:

BRIDGE CONSTRUCTION

The sign message to be used for the Year of Completion of Project Construction will be furnished by the Engineer. The Contractor shall furnish and install the "Year" sign overlay within 10 working days of notification of the year date to be used.

The letter sizes to be used shall be as shown on the plans. The information shown on the signs shall be limited to that shown on the plans.

The signs shall be kept clean and in good repair by the Contractor.

Upon completion of the work, the signs shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Full compensation for furnishing, erecting, maintaining, and removing and disposing of the construction project information signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefor.

10-1.01 ORDER OF WORK

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these special provisions.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages," of these special provisions.

As first order of work, the Contractor shall complete all work within the designated area, marine access areas, as shown on the plans, no later than 410 working days after contract award. The Contractor shall vacate the designated areas and shall not interfere with the Contract 04-012044, Oakland Touchdown Contractor's access to these areas.

Attention is directed to Environmental Work Restrictions" and "Environmentally Sensitive Areas (General)" of these special provisions.

Attention is directed to "Maintaining Traffic" of these special provisions.

Attention is directed to "Progress Schedule (Critical Path Method)" of these special provisions regarding the submittal of a general time-scaled logic diagram within 10 days after approval of the contract. The diagram shall be submitted prior to performing any work that may be affected by any proposed deviations to the construction sequencing of the project.

The work shall be performed in conformance with the construction sequences as shown on the plan. Nonconflicting work in subsequent sequences may proceed concurrently with work in preceding sequences , provided satisfactory progress is maintained in the preceding sequences of construction.

Existing steel shell test piles shall be re-driven prior to installing production piling.

The bridge deck surface shall be constructed after the installations of modular joint seal assemblies are complete in place and the Engineer has approved the watertight test.

The following items shall be a first order of work:

A. Submit working drawing submittal schedule
B. Order the steel casing for the cast-in-steel shell piling.
C. Submit to the Engineer for approval of the thermal control plans as specified in section "Mass Concrete" of these special provisions.
D. Submit mix designs.
E. Notify the Captain of the Port in conformance with the publication "Notice to Mariners," and conformance with "Relations With Coast Guard," of these special provisions.
F. Submit working drawings in conformance with "Navigation Requirements," of these special provisions.
G. Restrike existing steel test piles.

Not less than 120 days prior to installing call boxes, the Contractor shall notify the Engineer to schedule for proper training. Installation of call boxes shall not be performed until training has been approved by the Engineer.

At each seismic sensor and recorder location, the sequence of work shall be as follows:

A. Install the seismic monitoring casings and downholes.
B. Construct the free field.
C. Mount the seismic sensor enclosures, seismic sensor cable junction boxes and the complete conduit system.
D. Pull all seismic cables (without any splices) from each seismic sensor enclosure to the respective seismic recorder location as shown on the plans.
E. Pull all interconnect cables (without any splices) from each seismic recorder location to the next seismic recorder locations as shown on the plans.
F. Ensure that electrical power and telephone service is present at each of the recorder locations.
G. Notify the Engineer 20 working days in advance when the Contractor wants California Division of Mines and Geology (CDMG) to install and test their equipment as specified elsewhere in these special provisions.

The Contractor shall furnish the Engineer with statements from the vendors or suppliers that the order for the unit substation materials, traffic operation system materials, and supervisory control and data acquisition remote terminal unit system required for this contract has been received and accepted by the individual vendors; and the statements shall be furnished within 60 calendar days after the contract has been approved by the Attorney General, or the attorney appointed and authorized to represent the Department of Transportation. The statements shall included detailed information about the material to be installed, but not limited to those listed elsewhere in these special provisions. In addition, a point of contact and phone number of the vendors or suppliers to answer any questions of the various equipment to be supplied shall also be provided. The Engineer will have 30 calendar days to review and accept the unit substation materials, traffic operation system materials, and supervisory control and data acquisition remote terminal unit system required for this contract. Once accepted by the Engineer, the Contractor will not be able to change the equipment to be ordered without prior written approval of the Engineer.

10-1.02 WATER POLLUTION CONTROL

Water pollution control work shall conform to the requirements in Section 7-1.01G, "Water Pollution," of the Standard Specifications and these special provisions.

This project is located within the jurisdiction of the San Francisco Bay Regional Water Control Board and shall conform to the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for General Construction Activity Storm Water number CAS000002, 99-08-DWQ, and the NPDES Permit for the State of California Department of Transportation Properties, Facilities and Activities number CAS000003, Order Number 99-06-DWQ issued by the State Water Resources Control Board. These Permits, hereafter referred to as the "Permit," regulate storm water discharges associate with construction activities.

Water pollution control work shall conform to the requirements in the "Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual" and the "Construction Site Best Management Practices (BMPs) Manual," and addenda thereto issued up to, and including, the date of advertisement of the project, hereafter referred to respectively as the "Preparation Manual" and the "Construction Site BMP Manual" and collectively as the "Manuals." Copies of the Manuals and the Permits may be obtained from the Department of Transportation, Material Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone: (916) 445-3520 and are available for inspection at the Office of the Toll Bridge Duty Senior, at the District 04 office, 111 Grand Avenue, Oakland, California 94612, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5594. Copies of the Manuals may also be obtained from the Department's Internet Web Site at: http://www.dot.ca.gov/hq/construc/stormwater.html.

In addition, a Conceptual Storm Water Pollution Prevention Plan (CSWPPP) has been prepared for this project by the Department and is available for review at 111 Grand Avenue, Oakland, CA 94612. Contact the Toll Bridge Duty Senior, telephone number (510) 286-5549 to reserve a copy of the document at least 24 hours in advance. This document may be used by the Contractor for developing the actual contract Storm Water Pollution Prevention Plan (SWPPP).

The Contractor shall become fully informed of and comply with the applicable provisions of the Manual, Permits, and Federal, State and local regulations that govern the Contractor's operations and storm water discharges from both the project site and areas of disturbance outside the project limits during construction. The Contractor shall maintain a copy of the Permit at the project site and shall make the Permit available during construction activities.

Unless arrangements for disturbance or use of areas outside the project limits are made by the Department and made part of the contract, it is expressly agreed that the Department assumes no responsibility for the Contractor or property owner with respect to any arrangements made between the Contractor and property owner. The Contractor shall implement, inspect and maintain all necessary water pollution control practices to satisfy all applicable Federal, State, and Local laws and regulations that govern water quality for areas used outside of the highway right-of-way or areas arranged for the specific use of the Contractor for this project. Installing, inspecting, and maintaining water pollution control practices on areas outside the highway right-of-way not specifically arranged for and provided for by the Department for the execution of this contract will not be paid for.

The Contractor shall be responsible for the costs and for liabilities imposed by law as a result of the Contractor's failure to comply with the provisions set forth in this section "Water Pollution Control", including but not limited to, compliance with the applicable provisions of the Manuals, Permits and Federal, State and local regulations. Costs and liabilities include, but are not limited to, fines, penalties, and damages whether assessed against the State or the Contractor, including those levied under the Federal Clean Water Act and the State Porter Cologne Water Quality Act.

In addition to the remedies authorized by law, money due the Contractor under the contract, in an amount determined by the Department, may be retained by the State of California until disposition has been made of the costs and liabilities.

When a regulatory agency or other third party identifies a failure to comply with the permit or any other local, State, or federal requirement, the Engineer may retain money due the Contractor, subject to the following:

A. The Department will give the Contractor 30 calendar days notice of the Department's intention to retain funds from partial payments which may become due to the Contractor prior to acceptance of the contract. Retention of funds from payments made after acceptance of the contract may be made without prior notice to the Contractor.
B. No retention of additional amounts out of partial payments will be made if the amount to be retained does not exceed the amount being withheld from partial payments pursuant to Section 9-1.06, "Partial Payments," of the Standard Specifications.
C. If the Department has retained funds and it is subsequently determined that the State is not subject to the costs and liabilities in connection with the matter for which the retention was made, the Department shall be liable for interest on the amount retained for the period of the retention, and the rate of interest payable shall be 6 percent per annum.

Conformance with the provisions of this section "Water Pollution Control" shall not relieve the Contractor from the Contractor's responsibilities, as provided in Section 7, "Legal Relations and Responsibilities," of the Standard Specifications.

The Contractor shall notify the Engineer immediately upon request from the regulatory agencies to enter, inspect, sample, monitor or otherwise access the project site or the Contractor's records pertaining to water pollution control work.

STORM WATER POLLUTION PREVENTION PLAN PREPARATION, APPROVAL AND AMENDMENTS

As part of the water pollution control work, a Storm Water Pollution Prevention Plan, hereafter referred to as the "SWPPP," is required for this contract. The SWPPP shall conform to the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications, the requirements in the Manuals, the requirements of the Permits, and these special provisions. Upon the Engineer's approval of the SWPPP, the SWPPP shall be considered to fulfill the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications for development and submittal of a Water Pollution Control Program.

No work having potential to cause water pollution, as determined by the Engineer, shall be performed until the SWPPP has been approved by the Engineer.

The Contractor shall designate a Water Pollution Control Manager. The Water Pollution Control Manager shall be responsible for the preparation of the SWPPP and any required modifications or amendments and shall be responsible for the implementation and adequate functioning of the various water pollution control practices employed. The Water Pollution Control Manager shall serve as the primary contact for all issues related to the SWPPP or its implementation. The Contractor shall submit to the Engineer a statement of qualifications, describing the training, previous work history and expertise of the individual selected by the Contractor to serve as Water Pollution Control Manager. The Engineer will reject the Contractor's submission of a Water Pollution Control Manager if the submitted qualifications are deemed to be inadequate.

Within 21 working days after the approval of the contract, the Contractor shall submit 3 copies of the SWPPP to the Engineer. The Contractor shall allow 11 working days for the Engineer to review the SWPPP. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the SWPPP within 11 working days of receipt of the Engineer's comments and shall allow 7 working days for the Engineer to review the revisions. Upon the Engineer's approval of the SWPPP, 4 additional copies of the SWPPP, incorporating the required changes, shall be submitted to the Engineer. In order to allow construction activities to proceed, the Engineer may conditionally approve the SWPPP while minor revisions are being completed. If the Engineer does not review or approve the SWPPP within the time specified, compensation will be made in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The SWPPP shall apply to all areas that are directly related to construction including, but not limited to, staging areas, storage yards, material borrow areas, and access roads within or outside of the highway right-of-way.

The SWPPP shall incorporate water pollution control practices in the following six categories:

A. Soil stabilization;
B. Sediment control;
C. Wind erosion control;
D. Tracking control;
E. Non-storm water control; and
F. Waste management and material pollution control.

The Contractor shall develop a Water Pollution Control Schedule that shall describe the timing of grading or other work activities that could affect water pollution. The Water Pollution Control Schedule shall be updated by the Contractor to reflect any changes in the Contractor's operations that would affect the necessary implementation of water pollution control practices.

The Contractor shall incorporate the "Minimum Requirements" presented in the Preparation Manual into the SWPPP. In addition to the "Minimum Requirements" presented in the Preparation Manual, the Contractor shall complete the BMP Consideration Checklist presented in the Preparation Manual. The Contractor shall identify and incorporate into the SWPPP the water pollution control practices selected by the Contractor or as directed by the Engineer.

In addition to the Minimum Requirements presented in the Preparation Manual, special requirements shall be incorporated into the SWPPP and the Water Pollution Control Cost Break-Down as follows:

Special Requirement(s)

Category	BMP, location and quantity
Tracking Control Practices	TC-1 Stabilized Construction Entrance/Exit; Various locations of site entry from roadways, 4 EA
Waste Management & Materials Pollution Control	WM-6 Hazardous Waste Management, Various, Lump Sum

The following contract items of work, shall be incorporated into the SWPPP as "Temporary Water Pollution Control Practices":

Temporary Concrete Washout Facility.

The Contractor's attention is directed to these special provisions provided for each temporary water pollution control practice.

The following contract items of work, as shown on the project plans or as specified elsewhere in these special provisions, shall be identified in the SWPPP as permanent water pollution control practices: Temporary Fence (Type ESA). These permanent water pollution control practices shall be constructed as specified in "Order of Work" of these special provisions, and utilized during the construction period. The Contractor shall maintain and protect the permanent water pollution control practices throughout the duration of the project and shall restore these controls to the lines, grades and condition shown on the plans prior to acceptance of the contract.

The SWPPP shall include, but not be limited to, the items described in the Manuals, Permits and related information contained in the contract documents.

The Contractor shall prepare an amendment to the SWPPP when there is a change in construction activities or operations which may affect the discharge of pollutants to surface waters, ground waters, municipal storm drain systems, or when the Contractor's activities or operations violate any condition of the Permits, or when directed by the Engineer. Amendments shall show additional water pollution control practices or revised operations, including those areas or operations not shown in the initially approved SWPPP. Amendments to the SWPPP shall be prepared, and submitted for review in the same manner as specified for the SWPPP approval. Subsequent amendments shall be submitted within a time approved by the Engineer, but in no case longer than the time specified for the initial submittal and review of the SWPPP.

The Contractor shall keep a copy of the SWPPP and approved amendments at the project site. The SWPPP shall be made available upon request of a representative of the San Francisco Bay Regional Water Quality Control Board, State Water Resources Control Board, U.S. Environmental Protection Agency or local storm water management agency. Requests by the public shall be directed to the Engineer.

COST BREAK-DOWN

The Contractor shall submit to the Engineer a cost break-down for the contract lump sum item of water pollution control, together with the SWPPP.

The cost break-down shall be completed and furnished in the format shown in the example of the cost break-down included in this section. Unit descriptions and quantities shall be designated by the Contractor, except for the specified special requirements shown in the example. The units and quantities given in the example, if provided, are special requirements specified for the SWPPP, and shall be included in the cost break-down furnished to the Engineer. The Contractor shall verify the estimated quantities of the special requirements and submit revised quantities in the cost break-down.

The Contractor shall determine the quantities required to complete the work of water pollution control. The quantities and their values shall be included in the cost break-down submitted to the Engineer for approval. The Contractor shall be responsible for the accuracy of the quantities and values used in the cost break-down submitted for approval. The cost break-down shall not include water pollution control practices which are shown on the plans and for which there is a separate contract item.

The sum of the amounts for the units of work listed in the cost break-down shall be equal to the contract lump sum price bid for water pollution control. Profit shall be included in each individual unit listed in the cost break-down. The cost break-down shall be submitted and approved within the same times specified for the SWPPP. Partial payment for the item of water pollution control will not be made until the cost break-down is approved, in writing, by the Engineer. Attention is directed to "Overhead" of these special provisions.

Adjustments in the items of work and quantities listed in the approved cost break-down shall be made when required to address amendments to the SWPPP, except when the adjusted items are paid for as extra work.

No adjustment in compensation will be made in the contract lump sum price paid for water pollution control due to differences between the quantities shown in the approved cost break-down and the quantities required to complete the work as shown on the approved SWPPP. No adjustment in compensation will be made for ordered changes to correct SWPPP work resulting from the Contractor's own operations or from the Contractor's negligence.

The approved cost break-down will be used to determine partial payments during the progress of the work and as the basis for calculating the adjustment in compensation for the item of water pollution control due to increases or decreases of quantities ordered by the Engineer. When an ordered change increases or decreases the quantities of an approved cost break-down item, the adjustment in compensation will be determined in the same manner specified for increases and decreases in the quantity of a contract item of work in conformance with the provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications. If an ordered change requires a new item not on the approved cost break-down, the adjustment in compensation will be determined in the same manner specified for extra work in conformance with Section 4-1.03D, "Extra Work," of the Standard Specifications.

If requested by the Contractor and approved by the Engineer, changes to the water pollution control practices listed in the approved cost break-down, including the addition of new water pollution control practices, will be allowed. The changes shall be included in an approved amendment to the SWPPP. If the changes to the water pollution control practices requested by the Contractor would result in a net cost increase to the lump sum price for water pollution control, an adjustment in compensation will be made without change to the item of water pollution control. The net cost increase to the item of water pollution control resulting from changes requested by the Contractor will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

WATER POLLUTION CONTROL COST BREAK-DOWN

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UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
MINIMUM REQUIREMENTS				
SS-1 Scheduling	LS			
SS-2 Preservation of Existing Vegetation	LS			
SS-3 Hydraulic Mulch	M2			
SS-4 Hydroseeding	M2			
SS-5 Soil Binders	M2			
SS-6 Straw Mulch	M2			
SS-7 Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats	M2			
SC-7 Street Sweeping and Vacuuming	LS			
SC-10 Storm Drain Inlet Protection	EA			
TC-2 Stabilized Construction Roadway	M2			
WE-1 Wind Erosion Control	LS			
NS-6 Illicit Connection/Illegal Discharge Detection And Reporting	LS			
NS-8 Vehicle and Equipment Cleaning	LS			
NS-9 Vehicle and Equipment Fueling	LS			
NS-10 Vehicle and Equipment Maintenance	LS			
WM-1 Material Delivery and Storage	LS			
WM-2 Material Use	LS			
WM-4 Spill Prevention and Control	LS			
WM-5 Solid Waste Management	LS			
WM-9 Sanitary/Septic Waste Management	LS			
SPECIAL REQUIREMENTS				
TC-1 Stabilized Construction Entrance/Exit	EA	4		
WM-6 Hazardous Waste Management	LS	Lump Sum		

TOTAL _____

SWPPP IMPLEMENTATION

Upon approval of the SWPPP, the Contractor shall be responsible throughout the duration of the project for installing, constructing, inspecting and maintaining the control measures included in the SWPPP and any amendments thereto and for removing and disposing of temporary control measures. Unless otherwise directed by the Engineer or specified in these special provisions, the Contractor's responsibility for SWPPP implementation shall continue throughout any temporary suspension of work ordered in accordance with Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. Requirements for installation, construction, inspection, maintenance, removal and disposal of control measures are specified in the Handbook and these special provisions.

If the Contractor or the Engineer identifies a deficiency in any aspect of the implementation of the approved SWPPP or amendments, the deficiency shall be corrected immediately. The deficiency may be corrected at a later date and time if requested by the Contractor and approved by the Engineer in writing, but not later than the onset of precipitation. If the Contractor fails to correct the identified deficiency by the date agreed or prior to the onset of precipitation the project shall be in noncompliance. Attention is directed to Section 5-1.01, "Authority of the Engineer," of the Standard Specifications and the payment sections of these special provisions for possible noncompliance penalties.

If the Contractor fails to conform to the provisions of "Water Pollution Control," the Engineer may order the suspension of construction operations which create water pollution.

Implementation of water pollution control practices may vary by season. The Construction Site BMP Manual and these special provisions shall be followed for control practice selection of year round, rainy season and non-rainy season water pollution control practices.

Year-Round Implementation Requirements

The Contractor shall have a year-round program for implementing, inspecting and maintaining water pollution control practices for wind erosion control, tracking control, non-storm water control, and waste management and materials pollution control.

The National Weather Service weather forecast shall be monitored and used by the Contractor on a daily basis. An alternative weather forecast proposed by the Contractor may be used if approved by the Engineer. If precipitation is predicted, the necessary water pollution control practices shall be deployed prior to the onset of the precipitation.

Disturbed soil areas shall be considered active whenever the soil disturbing activities have occurred, continue to occur or will occur during the ensuing 15 working days. Non-active areas shall be protected as prescribed in the Construction Site BMP Manual within 10 working days of cessation of soil disturbing activities or prior to the onset of precipitation, whichever occurs first.

Rainy Season Requirements

Soil stabilization and sediment control practices conforming to the requirements in the Special Requirements and applicable Preparation Manual Minimum Requirements, shall be provided throughout the rainy season, defined as between October 1 and May 1.

An implementation schedule of required soil stabilization and sediment control practices for disturbed soil areas shall be completed not later than 15 working days prior to the beginning of each rainy season. The implementation schedule shall identify the soil stabilization and sediment control practices to be implemented and the dates on which the implementation will be 25 percent, 50 percent and 100 percent complete, respectively. Construction activities beginning during the rainy season shall implement applicable soil stabilization and sediment control practices. The Contractor shall implement soil stabilization and sediment control practices a minimum of 8 working days prior to the start of the rainy season.

Throughout the defined rainy season, the active disturbed soil area of the project site shall be not more than 2 hectares. The Engineer may approve, on a case-by-case basis, expansions of the active disturbed soil area limit. Soil stabilization and sediment control materials shall be maintained on site sufficient to protect the unprotected disturbed soil area. A detailed plan for the mobilization of sufficient labor and equipment shall be maintained to deploy the water pollution control practices required to protect the project site prior to the onset of precipitation events.

Non-Rainy Season Requirements

The non-rainy season shall be defined as all days outside the defined rainy season. The Contractor's attention is directed to the Construction Site BMP Manual for soil stabilization and sediment control implementation requirements on disturbed soil areas during the non-rainy season. Disturbed soil areas within the project shall be protected in conformance with the requirements in the Construction Site BMP Manual with an effective combination of soil stabilization and sediment control.

MAINTENANCE

To ensure the proper implementation and functioning of water pollution control practices, the Contractor shall regularly inspect and maintain the construction site for the water pollution control practices identified in the SWPPP. The construction site shall be inspected by the Contractor as follows:

A. Prior to a forecast storm;
B. After a precipitation event which causes site runoff;
C. At 24 hour intervals during extended precipitation events;
D. Routinely, a minimum of once every 10 working days outside of the defined rainy season;
E. Routinely, a minimum of once every 5 working days during the defined rainy season.

The Contractor shall use the Storm Water Quality Construction Site Inspection Checklist provided in the CSWPPP or an alternative inspection checklist provided by the Engineer. One copy of each site inspection record shall be submitted to the Engineer within 24 hours of completing the inspection.

REPORTING REQUIREMENTS

Report of Discharges, Notices or Orders

If the Contractor identifies any discharge into receiving waters in a manner causing, or potentially causing, a condition of pollution, or if the project receives a written notice or order from any regulatory agency, the Contractor shall immediately inform the Engineer. The Contractor shall submit a written report to the Engineer within 5 working days of the discharge event, notice, or order. The report shall include the following information:

A. The date, time, location, nature of the operation, and type of discharge, including the cause or nature of the notice or order.
B. The water pollution control practices deployed before the discharge event, or prior to receiving the notice or order.
C. The date of deployment and type of water pollution control practices deployed after the discharge event, or after receiving the notice, or order, including additional measures installed or planned to reduce or prevent reoccurrence.
D. An implementation and maintenance schedule for any affected water pollution control practices.

Report of First-Time Non-Storm Water Discharge

The Contractor shall notify the Engineer at least 3 working days in advance of each first-time non-storm water discharge event, excluding exempted discharges. The Contractor shall notify the Engineer of each different operation causing a non-storm water discharge and shall obtain field approval for each first-time non-storm water discharge. Non-storm water discharges shall be monitored at each first-time occurrence and routinely thereafter.

Annual Certifications

By June 15 of each year, the Contractor shall complete and submit an Annual Construction Activity Certification as contained in the Preparation Manual to the Engineer.

PAYMENT

The contract lump sum price paid for prepare storm water pollution prevention plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in developing, preparing, obtaining approval of, revising and amending the SWPPP as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Attention is directed to Sections 9-1.06, "Partial Payments," and 9-1.07, "Payment After Acceptance," of the Standard Specifications. Payments for prepare storm water pollution prevention plan will be made as follows:

A. After the SWPPP has been approved by the Engineer, 75 percent of the contract item price for prepare storm water pollution prevention plan will be included in the monthly partial payment estimate; and
B. After acceptance of the contract pursuant to Section 7-1.17, "Acceptance of Contract," the remaining 25 percent of the contract item price for prepare storm water pollution prevention plan will be made in accordance with Section 9-1.07.

The contract lump sum price paid for water pollution control shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing, constructing, removing, and disposing of water pollution control practices, including non-storm water and waste management and materials pollution water pollution control practices except those shown on the plans and for which there is a contract item of work, and excluding developing, preparing, obtaining approval of, revising, and amending the SWPPP, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The cost of maintaining the temporary water pollution control practices shall be divided equally by the State and the Contractor as follows:

Soil Stabilization

All temporary water pollution control practices except:

A. SS-1 Scheduling; and
B. SS-2 Preservation of Existing Vegetation.

Sediment Control

All temporary water pollution control practices.

Tracking Control

All temporary water pollution control practices except:
SC-7 Street Sweeping and Vacuuming

Wind Erosion Control

All temporary water pollution control practices.

Non-Storm Water Control

No sharing of maintenance costs will be allowed.

Waste Management & Material Control

No sharing of maintenance costs will be allowed.

The division of cost will be made by determining the cost of maintaining temporary water pollution control practices in conformance with the provisions in Section 9-1.03, "Force Account Payment," of the Standard Specifications and paying to the Contractor one-half of that cost. Clean-up, repair, removal, disposal, improper installation, and replacement of temporary water pollution control practices damaged by the Contractor's negligence shall not be considered as included in the cost for performing maintenance and no additional compensation will be allowed therefor.

The provisions for sharing maintenance costs shall not relieve the Contractor from the responsibility for providing appropriate maintenance on those items where maintenance costs are not shared.

Full compensation for maintenance costs of water pollution control practices not shared, as specified in these special provisions, shall be considered as included in the contract lump sum price paid for water pollution control and no additional compensation will be allowed therefor.

Those water pollution control practices which are shown on the plans and for which there is a contract item of work will be measured and paid for as that contract item of work.

The Engineer will retain an amount equal to 25 percent of the estimated value of the contract work performed during estimate periods in which the Contractor fails to conform to the provisions of this section "Water Pollution Control," as determined by the Engineer.

Retention for failure to conform to the provisions in this section "Water Pollution Control" shall be in addition to the other retention provided for in the contract. The amounts retained for failure of the Contractor to conform to the provisions in this section will be released for payment on the next monthly estimate for partial payment following the date that an approved SWPPP has been implemented and maintained, and water pollution is adequately controlled, as determined by the Engineer.

10-1.03 NON-STORM WATER DISCHARGES

Non-storm water discharges shall conform to the requirements in Section 7-1.01G, "Water Pollution," of the Standard Specifications and these special provisions.

Conformance with the requirements of this section shall in no way relieve the Contractor from the Contractor's responsibilities, as provided in Section 7-1.11, "Preservation of Property," and Section 7-1.12, "Responsibility for Damage," of the Standard Specifications.

The special minimum measures required under this contract for non-storm water discharges are as follows:

PILE AND COFFERDAM DEWATER.--Suspended solids shall be removed during the dewatering operation for piles and cofferdams, as specified in these special provisions.

Suspended solids shall be removed to the extent that visible, floating products are not apparent within the discharge. Also, the discharge shall be of a purity such that turbidity and apparent color beyond present natural background levels are not apparent within the receiving water body of the San Francisco Bay. The turbidity, measured in Nephelometric Turbidity Units (NTU), of the discharge shall not be greater than a 10 percent increase of the background turbidity for the San Francisco Bay upgradient of the piles and cofferdams at a distance of at least 20 meters, but not greater than 45 meters. The point of effluent discharge shall not cause bottom sediments, aquatic vegetation, or surface soils to become dislodged or disturbed.

The Contractor shall graphically depict the dewatering process within the Storm Water Pollution Prevention Plan (SWPPP) as specified elsewhere in these special provisions. The graphic shall show both a sectional and plan view that details the removal techniques for suspended solids. The graphic shall define the flow path and placement of pipes, hoses, pumps, and other equipment used to convey the discharge. In addition, the Contractor shall provide a sketch that depicts the general position of the apparatus relative to the pile(s) or cofferdam(s) undergoing dewatering and the point of effluent discharge.

The Contractor shall describe, within the appropriate sections of the SWPPP, the pile dewatering apparatus. The description shall include, but not be limited to, an estimate of the discharge volume, flow rate, and frequency; location of discharge; and inspection and monitoring procedures related to the discharge.

The Contractor shall conduct a daily inspection of the dewatering equipment, when in use, to ensure that all components are functional and routinely maintained to prevent leakage prior to removal of suspended solids. Any component of the apparatus that is found to be damaged or to affect the performance of the apparatus shall be either immediately repaired or replaced.

The Contractor shall monitor both the discharge and the receiving water body. The observations made during monitoring shall include the color, size of affected area, presence of suspended material, presence of water fowl or aquatic wildlife, wind direction and velocity, tidal condition, atmospheric condition, time, and date. In addition, the Contractor shall supplement the observations with photographs. During monitoring events, Contractor shall obtain NTU measurements for the discharge turbidity and the receiving water (background) turbidity. The Contractor shall conduct monitoring, at a minimum, one hour prior to discharge, during the first ten minutes of initiating discharge, every four hours during discharge, and upon cessation of discharge. The observations and turbidity measurements shall be recorded daily in a tabular format known as the monitoring report provided within the Conceptual Storm Water Pollution Prevention Plan, as described within "Water Pollution Control" of these special provisions. The monitoring report, including photographs, shall be submitted weekly to the Engineer, or as directed by the Engineer.

Observations or measurements which indicate that the discharge is of a purity such that turbidity and apparent color are beyond the present natural background levels shall be immediately reported to the Engineer. The discharge activity shall immediately cease, so that corrective actions are undertaken to repair, modify, or replace the equipment. The commencement of discharge activities shall be allowed upon approval by the Engineer.

FLUIDS FROM TEST BORING AND PILE INSTALLATION.--Fluids from test boring and pile installation shall be contained during and after the test boring or piling operations.

The Contractor shall submit to the Engineer schematic diagrams showing the process in conveying and containing fluids including any fluid recirculation system intended to be used during test boring or piling operations. In addition, the Contractor shall supplement the schematic diagrams with contingency plans in event of spills. Schematic diagrams shall conform to the requirements of "Working Drawings" of these special provisions. For initial review, 4 sets of schematic diagrams for review shall be submitted. After review 10 sets shall be submitted to the Engineer for final approval and for use during construction.

Test boring or piling operations shall not be performed until the Contractor receives written approval from the Engineer.

Attention is directed to the requirements in "Spill Contingency" of this section in the event of spill.

Disposal of fluids from test boring and pile installation not using cofferdams shall conform to Section "Dredging" of these special provisions and shall be fully described in the SWPPP.

Disposal of fluids from pile installation within cofferdams shall conform to the requirements under "Pile and Cofferdam Dewater" of these special provisions and shall be fully described in the SWPPP.

All water removed from piles shall be handled in accordance with a National Pollution Discharge Elimination System (NPDES) Permit which will be issued by the San Francisco Bay Regional Water Quality Control Board prior to the Bid Open Date. Copies of the permit and its amendments, when they become available for inspection at the Office of the Toll Bridge Duty Senior, District 04 Office, 111 Grand Avenue, Oakland, California, email duty_senior_tollbridge_district04@dot.ca.gov, telephone number (510) 286-5549. Penalties assessed against the State for permit non-compliance by the Contractor will be borne by the Contractor. Such penalties will be deducted from the monthly progress payment.

SPILL CONTINGENCY.--The Contractor shall prepare and submit to the Engineer a contingency plan for the management of spills or leaks of any materials or wastes that may impact the water quality of the San Francisco Bay.

The spill contingency plan shall be incorporated within the Storm Water Pollution Prevention Plan (SWPPP), as specified in "Water Pollution Control" of these special provisions. The contingency plan shall include instructions and procedures for reporting spills, and a list of spill containment and collection materials and equipment to be maintained onsite. The contingency plan shall be reviewed and updated at least every 90 calendar days.

LIQUIDS, RESIDUES AND DEBRIS.--The control and disposal of liquids, residues, and debris shall be described within the SWPPP, as specified in "Water Pollution Control" of these special provisions. The SWPPP shall, at a minimum, depict and describe the procedural and structural methods of detaining, collecting, and disposing of all slurries, liquids, residues, and debris associated with the construction operations. Sufficient redundancy shall be incorporated into the procedural and structural methods such that the liquids, residues, and debris are not conveyed into or become present in drainage systems, San Francisco Bay or other water bodies.

Nothing in this section, "Non-Storm Water Discharges," will be construed as relieving the Contractor of full responsibility of complying with Section 7-1.16 "Contractor's Responsibility for the Work and Materials" of the Standard Specification.

Full compensation for all pile and cofferdam dewatering operations including, but not limited to, providing power to operate pumping equipment; monitoring and inspection of discharges, and receiving water body; providing all necessary maintenance, labor, vehicles, equipment, and other incidentals; removal and disposal of materials, liquids, residues, and debris; and preparation of a spill contingency plan shall be considered as included in the contract lump sum price paid for water pollution control and no additional compensation will be allowed therefor.

10-1.04 TEMPORARY FENCE (TYPE ESA)

The Contractor shall furnish, install, maintain, and later remove temporary fence (Type ESA), as shown on the plans, and as specified elsewhere these special provisions, and as directed by the Engineer.

Temporary fence (Type ESA) shall be installed as shown on the plans and prior to any construction related activity and shall be located so that it will be unobstructed from view by heavy equipment operators and other construction personnel.

Used materials may be installed provided the used materials are good, sound and are suitable for the purpose intended, as determined by the Engineer.

Materials may be commercial quality provided the dimensions and sizes of the materials are equal to, or greater than, the dimensions and sizes shown on the plans or specified herein. Fabric used for temporary high visibility fence shall also conform to the following:

Material:	Polypropylene or Polyethylene
Color	Orange
Mesh opening	50 mm x 50 mm
UV Resistance	Fully Stabilized
Fabric Width, min.	1.22 m

Posts shall be either metal or wood at the Contractor's option, and shall be suitable for the purpose intended. Metal posts shall have a minimum diameter of 21.5 mm x 1600 mm in length. Wood posts shall be fir or pine and shall be a minimum of 25 mm x 50 mm x 1600 mm in length. Posts shall be driven into the soil a minimum of 400 mm. Post spacing shall be adequate to completely support the fence fabric in an upright position.

If metal posts are used, the top of the post shall be protected with a safety approved cap designed to prevent impalement.

Galvanizing and painting of steel items will not be required.

Treating wood with a wood preservative will not be required.

Concrete footings for posts will not be required.

Temporary fence (Type ESA) that is damaged during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense.

When no longer required for the work, as determined by the Engineer, the temporary fence (Type ESA) shall be removed. Removed materials shall become the property of the Contractor and shall be removed from the site of the work, except as otherwise provided in this section.

Holes caused by the removal of the temporary fence (Type ESA) shall be backfilled in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary fence (Type ESA) shall be measured in the manner specified for permanent fences in Section 80, "Fences," of the Standard Specifications.

The contract price paid per meter for temporary fence (Type ESA) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing temporary fence complete in place, including maintenance, removal and disposal of materials, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.05 TEMPORARY CONCRETE WASHOUT FACILITY

Temporary concrete washout facilities shall be constructed, maintained, and later removed as shown on the plans, in conformance with these special provisions and as directed by the Engineer. Alternative temporary concrete washout facilities may be used. The Contractor shall provide drawings, both sectional and plan view, of the alternative temporary concrete washout facilities.

Temporary concrete washout facilities shall be installed prior to beginning any placement of concrete and located a minimum of 15 m from storm drain inlets, open drainage facilities, and watercourses, unless determined infeasible by the Engineer. Each facility shall be located away from construction traffic or access areas to prevent disturbance or tracking.

A sign shall be installed as shown on the plans adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.

Temporary concrete washout facilities shall be constructed on grade or below grade at the option of the Contractor. These facilities shall be constructed to contain all liquid and concrete waste without seepage, spillage or overflow. The minimum quantity of concrete washouts required for this project shall be 20.

MATERIALS

Materials used in the construction of temporary concrete washout facility shall conform to the following:

PLASTIC SHEETING.--Plastic sheeting shall be new and a minimum of 0.33 mm thick polyethylene sheeting and shall be free of holes, tears or other defects that compromise the impermeability of the material. Plastic sheeting shall not have seams or overlapping joints.

ROCK BAGS.--Rock bag fabric shall be non-woven polypropylene, with a minimum unit mass of 250g/m^2. The fabric shall have a mullen burst strength of at least 2500 kPa, per ASTM Designation: D 3786 and an ultraviolet (UV) stability exceeding 70 percent at 500 hours. Rock bags shall have a length of 600 mm to 800 mm, width of 400 mm to 500 mm, thickness of 150 mm to 200 mm, and shall be filled to a weighted mass ranging from 13 kg to 22 kg. Rock bag fill material shall be non-cohesive, gravel, free from deleterious material. After filling, the opening shall be secured such that rock shall not escape from the bag.

STRAW BALES.--Straw for straw bales shall conform to the provisions in Section 20-2.06, "Straw," of the Standard Specifications. Each straw bale shall be a minimum of 360 mm wide, 450 mm in height, 900 mm in length and shall have a minimum mass of 23 kg. The straw bale shall be composed entirely of vegetative matter, except for binding material.

Bales shall be bound by either wire, nylon or polypropylene string. Jute and cotton binding shall not be used. Wire shall be a minimum of 1.57 mm (16-gage) baling wire. Nylon or polypropylene string shall be approximately 2 mm in diameter with 360 N of breaking strength.

STAKES.--Stakes shall be 50 mm x 50 mm wood posts. Each stake shall have a minimum length of one meter. Metal stakes may be used as an alternative. The Contractor shall submit a sample of the metal stake to the Engineer for approval prior to installation. The tops of the metal stakes shall be bent over at a 90-degree angle. No additional compensation will be allowed for the use of a metal stake.

STAPLES.— Staples shall be made of 11-gage minimum steel wire and shall be U-shaped with 200-mm legs and 50-mm crown.

TEMPORARY CONCRETE WASHOUT FACILITY (TYPE ON GRADE)

Temporary concrete washout facility (type on grade) shall be constructed as shown on the plans with a minimum length of 3 meters and a minimum width of 4.5 meters. The length and width of a facility may be increased, at the Contractor's expense.

TEMPORARY CONCRETE WASHOUT FACILITY (TYPE BELOW GRADE)

Temporary concrete washout facility (type below grade) shall be constructed as shown on the plans with a minimum length of 3 m and a minimum width of 4.5 m. The length and width of a facility may be increased, at the Contractor's expense.

MAINTENANCE AND REMOVAL

Temporary concrete washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of 100 mm for on grade facilities and 300 mm for below grade facilities. Maintaining temporary concrete washout facilities shall include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials shall be removed and disposed of in conformance with the provisions in Section 15-3.02, "Removal Methods," of the Standard Specifications. Minor holes and tears in the plastic sheeting may be taped as long as the repair does not compromise the impermeability of the material.

When temporary concrete washout facilities are no longer required for the work, as determined by the Engineer, the hardened concrete shall be removed and disposed of in conformance with the provisions in Section 15-3.02 of the Standard Specifications. Materials used to construct temporary concrete washout facilities shall become the property of the Contractor, shall be removed from the site of the work, and shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled and repaired in conformance with the provisions in Section 15-1.02, "Preservation of Property," of the Standard Specifications.

PAYMENT

The contract lump sum price paid for temporary concrete washout facilities shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing, maintaining and removing temporary concrete washout facilities, complete in place, including straw bales, plastic lining, sign, portable delineators, lath and flagging, rock bags, stakes, staples, excavation, and backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.06 COOPERATION

Attention is directed to Section 7-1.14, "Cooperation," and Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications and these special provisions.

It is anticipated that work by other contractors may be in progress adjacent to or within the limits of this project during progress of the work on this contract. The Contractor shall be responsible for coordinating with other contractors performing work within these contract limits.

Contracts which may be in progress during the working period of this contract, include, but are not necessarily limited to the following:

1. Contract No. 04-012014: constructing roadway,and ramps and Main Span Bridge structures, in the City and County of San Francisco, on Route 80, between Yerba Buena Island at KP 12.4 (PM 7.7) and the west end of Contract 04-012024 at KP 13.9 (PM 8.7).
2. Contract No. 04-012044: constructing San Francisco-Oakland Bay Bridge approach structure and roadway on Route 80, between the east end of Contract 04-012024 at KP 1.6 (PM 1.0) and San Francisco-Oakland Toll Plaza at KP 3.2 (PM 2.0).

3. Contract No. 04-002974: constructing Toll Operation Building, and ramps, at the south side of the San Francisco-Oakland Toll Plaza, on Route 80, between KP 1.6 (PM 1.0) and KP 3.7 (PM 2.3) , in Alameda County.
4. Contract No. 04-012054: constructing roadway embankment on westbound Route 80, between the east end of Contract 04-012024 at KP 1.6 (PM 1.0) and San Francisco-Okland Toll Plaza at KP 3.2 (PM 2.0), in Alameda County.
5. Contract No. 04-014004: constructing Maintenance Buildings and Maintenance roadway access and reconstructing ramps, on Route 80, between KP 1.6 (PM 1.0) and San Francisco-Okland Toll Plaza at KP 3.7 (PM 2.3), in Alameda County.
6. Contract No. 04-0435V4: providing Seismic Retrofit by Replacement, on Route 80 from West Anchorage San Francisco-Oakland Bay Bridge at KP 7.9 (PM 4.9) to 5th Street On/Off-Ramps at KP 9.5 (PM 5.9), in the City and County of San Francisco.
7. Contract 04-0435C4: providing Seismic Retrofit and Archeology Investigation, on Route 80, on Route 80 from West Anchorage San Francisco-Oakland Bay Bridge at KP 7.9 (PM 4.9) to 5th Street On/Off-Ramps at KP 9.5 (PM 5.9), in the City and County of San Francisco.

Work by State forces will be in progress within the contract limits during the working period of this contract.

10-1.07 PHOTO SURVEY/PUBLIC RELATIONS

The Contractor shall provide time-lapse video and still photography to document pre-construction conditions, and progress and completion of the work, and facilitate public relation activities as directed by the Engineer. Photography will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications, and will not be considered a special service as specified in Section 9-1.03B of the Standard Specifications.

10-1.08 TRANSPORTATION FOR THE ENGINEER

The Contractor shall provide transportation for the Engineer in accordance with Section 5-1.08, "Inspection," of the Standard Specifications and these special provisions.

The Contractor shall provide, operate, berth and maintain, throughout the life of the contract, one crew boat for the sole use of the Engineer and the Engineer's staff in performance of their work. In addition, the Engineer and all authorized representatives of the State, acting within the scope of their duties in connection with the work under this contract, shall be permitted to ride as passengers, without charge, on any boat operated by, or for, the Contractor for the transportation of personnel, equipment or materials. It is agreed that such transportation will be only on the boats that are making trips in connection with the Contractor's operation.

The crew boat shall be 40 foot, adequate for open water operations, or equal, with protected seating and meeting or exceeding the following minimum requirements:

A. DRIVE POWER:
   1. Engines – Diesel engines, 600 HP total, twin screw, capable of at least 25 knots.
   2. Fuel Tank – 173 gal. tank
B. EQUIPMENT:
   1. Aluminum or steel hull construction
   2. Tires or rubber fenders for fendering around the boat
   3. Mooring bits located forward and aft on boat
   4. 22 kg anchor with chain and line (adequate for specific site condition)
C. ELECTRONICS:
   1. VHF/FM Radio System
   2. One (1) Com 58 or equal
   3. Radar system, Furuno 1731 or equal
   4. Depth finder digital
   5. Compass, Richie navigator 2 each or equal

United States Coast Guard-approved life jackets for the Contractor's personnel shall be provided and maintained on the boats at all times, as required by the United States Coast Guard. Life jackets for the Department's visitors and representatives will be provided by the Department at no cost to the Contractor.

The Contractor shall provide for the Department's visitors and representatives safe and protected permanent vertical access, as approved by the Engineer, to all marine construction equipment being utilized for construction of the project.

The Contractor shall provide safety training relative to marine transportation to the State's and the Contractor's personnel, prior to the commencement of work. Training shall include a review of the approved U.S. Coast Guard Safety Manual by all

personnel prior to using the Contractor's provided marine transportation. The Contractor shall also conduct a quarterly Marine Safety Workshop for the Department's representatives.

The Contractor shall furnish a licensed boat operator and crew members, as required for the boat's operation and in accordance with all Maritime Agreements and Laws, including, but not limited to, the regulations contained in Title 46 Code of Federal Regulation Section 16 and Sections 24 through 26. The boat must have a valid U.S. Coast Guard Certificate of Inspection (COI), and must be manned and operated in accordance with the COI. The boat, boat operator and crew shall be furnished 90 days after the award of the contract for the duration of the contract. The boat, boat operator and crew shall be furnished for the complete duration of the work on the days when the Contractor's work is in progress and for all hours worked by the Contractor each day excluding Sundays and legal holidays on the days when the Contractor's work is not in progress.

The Contractor shall provide insurance coverage under the Federal Longshoremen's and Harbor Workers Compensation Act, the Jones Act and the Marine Act with respect to work performed from, or by use of, vehicles on any navigable water of the United States, including liability insurance for watercraft operations. At the option of the Contractor, liability insurance for watercraft operations may be covered under a separate Protection and Indemnity policy, provided the policy contains a combined single limit of at least $50,000,000 per occurrence and $50,000,000 aggregate.

The Contractor shall provide berthing facilities at the same location the Contractor utilizes for the departure of its construction crew, or at an alternate location approved by the Engineer.

The Contractor shall maintain the boat provided to the Engineer, including daily fueling, routine maintenance, equipment compliance, systems operations and the immediate repair of damage to the boat or its elements.

The boat shall remain the property of the Contractor. The boat shall not be removed from the site of the work until after acceptance of the contract.

The contract lump sum price paid for transportation for the Engineer shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in providing transportation for the Engineer as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payment for furnishing a boat, boat operator and crew within the first 90 days after the award of the contract and in excess of the complete duration of the work on the days when the Contractor's work is in progress, in excess of the hours worked by the Contractor, excluding Sundays and legal holidays on the days when the contractor's work is not in progress, and on Sundays and legal holidays will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. No additional payment will be made for furnishing the boat, boat operator and the crew in excess of the time specified herein.

10-1.09 ENGINEER'S FIELD OFFICE

The Contractor shall provide two field offices for the sole use of the Engineer and his representatives. The first field office shall have at least 18.5 square meters of floor space and shall be located on a barge within the Caltran's right of way, as directed by the Engineer. The second field office shall have at least 75 square meters of floor space and shall be a staging facility in close proximity of the pier where the Engineer's crew boat will be moored.

Both field offices shall have windows, doors with locks, a desk (at least 750 mm by 1500 mm), and executive chair, three office chairs, a drafting table (at least 900 mm by 1800 mm), drafting stool, drafting table lamp, 1200 mm tall bookshelf, pencil sharpener, heating, air-conditioning, electric lighting, communication hookups, use of copying machine, and bottled water service. The second field office shall have parking facilities for approximately 20 vehicles. If the Engineer's office is to be located in the same building as the Contractor's Superintendent's office, it shall be partitioned off and provided with a separate entrance.

Equipment to be furnished shall be of standard quality and new, or like new in appearance and function.

The Contractor shall provide, maintain, and subsequently remove as his property, the field office as specified herein, for the free and exclusive use of the Engineer and his representatives.

The Engineer's field office, equipped as specified, shall be available at the site for the Engineer's use prior to the start of any field work under this contract. The Contractor shall make all necessary arrangements for locating the Engineer's field office at the construction site.

Sanitary facilities shall be provided which complies with the State and local governing authorities.

The contract lump sum price paid for Engineer's field office shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in the Engineer's field office, complete in place, including maintaining and removing the temporary field office for the Engineer, and supplying and paying for electricity, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.10 PROGRESS SCHEDULE (CRITICAL PATH)

Progress schedules will be required for this contract. Progress schedules shall utilize the Critical Path Method (CPM). Attention is directed to "COOPERATION," and "OBSTRUCTIONS" of these special provisions. Nothing in theses special

provisions shall be construed as relieving the Contractor from the responsibilities specified in Section 7, "Legal Relations and Responsibility," of the Standard Specifications.

DEFINITIONS

The following definitions apply to this section "Progress Schedule (Critical Path)":

A. Activity: Any task, or portion of a project, which takes time to complete.
B. Baseline Schedule: The initial CPM schedule representing the Contractor's original work plan, as accepted by the Engineer.
C. Controlling Operation: The activity considered at the time by the Engineer, within that series of activities defined as the critical path, which if delayed or prolonged, will delay the time of completion of the contract.
D. Critical Path: The series of activities, which determines the earliest completion of the contract (Forecast Completion Date). This is the longest path of activities having the least amount of float.
E. Critical Path Method: A mathematical calculation to determine the earliest completion of the contract represented by a graphic representation of the sequence of activities that shows the interrelationships and interdependencies of the elements composing a project.
F. Current Contract Completion Date: The extended date for completion of the contract shown on the weekly statement of working days furnished by the Engineer in accordance with Section 8-1.06, "Time of Completion," of the Standard Specifications.
G. Early Completion Time: The difference in time between the current contract completion date and the Contractor's scheduled early forecast completion date as shown on the accepted baseline schedule, or schedule updates and revisions.
H. Float: The amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any activity or group of activities in the network.
I. Forecast Completion Date: The completion date of the last scheduled work activity identified on the critical path.
J. Fragnet: A section or fragment of the network diagram comprised of a group of activities.
K. Free Float: The amount of time an activity can be delayed before affecting a subsequent activity.
L. Hammock Activity: An activity added to the network to span an existing group of activities for summarizing purposes.
M. Milestone: A marker in a network, which is typically used to mark a point in time or denote the beginning or end of a sequence of activities. A milestone has zero duration, but will otherwise function in the network as if it were an activity.
N. Revision: A change in the future portion of the schedule that modifies logic, adds or deletes activities, or alters activities, sequences, or durations.
O. Tabular Listing: A report showing schedule activities, their relationships, durations, scheduled and actual dates, and float.
P. Total Float: The amount of time that an activity may be delayed without affecting the total project duration of the critical path.
Q. Update: The modification of the CPM progress schedule through a regular review to incorporate actual progress to date by activity, approved time adjustments, and projected completion dates.
R. Time Scaled Logic Diagram: A schematic display of the logical relationships of project activities, drawn from left to right to reflect project chronology with the positioning and length of the activity representing its duration.
S. Bar Chart (Gantt Chart): A graphic display of scheduled-related information, activities or other project elements are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
T. State Owned Float Activity: The activity documenting time saved on the critical path by actions of the Engineer.
U. Near Critical Path: A path having 30 working days or less of total float.

PRECONSTRUCTION SCHEDULING CONFERENCE

The Engineer shall schedule and conduct a Preconstruction Scheduling Conference with the Contractor's Project Manager and Construction Scheduler within seven days after the bidder has received the contract for execution. At this meeting, the requirements of this section of the special provisions will be reviewed with the Contractor. The Contractor shall be prepared to discuss its schedule methodology, proposed sequence of operations, the activity identification system for labeling all work activities, the schedule file numbering system, and any deviations it proposes to make from the Stage Construction Plans. The Engineer shall submit a diskette of a scheduling shell project, displaying an activity code dictionary consisting of fields populated with the Caltrans Scope Breakdown Structure (SBS) Code. The SBS structure will be finalized after submittal of the accepted Baseline schedule. The Contractor shall utilize these codes, and may add other codes as

necessary, to group and organize the work activities. Periodically the Engineer may request the Contractor to utilize additional filters, layouts or activity codes to be able to further group or summarize work activities.

Also, the Engineer and the Contractor shall review the requirements for all submittals applicable to the contract and discuss their respective preparation and review durations. All submittals and reviews are to be reflected on the Interim Baseline Schedule and the Baseline Schedule.

INTERIM BASELINE SCHEDULE

Within 15 days after approval of the contract, the Contractor shall submit to the Engineer an Interim Baseline Project Schedule which will serve as the progress schedule for the first 120 days of the project, or until the Baseline Schedule is accepted, whichever is sooner. The Interim Baseline Schedule shall utilize the critical path method. The Interim Baseline Schedule shall depict how the Contractor plans to perform the work for the first 120 days of the contract. Additionally, the Interim Baseline Schedule shall show all submittals required early in the project, and shall provide for all permits, and other non-work activities necessary to begin the work. The Interim Baseline Schedule submittal shall include a 3 l/2 inch floppy diskette which contains the data files used to generate the schedule.

The Engineer shall be allowed 10 days to review the schedule and to provide comments, including the Contractor's application of the supplied scope breakdown structure. The Interim Baseline Schedule does not require Caltrans acceptance but all comments are to be implemented into the Baseline Schedule. Re-submittal of the Interim Baseline Schedule is not required. Late review of the Interim Baseline Schedule shall not restrain the submittal of the Baseline Schedule.

BASELINE SCHEDULE

Within 30 days, after approval of the contract, the Contractor shall submit to the Engineer a Baseline Project Schedule including the incorporation of all comments provided to the Interim Baseline Schedule. The Baseline Schedule shall have a data date of the day prior to the first working day of the contract. The schedule shall not include any actual start dates, actual finish dates, or constraint dates (except for Contract Milestone dates.) The Baseline Schedule shall meet interim milestone dates, contract milestone dates, stage construction requirements, internal time constraints, show logical sequence of activities, and must not extend beyond the number of days originally provided for in the contract.

All task activities shall be assigned to a project calendar. Each calendar shall identify a workweek, and holidays. Use different calendars for work activities that occur on different work schedules. Activities for the preparation and the review of submittals plus fabrication are to be assigned to the same calendar.

The Contractor shall not add job inefficiencies or weather days to a project calendar without prior approval by the Engineer.

The Contractor shall not assign negative lags to any activities.

The Baseline CPM Schedule submitted by the Contractor shall have a sufficient number of activities to assure adequate planning of the project and to permit monitoring and evaluation of progress and the analysis of time impacts. The Baseline Schedule shall depict how the Contractor plans to complete the whole work involved, and shall show all activities that define the critical path. Each activity shall have durations of not more than 20 working days, and not less than one working day unless permitted otherwise by the Engineer. All activities in the schedule, with the exception of the first and last activities, shall have a minimum of one predecessor and a minimum of one successor. Multiple critical paths and near-critical paths shall be kept to a minimum, as determined by the Engineer. A total of not more than 50 percent of the baseline schedule activities shall be critical or near-critical, unless otherwise approved by the Engineer.

The Baseline Schedule shall not attribute negative float to any activity. State owned float shall be considered a resource for the exclusive use of the State. The Engineer may accrue State owned float by the early completion of review of any type of required submittal when it saves time on the critical path. The Contractor shall conduct a time impact analysis, when directed by the Engineer, to determine the effect of the action as described in "Time Impact Analysis" specified herein. The Engineer will document State owned float by directing the Contractor to update the State owned float activity on the next schedule update. The Contractor shall include a log of the action on the State owned float activity and include a discussion of the actions in the narrative report. The Engineer may use State owned float to mitigate past or future State delays by offsetting potential time extensions for contract change work orders.

The Contractor shall be responsible for assuring that all work sequences are logical and the network shows a coordinated plan for complete performance of the work. Failure of the Contractor to include any element of work required for the performance of the contract in the network shall not relieve the Contractor from completing all work within the time limit specified for completion of the contract. If the Contractor fails to define any element of work, activity or logic, the Contractor in the next monthly update or revision of the schedule shall correct it.

The Baseline Schedule shall be supplemented with resource allocations for every task activity to a level of detail that facilitates report generation based on labor craft and equipment class for the Contractor and subcontractors. The Contractor shall use average composite crews to display the labor loading of on-site construction activities. On the P3 resource dictionary, each resource should have the normal and maximum limits for the specified period of time. Based on the resource limits, the Contractor shall optimize and level labor to reflect a reasonable plan for accomplishing the work of the contract

and to assure that resources are not duplicated in concurrent activities. Along with the baseline progress schedule, the Contractor shall also submit to the Engineer time-scaled resource histograms of the labor crafts and equipment classes to be utilized on the contract.

The Contractor shall not create hammock activities for the purpose of resources loading.

The Contractor shall require each subcontractor to submit in writing a statement certifying that the subcontractor has concurred with the Contractor's CPM, including major updates, and that the subcontractor's related schedule has been incorporated accurately, including the duration of activities, labor and equipment loading. Should the Baseline Schedule or schedule update, submitted for acceptance, show variances from the requirements of the contract, the Contractor shall make specific mention of the variations in the letter of transmittal, in order that, if accepted, proper adjustments to the project schedule can be made. The Contractor will not be relieved of the responsibility for executing the work in strict accordance with the requirements of the contract documents. In the event of a conflict between the requirements of the contract documents and the information provided or shown on an accepted schedule, the requirements of the contract documents shall take precedence.

Each schedule submitted to the Engineer shall comply with all limits imposed by the contract, with all specified intermediate milestone and contract completion dates, and with all constraints, restraints or sequences included in the contract. The degree of detail shall include factors including, but not limited to:

A. Physical breakdown of the project;
B. Contract milestones and completion dates, substantial completion dates, constraints, restraints, sequences of work shown in the contract, the planned substantial completion date, and the final completion date;
C. Type of work to be performed, the sequences, and the major subcontractors involved;
D. All purchases, submittals, submittal reviews, manufacture, fabrication, tests, delivery, and installation activities for all major materials and equipment, including submittal of requests for audits of manufacturers and fabricators in conformance with "Manufacturing and Fabrication Qualification Audit for Materials" of these special provisions;
E. Preparation, submittal and approval of shop and working drawings and material samples, showing time, as specified elsewhere, for the Engineer's review. The same time frame shall be allowed for at least one resubmittal on all major submittals so identified in the contract documents;
F. Identification of interfaces and dependencies with preceding, concurrent and follow-on contractors, railroads, and utilities as shown on the plans or specified in the specifications;
G. Identification of each and every utility relocation and interface as a separate activity, including activity description and responsibility coding that identifies the type of utility and the name of the utility company involved;
H. Actual tests, submission of test reports, and approval of test results;
I. All start-up, testing, training, and assistance required under the Contract;
J. Punchlist and final clean-up;
K. Identification of any manpower, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as double shifts, 6-day weeks, specified overtime, or work at times other than regular days or hours;
L. Identification of each and every ramp closing and opening event as a separate one-day activity, including designation by activity coding and description that it is a north-bound, south-bound, east-bound, west-bound, and entry or exit ramp activity;
M. Separate resources graphs for the Contract's labor, equipment and critical path labor, with an accompanying analysis of each and explanation for any variances (i.e., example front-end resource loading of schedules); and
N. Equipment and labor shall be differentiated by a cost account code within the resource dictionary.
O. State owned float as the last activity in the schedule, at the end of which is the Scheduled Completion Date.

The Baseline Schedule submittal shall include a 3 l/2 inch floppy diskette which contains the data files used to generate the schedule, a schedule narrative describing the critical path, narratives providing additional schedule detail as requested by the Engineer and all schedule reports.

The Engineer shall be allowed 15 days to review and accept or reject the baseline project schedule submitted. Rejected schedules shall be resubmitted to the Engineer within 5 days, at which time a new 15 day review period by the Engineer will begin.

PROJECT SCHEDULE REPORTS

Schedules submitted to the Engineer including Interim Baseline, Baseline, and update schedules shall include time scaled network diagrams in a layout format requested by the Engineer. The network diagrams submitted to the Engineer shall also be accompanied by four computer-generated mathematical analysis tabular reports for each activity included in the project

schedule. The reports (8 1/2" x 11" size) shall include a network diagram report showing the activity columns only, a predecessor and successor report, a resource report (Interim Baseline and Baseline Schedules), and a scheduling and leveling calculation report. The network diagram report~~s~~ shall include, at a minimum, the following for each activity:

A. Activity number and description;
B. Activity codes;
C. Original, actual and remaining durations;
D. Early start date (by calendar date);
E. Early finish date (by calendar date);
F. Actual start date (by calendar date);
G. Actual finish date (by calendar date);
H. Late start date (by calendar date);
I. Late finish date (by calendar date);
J. Identify activity calendar ID;
K. Total Float and Free Float, in work days; and
L. Percentage complete.

Network diagrams shall be sorted and grouped in a format requested by the Engineer reflecting the project breakdown per the Caltrans scope breakdown structure codes. They shall show a continuous flow of information from left to right per the project sorting and grouping codes. E.g., project milestones, submittals sub-grouped by description, and the construction activities sub-grouped by the scope breakdown structure. The primary paths of criticality shall be clearly and graphically identified on the networks. The network diagram shall be prepared on E-size sheets (36" x 48"), shall have a title block in the lower right-hand corner, and a timeline on each page. Exceptions to the size of the network sheets and the use of computer graphics to generate the networks shall be subject to the approval of the Engineer.

Schedule network diagrams the tabular reports shall be submitted to the Engineer for acceptance in the following quantities:

A. 2 sets of the Network Diagrams;
B. 2 copies of the tabular reports (8 1/2" x 11" size); and
C. 3 computer diskettes.

WEEKLY SCHEDULE MEETINGS

The Engineer and the Contractor shall hold weekly scheduling meetings to discuss the near term schedule activities, to address any long-term schedule issues, and to discuss any relevant technical issues. The Contractor shall develop a rolling 4-weeks schedule identifying the previous week worked and a 3-week look ahead. It shall provide sufficient detail to include the actual and planned activities of the Contractor and all the subcontractors for offsite and construction activities, addressing all activities to be performed and to identify issues requiring engineering action or input.

Each activity in the 4 week rolling schedule should be identified by an associated CPM schedule activity ID numbering system. This schedule should not be hand written. To create the 4 weeks rolling schedules, the Contractor should utilize the use of EXCEL spreadsheet, or Primavera scheduling software, as acceptable by the Engineer. The Engineer will provide the format of the schedule. This schedule should be electronically submitted to the Engineer one day prior to the scheduled meeting date.

MONTHLY UPDATE SCHEDULES

The Contractor shall submit a Monthly Update Schedule to the Engineer once in each month within 5 days of the data date. The proposed update schedule prepared by the Contractor shall include all information available as of the 20th calendar day of the month, or other data date as established by the Engineer. A detailed list of all proposed schedule changes such as logic, duration, lead/lag, forecast completion date, additions and deletions shall be submitted with the update.

The monthly update of the schedule shall focus on the period from the last update to the current cut-off data date. Changes to activities or logic beyond the data date are classified as revisions and need to be addressed per the schedule revision section of this specification. Activities that have either started or finished shall be reported as they actually occurred and designated as complete, if actually completed. For activities in progress that are forecasted to complete longer than planned, the remaining durations shall be revised, not the original durations. All out of sequence activities are to be reviewed and their relationships either verified or changed.

The Monthly Update Schedule submitted to the Engineer shall be accompanied by a Schedule Narrative Report. The report shall describe the physical progress during the report period, plans for continuing the work during the forthcoming report period, actions planned to correct any negative float, and an explanation of potential delays or problems and their estimated impact on performance, milestone completion dates, forecast completion date, and the overall project completion

date. In addition, alternatives for possible schedule recovery to mitigate any potential delay or cost increases shall be included for consideration by the Engineer. The report shall follow the outline set forth below:

Contractor's Schedule Narrative Report Outline:

A. Contractor's Transmittal Letter;
B. Work completed during the period;
C. Description of the current critical path;
D. Description of current problem areas;
E. Current and anticipated delays;
    1. Cause of the delay;
    2. Corrective action and schedule adjustments to correct the delay; and
    3. Impact of the delay on other activities, milestones, and completion dates;
F. Changes in construction sequences;
G. Pending items and status thereof;
    1. Permits;
    2. Change Orders;
    3. Time Extensions; and
    4. Non-Compliance Notices;
H. Contract completion date(s) status;
    1. Ahead of schedule and number of days; and
    2. Behind schedule and number of days; and
I. Include updated Network Diagram and Reports.

The Contractor shall provide to the Engineer a 3 1/2" electronic disk of the schedule, together with printed copies of the network diagrams and tabular reports described under "Project Schedule Reports", and the Schedule Narrative Report.

Portions of the network diagram on which all activities are complete need not be reprinted and submitted in subsequent updates. However, the electronic disk file of the submitted schedule and the related reports shall constitute a clear record of progress of the work from award of contract to final completion.

On a date determined by the Engineer, the Contractor shall meet with the Engineer to review the monthly schedule update. At the monthly progress meeting, the Contractor and the Engineer shall review the updated schedule and shall discuss the content of the Narrative Report. The Engineer shall be allowed 10 days after the meeting to review and accept or reject the update schedule submitted. Rejected schedules shall be resubmitted to the Engineer within 5 days, at which time a new 5 day review period by the Engineer will begin. All efforts shall be made between the Engineer and the Contractor to complete the review and the acceptance process prior to the next update schedule data date. To expedite the process a second meeting between the Engineer and the Contractor shall be held.

SCHEDULE REVISIONS

If the Contractor desires to make a change to the accepted schedule, the Contractor shall request permission from the Engineer in writing, stating the reasons for the change, and proposed revisions to activities, logic and duration. The Contractor shall submit for acceptance an analysis showing the effect of the revisions on the entire project. The analysis shall include:

A. An updated schedule not including the revisions. The schedule shall have a data date just prior to implementing the proposed revisions and includes a project completion date;
B. A revised schedule that includes the proposed revisions. The schedule will have the same data date as the updated schedule and include a project completion date;
C. The Contractor should add resources for all new activities, also adjust resources for those activities that their remaining duration were changed;
D. A narrative explanation of the revisions and their impact to the schedule; and
E. Computer files of the updated schedule and the revised schedule sequentially numbered or renamed for archive (record) purposes.

The Engineer will provide a response within 10 days to Contractor proposed schedule revisions.

Within 15 calendar days, the Contractor shall submit a revised CPM network for approval when requested by the Engineer, or when any of the following occurs:

A. there is a significant change in the Contractor's operations that will affect the critical path;

B. the current updated schedule indicates that the contract progress is 4 weeks or more behind the planned schedule, as determined by the Engineer; or
C. the Engineer determines that an approved or anticipated change will impact the critical path, milestone or completion dates, contract progress, or work by other contractors.

The Engineer shall be allowed 10 days to review and accept or reject a schedule revision. Rejected schedule revisions shall be revised and resubmitted to the Engineer within 10 days, at which time a new 10 day review period by the Engineer will begin. Only upon approval of a change by the Engineer shall it be reflected in the next schedule update submitted by the Contractor. The revised schedule shall also include a narrative explanation of the revisions and their impact to the schedule.

SCHEDULE TIME

When the Contractor requests a time adjustments due to contract change orders or delays, or if the Contractor or the Engineer considers that an approved or anticipated change will impact the critical path or contract progress, the Contractor shall submit to the Engineer a written Time Impact Analysis illustrating the impact of each change or delay on the current scheduled completion date or milestone completion date, utilizing the current accepted schedule. Each Time Impact Analysis shall include a schedule update and schedule revision, both with the same data dates, demonstrating how the Contractor proposes to incorporate the Change Order or delay into the current schedule. The schedule revision shall include the sequence of activities and any revisions to the existing activities to demonstrate the impact of the delay, or change into the schedule.

Each Time Impact Analysis shall demonstrate the estimated time impact based on the events of delay, the anticipated or actual date of the contract change order work performance, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the current schedule in effect at the time the change or delay was encountered.

Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining float along the critical path of activities at the time of actual delay, or at the time the contract change order work is performed. Time extensions will not be granted nor will delay damages be paid unless:

A. the delay is beyond the control and without the fault or negligence of the Contractor and its subcontractors or suppliers, at any tier; and
B. the delay extends the actual performance of the work beyond the applicable scheduled contract completion date and the most recent date predicted for completion of the project on the accepted schedule update current as of the time of the delay or as of the time of issuance of the contract change order.

Time Impact Analyses shall be submitted in triplicate within 15 days after the delay occurs or after issuance of the contract change order. A schedule file diskette is also to be submitted.

Acceptance or rejection of each Time Impact Analysis by the Engineer will be made within 15 days after receipt of the Time Impact Analysis, unless subsequent meetings and negotiations delay the review. A copy of the Time Impact Analysis accepted by the Engineer shall be returned to the Contractor and the accepted schedule revisions illustrating the impact of the contract change orders or delays shall be incorporated into the project schedule during the first update after acceptance. Until such time that the Contractor provides the analysis, the Engineer may, at his option, construct and utilize the project as-built schedule or other recoginzed method to determine adjustments in contract time.

FINAL SCHEDULE UPDATE

Within 15 days after the acceptance of the contract by the Director, the Contractor shall submit a final update of the schedule with actual start and actual finish dates for all activities. This schedule submission shall be accompanied by a certification, signed by an officer of the company and the Contractor's Project Manager stating "To the best of my knowledge, the enclosed final update of the project schedule reflects the actual start and completion dates of the activities contained herein."

EQUIPMENT AND SOFTWARE

The Contractor shall provide for the State's exclusive possession and use a complete computer system specifically capable of creating, storing, updating and producing CPM schedules. Before delivery and setup of the computer system, the Contractor shall submit to the Engineer for approval a detailed list of all computer hardware and software the Contractor proposes to furnish. The minimum computer system to be furnished shall include the following:

A. Complete computer system, including keyboard, mouse, 20 inch color SVGA monitor (1024x768 pixels), Intel Pentium 350 MHz microprocessor chip, or equivalent;

B. Computer operating system software, compatible with the selected processing unit, for Windows 95 or later or equivalent;
C. Minimum sixty-four (64) megabytes of random access memory (RAM);
D. A 3.2 gigabytes minimum hard disk drive, a 1.44 megabyte 3 1/2 inch floppy disk drive, 32x speed minimum CD-ROM drive, Ethernet card and 56k modem;
E. A color-ink-jet plotter with a minimum 36 megabyte RAM, capable of 300 dots per inch color, 600 dots per inch monochrome, or equivalent, capable of printing fully legible, timescaled charts, and network diagrams, in four colors, with a minimum size of 36inches by 48 inches (E size) and is compatible with the selected system, an HP Design Jet 1055 CM or equivalent, plotter stand, roll paper assembly and automatic paper cutter, and provide plotter paper and ink cartridges throughout the contract;
F. CPM software shall be Primavera Project Planner, the latest version for Windows 95, or later;
G. Scheduler Analyzer Pro or equivalent (a suite of programs to assist in schedule analysis) in the latest version for Windows 95, Windows NT or later; and
H. Microsoft Office Software, the latest version for Windows 95, Windows NT or later and McAfee Virus software or equivalent.

The computer hardware and software furnished shall be compatible with that used by the Contractor for the production of the CPM progress schedule required by the Contract, and shall include original instruction manuals and other documentation normally provided with the software.

The Contractor shall furnish, install, set up, maintain and repair the computer hardware and software ready for use at a location determined by the Engineer. The hardware and software shall be installed and ready for use by the first submission of the baseline schedule. The Contractor shall provide 24 hours of formal training for the Engineer, and three other agents of the department designated by the Engineer, in the use of the hardware and software to include schedule analysis, reporting, and resource and cost allocations. An authorized vendor of Project Primavera shall perform the training.

All computer hardware and software furnished shall remain the property of the Contractor and shall be removed by the Contractor upon acceptance of the contract when no claims involving contract progress are pending. When claims involving contract progress are pending, computer hardware or software shall not be removed until the final estimate has been submitted to the Contractor.

PAYMENT

Progress schedule (critical path) will be paid for at a lump sum price. The contract lump sum price paid for progress schedule (critical path) shall include full compensation for furnishing all labor, materials (including computer hardware and software), tools, equipment, and incidentals; and for doing all the work involved in preparing, furnishing, updating and revising CPM progress schedules. Also for maintaining and repairing the computer hardware and training the Engineer in the use of the computer hardware and software as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for progress schedule (critical path) will be made as follows:

A. Interim baseline schedule accepted, then 10 percent payment for progress schedule (critical path) will be made.
B. Baseline schedule accepted, then 10 percent payment for progress schedule (critical path) will be made.
C. Monthly update schedules accepted, then 75 percent payment for progress schedule (critical path) will be made equally for each update.
D. Final schedule update accepted, then 5 percent payment for progress schedule (critical path) will be made.

The Department will retain an amount equal to 25 percent of the estimated value of the work performed during the first estimate period in which the Contractor fails to submit an interim baseline, baseline, revised or updated CPM schedule conforming to the requirements of this section, as determined by the Engineer. Thereafter, on subsequent successive estimate periods the percentage the Department will retain will be increased at the rate of 25 percent per estimate period in which acceptable CPM progress schedules have not been submitted to the Engineer. Retention's for failure to submit acceptable CPM progress schedules shall be additional to all other retention's provided for in the contract. The retention for failure to submit acceptable CPM progress schedules will be released for payment on the next monthly estimate for partial payment following the date that acceptable CPM progress schedules are submitted to the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications, shall not apply to the item of progress schedule (critical path). Adjustments in compensation for the project schedule will not be made for any increased or decreased work ordered by the Engineer in furnishing project schedules.

10-1.11 OVERHEAD

Overhead shall conform to these special provisions. The Contractor will be compensated for time-related overhead in conformance with these special provisions.

Attention is directed to "Force Account Payment" and "Progress Schedule (Critical Path)" of these special provisions.

The provisions in Section 9-1.08, "Adjustment of Overhead Costs," of the Standard Specifications shall not apply.

Time-related overhead shall consist of those overhead costs, including field and home office overhead, that are in proportion to the time required to complete the work. Time-related overhead shall not include costs that are not related to time, including but not limited to, mobilization, licenses, permits, and any other charges incurred only once during the contract.

Field office overhead expenses include time-related costs associated with the normal and recurring operations of the construction project, and shall not include costs directly attributable to any of the work of the contract. Such time-related costs include, but are not limited to, the salaries and benefits of project managers, general superintendents, field office managers and other field office staff assigned to the project, and rent, utilities, maintenance, security, supplies and equipment costs of the project field office.

Home office overhead or general and administrative expenses refer to the fixed costs of operating the Contractor's business. These costs include, but are not limited to, general administration, insurance, personnel and subcontract administration, purchasing, accounting, and project engineering and estimating. The rate of home office overhead shall exclude expenses specifically related to other contracts or other businesses of the Contractor, equipment coordination, material deliveries, and consultant and legal fees.

The quantity of time-related overhead to be paid will be measured by the working day, as specified in the Engineer's Estimate as WDAY. The estimated amount will be based on the number of working days, excluding any days for plant establishment, as specified in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions. In the event an early completion progress schedule, as defined in "Progress Schedule (Critical Path)" of these special provisions, is submitted by the Contractor and approved by the Engineer, the quantity of time-related overhead eligible for payment will be based on the total number of working days as specified in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, rather than the Contractor's early completion progress schedule. The quantity of time-related overhead, as measured above, will be adjusted only as a result of suspensions and adjustments of time which revise the current contract completion date and which are also any of the following:

A. Suspensions of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications, except:

    1. Suspensions ordered due to weather conditions being unfavorable for the suitable prosecution of the controlling operation or operations; or
    2. Suspensions ordered due to the failure on the part of the Contractor to carry out orders given, or to perform any provision of the contract; or
    3. Any other suspensions mutually agreed upon between the Engineer and the Contractor.

B. Extensions of time granted by the State in conformance with the provisions in the fifth paragraph in Section 8-1.07, "Liquidated Damages," of the Standard Specifications; or

C. Reductions in contract time set forth in approved contract change orders, in conformance with the provisions in Section 4-1.03, "Changes," of the Standard Specifications.

In the event a cost reduction proposal is submitted by the Contractor, and is subsequently approved by the Engineer, which provides for a reduction in contract time, the contract amount of time-related overhead associated with the reduction in contract time shall be considered as a net savings in the total cost of time-related overhead. The Contractor will be paid 50 percent of the estimated net savings of the time-related overhead, in conformance with the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications.

If the quantity of time-related overhead, measured as specified in this special provision, exceeds 149 percent of the number of working days specified in the Engineer's Estimate, the Contractor shall, within 60 days of the Engineer's written request, submit to the Engineer an audit examination and report performed by an independent Certified Public Accountant of the Contractor's actual overhead costs. The independent Certified Public Accountant's audit examination shall be performed in conformance with the requirements of the American Institute of Certified Public Accountants Attestation Standards. The audit examination and report shall depict the Contractor's project and company-wide financial records and shall specify the actual overall average daily rates for both field and home office overhead for the entire duration of the project, and whether the costs have been properly allocated. The rates of field and home office overhead shall exclude all unallowable costs as determined in the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31. The audit examination shall determine if the rates of field and home office overhead:

A. are allowable in conformance with the requirements of the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31;
B. are adequately supported by reliable documentation; and
C. related solely to the project under examination.

Upon the Engineer's written request, the Contractor shall make its financial records available for audit by the State for the purpose of verifying the actual rate of time-related overhead specified in the audit submitted by the Contractor. The actual rate of time-related overhead specified in the audit, submitted by the Contractor, will be subject to approval by the Engineer.

If the Engineer elects, or if requested in writing by the Contractor, contract item payments for time-related overhead, in excess of 149 percent of the number of working days designated in the Engineer's Estimate, will be adjusted to reflect the actual rate.

The cost of performing an audit examination and submitting the report, requested by the Engineer, will be borne equally by the State and the Contractor. The division of the cost will be made by determining the cost of providing an audit examination in conformance with the provisions of Section 9-1.03B, "Work performed by Special Forces or Other Special Services" of the Standard Specifications, and paying to the Contractor one-half of that cost.

The contract price paid per working day for time-related overhead shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in time-related overhead, complete in place, including all field and home office overhead costs incurred by the Contractor and by any joint venture partner, subcontractor, supplier or other party associated with the Contractor, and the Contractor's share of costs of audits of overhead costs requested by the Engineer, as specified in these special provisions, and as directed by the Engineer. The provisions in Sections 4-1.03B, "Increased or Decreased Quantities," 4-1.03C, "Changes in Character of the Work," of the Standard Specifications shall not apply to time-related overhead.

Full compensation for additional overhead costs involved in the performance of extra work at force account shall be considered as included in the markups specified in "Force Account Payment," of these special provisions.

Full compensation for additional overhead cost involved in performing additional contract item work that is not a controlling operation and for all overhead, other than the time-related overhead measured and paid for as specified in this section "Overhead", shall be considered as included in the various items of work involved, and no additional compensation will be allowed therefor.

For the purpose of making partial payments pursuant to the provisions in Section 9-1.06, "Partial Payments," of the Standard Specifications, the number of working days to be paid for time-related overhead in each monthly partial payment will be the number of working days, specified above to be measured for payment, that occurred during that monthly estimate period. The amount earned per working day for time-related overhead shall be either the contract item price, or 20 percent of the original total contract amount divided by the number of working days specified in "Beginning of Work, Time of Completion and Liquidated Damages," of these special provisions, whichever is the lesser.

After acceptance of the contract in conformance with the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount of the total contract item price for time-related overhead not yet paid, will be included for payment in the first estimate made after acceptance of the contract in conformance with the provisions in Section 9-1.07, "Payment After Acceptance," of the Standard Specifications.

10-1.12 WORKING DRAWING SUBMITTAL SCHEDULE

The Contractor shall submit the working drawing submittal schedule in accordance with the requirements of these special provisions.

The Contractor's attention is directed to the section "Progress Schedule (Critical Path)" of these special provisions for the definitions of Baseline Schedule and Controlling Operation.

Within 45 days, after approval of the contract, the Contractor shall submit to the Engineer for approval the working drawing submittal schedule in conjunction with the Baseline Schedule. The working drawing submittal schedule shall include the following:

A. Name and brief description of all working drawings and supplement including all subsections required by the Standard Specifications and these special provisions.
B. Reference section of the Standard Specifications or these special provisions for each working drawing submittal.
C. Allowable time for review of the working drawings by the Engineer as specified in the Standard Specifications and these special provisions.
D. The first occurrence of any Controlling Operation affected by each working drawing submittal.

The Contractor's proposed working drawing submittal schedule shall be in the order of the activities listed in the Baseline Schedule. Working drawing submittal schedule in contradiction with the Baseline Schedule will not be accepted. If there are any related working drawings with overlapping review time on the Controlling Operations listed on the Baseline Schedule, adjustment may be made by the Engineer in required review time.

If working drawing and supplement submittal for any activity is rejected by the Engineer, the allowable time for review of the working drawings by the Engineer as specified in the Standard Specifications and these special provisions will be reset after a re-submittal is made and the completeness of the re-submittal is checked by the Engineer. No compensation will be made for any costs incurred or for delay in completing the work resulting from rejected working drawing submittal.

Full compensation for preparing and submitting the working drawing submittal schedule including all revisions shall be considered as included in the contract lump sum price paid for Progress Schedule (Critical Path Method), and no additional compensation will be allowed therefor.

10-1.13 ELECTRONIC MOBILE DAILY DIARY COMPUTER SYSTEM DATA DELIVERY

Attention is directed to Sections 5-1.10, "Equipment and Plants," and 7-1.01A(3), "Payroll Records," of the Standard Specifications, and these special provisions.

The Contractor shall submit to the Engineer a list of each piece of equipment and its identifying number, type, make, model and rate code in accordance with the Department of Transportation publication entitled "Labor Surcharge and Equipment Rental Rate" which is in effect on the date the work is performed, and the names, labor rates and work classifications for all field personnel employed by the Contractor and all subcontractors in connection with the public work, together with such additional information as is identified below. This information shall be updated and submitted to the Engineer weekly through the life of the project.

This personnel information will only be used for this mobile daily diary computer system and it will not relieve the Contractor and subcontractors from all the payroll records requirements as required by Section 7-1.01A(3), "Payroll Records," of the Standard Specifications.

The Contractor shall provide the personnel and equipment information not later than 11 days after the contract award for its own personnel and equipment, and not later than 5 days before start of work by any subcontractor for the labor and equipment data of that subcontractor.

The minimum data to be furnished shall comply with the following specifications:

DATA CONTENT REQUIREMENTS.--

A. The Contractor shall provide the following basic information for itself and for each subcontractor that will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company name.	Alphanumeric; up to 30 characters.
Federal tax ID	Alphanumeric; up to 10 characters.
State contractor license	Alphanumeric; up to 20 characters.
Company type (prime or sub)	Alphanumeric; up to 10 characters.
Address (line 1).	Alphanumeric; up to 30 characters.
Address (line 2).	Alphanumeric; up to 30 characters.
Address (city).	Alphanumeric; up to 30 characters.
Address (2-letter state code).	Alphanumeric; up to 2 characters.
Address (zip code)	Alphanumeric; up to 14 characters.
Contact First Name.	Alphanumeric; up to 15 characters
Contact Last Name	Alphanumeric; up to 20 characters
Telephone number (with area code).	Alphanumeric; up to 20 characters.
Company code: short company name.	Alphanumeric; up to 10 characters.
Type of work (Department-supplied codes)	Alphanumeric; up to 30 characters
DBE status (Department-supplied codes)	Alphanumeric; up to 20 characters.
Ethnicity for DBE status (Department-supplied codes).	Alphanumeric; up to 20 characters.
List of laborers to be used on this contract (detail specified below).	
List of equipment to be used on this contract (detail specified below).	

For example, one such set of information for a company might be:

04-072359
XYZ CONSTRUCTION, INC.
94-2991040
AL1649T
SUB
1240 9TH STREET
SUITE 600
OAKLAND
CA
94612
JOHN
SMITH
(510) 834-9999
XYZ
PAVING
MBE
BLACK

B. The Contractor shall provide the following information for each laborer who will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company code (as defined above).	Alphanumeric; up to 10 characters.
Employee ID	Alphanumeric; up to 10 characters.
Last name.	Alphanumeric; up to 20 characters.
First name.	Alphanumeric; up to 15 characters.
Middle name.	Alphanumeric; up to 15 characters.
Suffix	Alphanumeric; up to 15 characters
Labor trade (Department-provided codes).	Alphanumeric; up to 10 characters.
Labor classification (Department-provided codes).	Alphanumeric; up to 10 characters.
Regular hourly rate.	Alphanumeric; up to (6,2)
Overtime hourly rate.	Alphanumeric; up to (6,2)
Doubletime hourly rate	Alphanumeric; up to (6,2)
Standby hourly rate.	Alphanumeric; up to (6,2)
Ethnicity (Department-provided codes).	Alphanumeric; up to 20 characters.
Gender.	Alphanumeric; up to 1 characters.

For example, one such set of information might be:

04-072359
XYZ
1249
GONZALEZ
HECTOR
VINCENT
JR.
OPR
JNY
12.50
18.75
25.00
0.00
HISPANIC
M

C. The Contractor shall provide the following information for each piece of equipment that will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company code (as defined above).	Alphanumeric; up to 10 characters.
Company's equipment ID number.	Alphanumeric; up to 10 characters.
Company's equipment description.	Alphanumeric; up to 60 characters.
Equipment type (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment make (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment model (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment rate code (from Department ratebook).	Alphanumeric; up to 10 characters
Regular hourly rate.	Alphanumeric; up to (6,2)
Overtime hourly rate.	Alphanumeric; up to (6,2)
Standby hourly rate	Alphanumeric; up to (6,2)
Idle hourly rate.	Alphanumeric; up to (6,2)
Rental flag.	Alphanumeric; up to 1 character.

For example, one such set of information might be:

04-072359
XYZ
B043
CAT TRACTOR D-6C
TRACC
CAT
D-6C
3645
75.00
75.00
0.00
0.00
N

DATA DELIVERY REQUIREMENTS.--

A. All data described in "Data Requirements" of this section shall be delivered to the Department electronically, on 3 1/2" floppy disks compatible with the Microsoft Windows operating system. The Contractor shall provide a weekly disk and hard copy of the required correct updated personnel and equipment information for the Contractor and all the subcontractors and verified correct by the Engineer.

B. Data of each type described in the previous section (contractor, labor, and equipment information) will be delivered separately, each type in one or more files on floppy disk. Any given file may contain information from one contractor or from multiple contractors, but only one type of data (contractor, labor, or equipment information).

C. The file format for all files delivered to Caltrans shall be standard comma-delimited, plain text files. This type of file (often called "CSV") is the most standard type for interchange of formatted data; it can be created and read by all desktop spreadsheet and desktop database applications. Characteristics of this type of file are:

- All data is in the form of plain ASCII characters.
- Each row of data (company, person, equipment) is delimited by a carriage return character.
- Within rows, each column (field) of data is delimited by a comma character.

D. The files shall have the following columns (i.e., each row shall have the following fields):

1. Contractor info: 17 columns (fields) as specified in "Data Requirements #1", above.
2. Labor info: 15 columns (fields) as specified in "Data Requirements #2", above.
3. Equipment info: 13 columns (fields) as specified in "Data Requirements #3", above.

For every one type of file, columns (fields) must be in the order specified under "Data Requirements", above. All columns (fields) described under "Data Requirements" must be present for all rows, even if some column (field) values are empty. The first row of each file must contain column headers (in plain text).

E. Column (field) contents must conform to the data type and length requirements described in the "Data Requirement" section, above. In addition, column (field) data must conform to the following restrictions:

1. All data shall be uppercase.
2. Company type shall be either "PRIME" or "SUB".
3. Labor trade and classification codes must conform to a list of standard codes that will be supplied by Department.
4. Contractor type of work codes and DBE status codes must conform to a list of standard codes that will be supplied by Department.
5. Ethnicity codes must conform to standard codes that will be supplied by Department.
6. Data in the "gender" column must be either "M" or "F".
7. Data in the "rental equipment" column must be either "Y" or "N".
8. Equipment owner's description may not be omitted. (The description, together with the equipment number, is how the equipment will be identified in the field.) Include manufacturer, rated capacity and trade description
9. Equipment type, make, model, and ratebook code shall conform to the Department of Transportation Publication entitled "Labor Surcharge and Equipment Rental Rate", which is in effect on the date the work is performed. If the equipment in question does not have an entry in the book, then alternate, descriptive entries may be made in these fields as directed by the Engineer.

F. The name of each file must indicate its contents, e.g., "labor.csv" for laborers, "equipment.csv" for equipment, and "contractor.csv" for contractors. Each floppy disk supplied to Caltrans must be accompanied by a printed list of the files it contains with a brief description of the contents of each file.

PAYMENT.--Payment for providing electronic mobile daily diary computer system data delivery will be made on a lump sum basis. The lump sum bid price for electronic mobile daily diary computer system data delivery will be made according to the following schedule:

The Contractor will receive not more than 3.3 per cent per month of the total bid price for electronic mobile daily diary computer system data delivery . After the completion of the work, 100 per cent payment will be made for electronic mobile daily diary computer system data delivery less the permanent deduction, if any, for failure to deliver complete weekly electronic mobile daily diary computer system data in each month.

The contract lump sum price paid for electronic mobile daily diary computer system data delivery shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in electronic mobile daily diary computer system data delivery as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Department of Transportation will retain an amount equal to 25 percent of the estimated value of the work performed during the first estimate period in which the Contractor fails to submit electronic mobile daily diary computer system data delivery conforming to the requirements of this section, as determined by the Engineer. Thereafter, on subsequent successive estimate periods the percentage the Department will retain will be increased at the rate of 25 percent per estimate period in which acceptable electronic mobile daily diary computer system data have not been submitted to the Engineer. Retentions for failure to submit acceptable electronic mobile daily diary computer system data shall be additional to all other retentions provided for in the contract. The retention for failure to submit acceptable electronic mobile daily diary computer system data will be released for payment on the next monthly estimate for partial payment following the date that acceptable electronic mobile daily diary computer system data is submitted to the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications, shall not apply to the item of electronic mobile daily diary computer system data delivery. Adjustments in compensation for electronic mobile daily diary computer system data delivery will not be made for any increased or decreased work ordered by the Engineer in furnishing electronic mobile daily diary computer system data.

10-1.14 OBSTRUCTIONS

Attention is directed to Section 8-1.10, "Utility and Non-Highway Facilities," and Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

Attention is directed to the existence of certain underground facilities that may require special precautions be taken by the Contractor to protect the health, safety and welfare of workers and of the public. Facilities requiring special precautions include, but are not limited to: conductors of petroleum products, oxygen, chlorine, and toxic or flammable gases; natural gas in pipelines greater than 150 mm in diameter or pipelines operating at pressures greater than 415 kPa (gage); underground electric supply system conductors or cables, with potential to ground of more than 300 V, either directly buried or in a duct or conduit which do not have concentric grounded or other effectively grounded metal shields or sheaths.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert-Northern California (USA)	1-800-642-2444 1-800-227-2600
Underground Service Alert-Southern California (USA)	1-800-422-4133 1-800-227-2600

The Contractor shall notify the Engineer and the Berkeley Seismology Specialist at Telephone: (510) 486-7314 or (510) 882-9816, at least 10 working days before any excavation or dredging work is to begin. The Contractor shall protect the University of California, Berkeley seismic monitoring cable. The Contractor shall field verify the location of the cable and ensure that the monitoring cable shall not be damaged.

Full compensation for locating and protecting the University of California, Berkeley seismic monitoring cable shall be considered as included in the contract prices paid for the various items of work involved and no separate payment will be made therefor.

The existing 12 kV Navy power cable and 250 mm PG&E gas main, which are located between Sta. 81+40 and Sta. 84+40, shall be protected from the Contractor's work and remain in service for the duration of the contract.

The Contractor shall notify the Engineer and contact the Utilities Manager of Treasure Island at Telephone: (415) 274-0333 for the 12 kV Navy power cable, and the Superintendent of Pacific Gas and Electric Company (PG&E) at Telephone: (510) 437-2230 or (510) 437-2110, at least 10 working days before any excavation or dredging work is to begin. The lines shall be physically located in the presence of the authorized representative of the utility owners, with the location indicated by flotation devices distributed at intervals of no more than 15-m apart. The Contractor shall not perform any excavation or dredging work close to these lines without representative from the utility owners. The flotation devices shall remain in place during all phases of dredging. The Contractor shall exercise extreme care while operating and anchoring barges, performing any excavation and dredging work at these lines to avoid damage to the existing utilities.

In addition, the Contractor shall verify the flotation devices for the actual location of the existing utilities to be protected in place, and shall leave them in good condition, before leaving the marine access areas as shown on the plans.

Full compensation for locating and protecting these utility lines, including tool and equipment, floatation devices, and sheet piling, and for verifying and maintaining the floatation devices for the actual location of the existing utilities to be protected in place shall be considered as included in the contract prices paid for the various items of work involved and no separate payment will be made therefor.

The existing 2.44-m East Bay Municipal Utility District (EBMUD) Outfall located south of the Bay Bridge at the Oakland shore is defined as a zero-load facility. The outfall shall be physically located in the presence of the Engineer should the Contractor anticipate operating and anchoring barges in the vicinity. In addition, should the Contractor elects to access over the EBMUD outfall on land, a temporary structure, capable of supporting the intended load, shall be designed and constructed to span over the outfall prior to traversing over this outfall. The temporary structure shall be designed and constructed in conformance with the requirements in Section 51-1.06, "Falsework," of the Standard Specifications, "Falsework" elsewhere in these special provisions and these special provisions.

In addition to the provisions in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications, the time to be provided for the Engineer's review of the working drawings for the temporary structures shall be as follows:

Structure or Portion of Structure	Review Time - Weeks
Temporary Structure over EBMUD outfall	2

A sample temporary structures plan used on a previous contract for EBMUD is included in the Materials Information Handout for information only.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in locating and protecting the EBMUD Outfall, including designing, constructing, maintaining, and removing the

temporary structure, shall be considered as included in the contract price paid for the item of work involved and no additional compensation will be allowed therefor.

10-1.15 MOBILIZATION

Mobilization shall conform to the provisions in Section 11, "Mobilization," of the Standard Specifications and these special provisions.

MARINE ACCESS

Attention is directed to "Dredging" and "End Use of Dredged Materials" of these special provisions. Marine access shall be defined as the mobilization work of furnishing barges, access dredging, and erecting and removing trestles and other facilities to provide marine access to the job site. The limits of access dredging are shown on the project plans.

Removal of underwater debris that is in conflict with construction work shown shall be as specified in "Existing Highway Facilities," of these special provisions.

The Contractor may construct an access trestle for access to the jobsite in accordance with the permits obtained by the State and these special provisions.

The Contractor shall submit, in accordance with the provisions in "Working Drawings" of these special provisions, calculations and working drawings of any access trestle that is to be constructed. The Contractor shall allow the Engineer 30 working days to review and approve the working drawings and supplemental calculations. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the working drawings and calculations within 15 working days of receipt of the Engineer's comments and shall allow 15 working days for the Engineer to review the revision.

Full compensation for establishing marine access to the job site, including access dredging and the disposal of dredged material, constructing, maintaining and removing access trestles, preparing and submitting calculations and working drawings shall be considered as including in the lump sum price paid for mobilization and no additional compensation will be allowed therefor.

10-1.16 CONSTRUCTION SURVEYING

This work shall consist of construction surveying by the Contractor using Global Positioning System (GPS) surveying methods, including Static and Real-time kinematic (RTK) GPS, conventional total station and other surveying means to establish and control the lines and grades required for completion of the bridge work as shown on the plans and in these special provisions and as specified in the Standard Specifications. Construction surveying shall include geometric control for the casting of precast concrete segments, the casting of precast panels, and the fabrication of steel structures.

Attention is directed to "Piling," "Furnish Precast Segments," "Erect Precast Segments," "Footing Construction" and "Steel Structures" of these special provisions for additional construction surveying requirements.

Except as otherwise provided herein for establishment of Project horizontal and vertical control and right-of-way staking (on land only), by the Engineer, all other specifications, including the first two paragraphs of Section 5-1.07, "Lines and Grades," of the Standard Specifications, which require the establishment of lines and grades by the Engineer, shall not apply.

The Engineer will determine the horizontal and vertical survey control data to be used for the project and will provide survey control referenced to the California Coordinate System 1983 (1991.35), Zone 3 coordinates and NGVD 1929 at western end of the Oakland Mole and the eastern side of Yerba Buena Island. Attention is directed to the "Contractors Information Handout" for the identification of project horizontal and vertical survey control data. The Contractor shall verify the accuracy of the control data prior to initiating construction surveying. The Engineer will also provide a control diagram for the monumentation. The Contractor's attention is directed to the third paragraph of Section 5-1.07, "Lines and Grades," of the Standard Specifications with regard to preserving control monuments furnished by the State.

Stake markings shall be in accordance with Chapter 12, "Construction Surveys," of the California Department of Transportation "Survey Manual."

The Contractor shall use GPS combined with software specifically designed for precise positioning of large structures, for positioning of the pile driving templates and for the positioning and driving of the permanent steel casings. The software shall provide a visual display on a computer screen that allows the viewer to see real-time, three-dimensional coordinates, attitude and orientation information with regard to a predetermined target position. The Contractor shall provide the Engineer access to the location where the computer monitor is located whenever the system is being used to maneuver and set piling or templates into place. The software shall also have user-defined reporting functions for quality control and as-built reporting. The records of the GPS work shall be submitted to the Engineer on a weekly basis.

Before starting any construction survey work, the Contractor shall submit a Survey Plan to the Engineer. The Survey Plan shall include working drawings and supplements in conformance to "Working Drawings" of these special provisions.

The working drawing submittal shall include the following:

A. Stake layout;

B. Location of all control points;
C. Datum information; and
D. Bridge alignment.

The supplement to the working drawing shall show the Contractor's proposed methods of construction surveying and a quality control plan for surveying, and shall include the following:

A. A detailed narrative of the step-by-step surveying control process;
B. A listing of the types of methods and the related item(s) to be constructed;
C. Detailed calculation forms, and a set of calculation for each type of survey method, including sample input and output of computer programs;
D. Identifications of all measuring equipment, procedures;
E. Qualifications of personnel who will carry out construction surveying, and for the Land Surveyor of record; and
F. Correlation between the data from geometric control for furnishing precast concrete segments and furnishing steel structures with data for erection and final line and grade.

Prior to submitting the Survey Plan, the Contractor and any entity performing surveying for this project shall hold a pre-survey meeting with the Engineer to the proposed procedures. The pre-survey meeting shall be held within the San Francisco Bay Area.

The Contractor shall allow 15 working days for the Engineer to review the Survey Plan after a complete plan has been submitted. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the Survey Plan. The Contractors shall allow 10 working days for the Engineer to review the revisions. No construction surveying shall began until the Engineer approves the written proposal.

The Contractor shall make the calculations necessary to establish the exact position of the work from the Project control points. Calculations, survey notes computer output, and other construction survey notes and records shall be neat, legible, and accurate. Copies of the survey calculations, notes and other records shall be submitted to the Engineer on a weekly basis.

The Survey Plan, and the calculations, survey notes and other records submitted to establish the exact position of the work shall be completed under the direction of and signed by a Land Surveyor who is licensed by the State of California.

The Contractor shall submit to the Engineer, a schedule of values detailing the cost breakdown of the contract lump sum item for construction surveying. The schedule of values shall reflect the items, work, quantities and costs required to do the surveying required by these special provisions, including surveying for geometry control during precast segmental bridge construction, for the installation of piling and in the erection of steel structures. The Contractor shall be responsible for the accuracy of the quantities and costs used in the schedule of values submitted for approval.

The sum of the amounts for the items and work listed in the schedule of values shall be equal to the contract lump sum price for construction surveying. Changes in the schedule of values, due to changes by the Contractor in the items and work listed, shall not result in a change in the contract lump sum price for construction surveying.

The schedule of values will be used only to determine progress payments for construction surveying during the progress of the work. No payment for construction surveying will be made until the schedule of values is approved in writing by the Engineer.

PAYMENT

The contract lump sum price paid for construction surveying shall include full compensation for furnishing all labor, materials (except survey marker disks), tools, equipment, and incidentals, and for doing all the required survey work involved in constructing the new bridge, including surveying for lines and grades, and for geometric control as specified in the these special provisions, and as directed by the Engineer.

10-1.17 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

Flagging, signs, and all other traffic control devices furnished, installed, maintained, and removed when no longer required shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Category 1 traffic control devices are defined as those devices that are small and lightweight (less than 45 kg), and have been in common use for many years. The devices shall be known to be crashworthy by crash testing, crash testing of similar devices, or years of demonstrable safe performance. Category 1 traffic control devices include traffic cones, plastic drums, portable delineators, and channelizers.

If requested by the Engineer, the Contractor shall provide written self-certification for crashworthiness of Category 1 traffic control devices. Self-certification shall be provided by the manufacturer or Contractor and shall include the following: date, Federal Aid number (if applicable), expenditure authorization, district, county, route and kilometer post of project limits; company name of certifying vendor, street address, city, state and zip code; printed name, signature and title of

certifying person; and an indication of which Category 1 traffic control devices will be used on the project. The Contractor may obtain a standard form for self-certification from the Engineer.

Category 2 traffic control devices are defined as those items that are small and lightweight (less than 45 kg), that are not expected to produce significant vehicular velocity change, but may otherwise be potentially hazardous. Category 2 traffic control devices include: barricades and portable sign supports.

Category 2 devices purchased on or after October 1, 2000 shall be on the Federal Highway Administration (FHWA) Acceptable Crashworthy Category 2 Hardware for Work Zones list. This list is maintained by FHWA and can be located at the following internet address: http://safety.fhwa.dot.gov/fourthlevel/hardware/listing.cfm?code=workzone. The Department maintains a secondary list at the following internet address: http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdffiles.htm.

Category 2 devices that have not received FHWA acceptance, and were purchased before October 1, 2000, may continue to be used until they complete their useful service life or until January 1, 2003, whichever comes first. Category 2 devices in use that have received FHWA acceptance shall be labeled with the FHWA acceptance letter number and the name of the manufacturer by the start of the project. The label shall be readable. After January 1, 2003, all Category 2 devices without a label shall not be used on the project.

If requested by the Engineer, the Contractor shall provide a written list of Category 2 devices to be used on the project at least 5 days prior to beginning any work using the devices. For each type of device, the list shall indicate the FHWA acceptance letter number and the name of the manufacturer.

Full compensation for providing self-certification for crashworthiness of Category 1 traffic control devices and for providing a list of Category 2 devices used on the project and labeling Category 2 devices as specified shall be considered as included in the prices paid for the various contract items of work requiring the use of the Category 1 or Category 2 traffic control devices and no additional compensation will be allowed therefor.

10-1.17A CONSTRUCTION AREA SIGNS

Construction area signs shall be furnished, installed, maintained, and removed when no longer required in conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Type II retroreflective sheeting shall not be used on construction area sign panels.

Attention is directed to "Construction Project Information Signs" of these special provisions regarding the number and type of construction project information signs to be furnished, erected, maintained, and removed and disposed of.

The Contractor shall notify the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar days, prior to commencing excavation for construction area sign posts. The regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert-Northern California (USA)	1-800-642-2444 1-800-227-2600
Underground Service Alert-Southern California (USA)	1-800-422-4133 1-800-227-2600

Excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined there are no utility facilities in the area of the proposed post holes.

Sign substrates for stationary mounted construction area signs may be fabricated from fiberglass reinforced plastic as specified under "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

10-1.18 MAINTAINING TRAFFIC

Attention is directed to Sections 7-1.08, "Public Convenience," 7-1.09, "Public Safety," and 12, "Construction Area Traffic Control Devices," of the Standard Specifications and to the provisions in "Public Safety" of these special provisions and these special provisions. Nothing in these special provisions shall be construed as relieving the Contractor from the responsibilities specified in Section 7-1.09.

Lane closures shall conform to the provisions in section "Traffic Control System for Lane Closure" of these special provisions.

Personal vehicles of the Contractor's employees shall not be parked within the right of way.

Whenever vehicles or equipment are parked on the shoulder within 1.8 m of a traffic lane, the shoulder area shall be closed as shown on the plans, and shall be closed only during the hours shown on the charts included in this section "Maintaining Traffic."

Lanes shall be closed only during the hours shown on the charts included in this section "Maintaining Traffic." Except work required under Sections 7-1.08 and 7-1.09, work that interferes with public traffic shall be performed only during the hours shown for lane closures.

Any lane closures on the day of major events at Candlestick Park, PacBell Park, Downtown San Francisco, Oakland Coliseum, and Downtown Oakland must be approved by the Engineer.

Designated legal holidays are: January 1st, the last Monday in May, July 4th, the first Monday in September, Thanksgiving Day, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday.

Minor deviations from the requirements of this section concerning hours of work which do not significantly change the cost of the work may be permitted upon the written request of the Contractor, if in the opinion of the Engineer, public traffic will be better served and the work expedited. These deviations shall not be adopted by the Contractor until the Engineer has approved the deviations in writing. All other modifications will be made by contract change order.

Chart No. 1
Multilane Lane Requirements

Location:Eastbound Route 80, between theYerba Buena Island on-ramp and the SFOBB Toll Plaza

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	2	2	1	1	1	2	4																		3
Fridays	3	2	2	1	1	2	4																		
Saturdays	4	4	3	3	1	2	2	3	4																
Sundays	4	3	3	2	1	1	2	2	3	4														4	3
Day before designated legal holiday	3	2	2	1	1	2	4																		
Designated legal holidays	4	3	3	2	1	1	2	2	3	4														4	3

Legend:

1	One lane open in direction of travel
2	Two adjacent lanes open in direction of travel
3	Three adjacent lanes open in direction of travel
4	Four adjacent lanes open in direction of travel
	No lane closure allowed

REMARKS:

Chart No. 2
Multilane Lane Requirements

Location:Westbound Route 80, between the east end of SFOBB and the Yerba Buena Island off-ramp

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	2	1	1	1	2																4	4	4	3	
Fridays	2	1	1	1	2																	4	4	3	
Saturdays	2	2	1	1	1	2	3	4																4	
Sundays	2	2	1	1	1	2	2	3	3													4	4	3	
Day before designated legal holiday	2	1	1	1	2																	4	4	3	
Designated legal holidays	2	2	1	1	1	2	2	3	3													4	4	3	

Legend:

1	One lane open in direction of travel
2	Two adjacent lanes open in direction of travel
3	Three adjacent lanes open in direction of travel
4	Four adjacent lanes open in direction of travel
	No lane closure allowed

REMARKS:

Chart No. 3
Shoulder Closure Requirements

Location:Eastbound Route 80, between theYerba Buena Island on-ramp and the SFOBB Toll Plaza

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	S	S	S	S	S	S	S	S	S	S	S	S	S	S										S	
Fridays	S	S	S	S	S	S	S	S	S	S	S	S	S	S											
Saturdays	S	S	S	S	S	S	S	S	S																
Sundays	S	S	S	S	S	S	S	S	S	S													S	S	
Day before designated legal holiday	S	S	S	S	S	S	S	S	S	S	S	S	S	S											
Designated legal holidays	S	S	S	S	S	S	S	S	S	S													S	S	

Legend:

S	Shoulder closure permitted
	No shoulder closure allowed

REMARKS:

Chart No. 4
Shoulder Closure Requirements

Location:Westbound Route 80, between the east end of SFOBB and the Yerba Buena Island off-ramp

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	S	S	S	S	S						S	S	S	S	S						S	S	S	S	
Fridays	S	S	S	S	S						S	S	S	S	S							S	S	S	
Saturdays	S	S	S	S	S	S	S	S																S	
Sundays	S	S	S	S	S	S	S	S	S													S	S	S	
Day before designated legal holiday	S	S	S	S	S						S	S	S	S	S							S	S	S	
Designated legal holidays	S	S	S	S	S	S	S	S	S													S	S	S	

Legend:

S	Shoulder closure permitted
	No shoulder closure allowed

REMARKS:

10-1.19 CLOSURE REQUIREMENTS AND CONDITIONS

Lane closures shall conform to the provisions in "Maintaining Traffic" of these special provisions and these special provisions.

The term closure, as used herein, is defined as the closure of a traffic lane or lanes, including ramp or connector lanes, within a single traffic control system.

CLOSURE SCHEDULE

By noon Monday, the Contractor shall submit a written schedule of planned closures for the following week period, defined as Friday noon through the following Friday noon.

The Closure Schedule shall show the locations and times when the proposed closures are to be in effect. The Contractor shall use the Closure Schedule request forms furnished by the Engineer. Closure Schedules submitted to the Engineer with incomplete, unintelligible or inaccurate information will be returned for correction and resubmittal. The Contractor will be notified of disapproved closures or closures that require coordination with other parties as a condition of approval.

Amendments to the Closure Schedule, including adding additional closures, shall be submitted to the Engineer, in writing, at least 3 working days in advance of a planned closure. Approval of amendments to the Closure Schedule will be at the discretion of the Engineer.

The Contractor shall confirm, in writing, all scheduled closures by no later than 8:00 a.m. 3 working days prior to the date on which the closure is to be made. Approval or denial of scheduled closures will be made no later than 4:00 p.m. 2 working days prior to the date on which the closure is to be made. Closures not confirmed or approved will not be allowed.

Confirmed closures that are cancelled due to unsuitable weather may be rescheduled at the discretion of the Engineer for the following working day.

CONTINGENCY PLAN

The Contractor shall prepare a contingency plan for reopening closures to public traffic. The Contractor shall submit the contingency plan for a given operation to the Engineer within one working day of the Engineer's request.

LATE REOPENING OF CLOSURES

If a closure is not reopened to public traffic by the specified time, work shall be suspended in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. The Contractor shall not make any further closures until the Engineer has accepted a work plan, submitted by the Contractor, that will insure that future closures will be reopened to public traffic at the specified time. The Engineer will have 2 working days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to any compensation for the suspension of work resulting from the late reopening of closures.

For each 10-minute interval, or fraction thereof past the time specified to reopen the closure, the Department will deduct $197,000.00 per interval from moneys due or that may become due the Contractor under the contract.

COMPENSATION

The Contractor shall notify the Engineer of any delay in the Contractor's operations due to the following conditions, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of those conditions, and the Contractor's loss due to that delay could not have been avoided by rescheduling the affected closure or by judicious handling of forces, equipment and plant, the delay will be considered a right of way delay within the meaning of Section 8-1.09, "Right of Way Delays," and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09:

A. The Contractor's proposed Closure Schedule is denied and his planned closures are within the time frame allowed for closures in "Maintaining Traffic" of these special provisions, except that the Contractor will not be entitled to any compensation for amendments to the Closure Schedule that are not approved.
B. The Contractor is denied a confirmed closure.

Should the Engineer direct the Contractor to remove a closure prior to the time designated in the approved Closure Schedule, any delay to the Contractor's schedule due to removal of the closure will be considered a right of way delay within the meaning of Section 8-1.09, "Right of Way Delays," and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09.

10-1.20 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

A traffic control system shall consist of closing traffic lanes in conformance with the details shown on the plans, the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications, the provisions under "Maintaining Traffic" and "Construction Area Signs" of these special provisions, and these special provisions.

The provisions in this section will not relieve the Contractor from the responsibility to provide additional devices or take measures as may be necessary to comply with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications.

Each vehicle used to place, maintain and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining or removing components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining or removing components when operated within a stationary lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the plans shall not be used on vehicles which are being used to place, maintain and remove components of a traffic control system and shall be in place before a lane closure requiring its use is completed.

If components in the traffic control system are displaced or cease to operate or function as specified, from any cause, during the progress of the work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location.

When lane closures are made for work periods only, at the end of each work period, components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder. If the Contractor so elects, the components may be stored at selected central locations designated by the Engineer within the limits of the highway right of way.

The contract lump sum price paid for traffic control system shall include full compensation for furnishing all labor, materials (including signs), tools, equipment, and incidentals, and for doing all the work involved in placing, removing, storing, maintaining, moving to new locations, replacing, and disposing of the components of the traffic control system shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications shall not apply to the item of traffic control system. Adjustments in compensation for traffic control system will be made only for increased or decreased traffic control system required by changes ordered by the Engineer and will be made on the basis of the cost of the increased or decreased traffic control necessary. The adjustment will be made on a force account basis as provided in Section 9-1.03, "Force Account Payment," of the Standard Specifications for increased work and estimated on the same basis in the case of decreased work.

Traffic control system required by work which is classed as extra work, as provided in Section 4-1.03D of the Standard Specifications, will be paid for as a part of the extra work.

10-1.21 EXISTING HIGHWAY FACILITIES

The work performed in connection with various existing highway facilities shall conform to the provisions in Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

Underwater debris, within the project limits, at the bottom of the bay, has been mapped and is shown in "Phase I Archaeological Survey Report - Maritime Archaeology", and "Addendum Archaeological Survey Report - Maritime Archaeology." Said reports are included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

Full compensation for removal of underwater debris (shown in said report) that is in conflict with construction work shown shall be considered as included in the prices paid for the various items of work involved, and no additional compensation will be allowed therefor.

EXISTING NAVIGATIONAL LIGHTS

The existing navigational lights mounted on piles as shown on the plans shall remain in place.

Attention is directed to "Order of Work," and "Piling," elsewhere in these special provisions. Navigational lighting on the existing piling shall be maintained, except when the Contractor's barge is adjacent to the existing piling for redriving.

PREPARE CONCRETE BRIDGE DECK SURFACE

This work shall consist of cleaning the portland cement concrete deck surface by using steel shot-blasting and blowing clean the deck surface, as shown on the plans and as described in these special provisions.

All laitance and surface contaminants including, but not limited to, rust, oil, paint, joint material, and other foreign material shall be cleaned from the surface of the existing concrete deck.

If the surface becomes contaminated at any time prior to placing the primer for the overlay, the surface shall be cleaned by abrasive blasting.

Equipment shall be fitted with suitable traps, filters, drip pans, or other devices, as necessary, to prevent oil or other deleterious material from being deposited on the deck.

Equipment or procedures that leave fractured aggregate or otherwise damage the concrete surface which is to remain shall not be used.

All removed materials shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Preparing concrete bridge deck surface will be measured by the square meter of surface which is prepared to receive the overlay, based on dimensions shown on the plans.

The contract price paid per square meter for prepare concrete bridge deck surface shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in preparing the concrete bridge deck surface complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.22 EARTHWORK

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Removal of underwater debris that is in conflict with construction work shown shall be as specified in "Existing Highway Facilities," of these special provisions.

Removal and relocation for earthwork shall conform to the additional requirements of "Dredging" elsewhere in these special provisions.

For the existing bridge, the piling shall not be exposed at any time. It is anticipated that at some Pier locations, shoring of the existing footings and piling will be required prior to underwater excavation (including dredging). The Contractor shall design, furnish, and install said shoring.

Foundation recommendations are included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

When shoring is used, the Contractor shall submit working drawings and supplement to the Engineer in accordance with the provisions in section "Working Drawings" of these special provisions. The working drawings shall include the proposed methods and equipment to be used to perform underwater excavation and the design of the shoring system as required. The Contractor shall allow the Engineer 20 working days to review and approve the working drawings and supplement.

For a given Pier location, underwater excavation (including dredging) shall be completed prior to installing piling.

Seal course concrete shall not be placed within 3 meters of any new piling. It is anticipated that a follower type cofferdam system will be required to facilitate foundation construction. Information on follower type cofferdams is included in the "Information Handout," available to the Contractor as provided in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications. Attention is directed to "Piling," and "Footing Construction," of these special provisions regarding foundation construction.

Full compensation for designing, furnishing, and installation of shoring of the existing bridge, , shall be considered as included in the contract price paid per cubic meter for structure excavation (bridge, underwater) and no separate payment will be made therefor.

10-1.23 DREDGING

Dredging shall include removal, relocation and disposal of marine sediment for construction access. Dredging shall conform to the requirements of these special provisions and to the permits in _____.

Excavation within the limits of structure excavation as shown on the plans shall be as specified in "Earthwork," of these special provisions.

Removal of materials within cast-in-steel shell concrete piling shall be as specified in "Piling" elsewhere in these special provisions.

Attention is directed to "Marine Access" of these special provisions for dredging for marine access.

At the Contractor's option, the Contractor may dredge for marine access in the areas within the horizontal limits that is defined by the bridge deck areas as shown on the plans, and also within the area within the horizontal limits that is defined as the width of the bridge deck by the length of 50 meters measured perpendicular to the north edge of the westbound end of the bridge deck. Dredging may also be done up to 49 meters east from contract limits of construction as shown on the plans. The width should be tapered from 50 meters to 45 meters measured perpendicular to the north edge of westbound end of the bridge deck. Dredging shall not be done at other locations.

Attention is directed to "Obstructions" of these special provisions and to the construction details sheets of the plans regarding the presence of the Navy's 12 kV power cable, the 250 mm PG&E gas main, and the East Bay Municipal Utility District (EBMUD) outfall structure.

All dredging shall be done in the presence of the Engineer.

The total amount of dredged material for marine access as shown on the plans, shall not exceed 97,000 cubic meters. The combined total amount of dredged and excavated materials for all construction work, including but not limited to, dredged material for marine access (including the access channel), structure excavation (65,000 cubic meters), removal of materials in cast-in-steel concrete piling, dredging for trestle, and dredging for temporary towers, shall not exceed 211,000 cubic meters.

Prior to beginning any dredging work, the Contractor shall submit a Dredging Operation Plan for approval 60 calendar days prior to the proposed commencement of dredging. Dredging shall not commence until all comments have been answered and written approval has been granted by the Army Corps of Engineers and the Engineer. The plan shall include the following:

1. Name and telephone number of the dredging Contractor's representatives on site;
2. Army Corp of Engineers permit number;
3. Dredging start and completion dates;
4. Schedule of dredging operations including sequence of work, anticipated quantities and production rates;
5. Names of vessels;
6. Dump scow numbers or identification;
7. Bin or barge capacities;
8. Identification of work as either maintenance dredging or new dredging;
9. Proposed dredging procedures, including types of equipment to be used, method of slurry of the material with detailed drawings or specifications of the grid or centrifugal pump system;
10. Quality of material to be removed;
11. Overall location of the area authorized to be dredged;
12. A vicinity map showing the proposed Upland disposal sites;
13. Proposed volume of material to be dredged and disposed;
14. Dredging design depth based on 1929 National Geodetic Vertical Datum (NGVD) and typical cross section including overdepth;
15. Date of last dredging operations and design depth.

The dredging operation plan shall also provide the following information:

1. The controls being established to ensure that dredging operations occur at the locations shown on the plans and as specified in these special provisions.
2. The controls being established to ensure that disposal of the dredged material at the disposal sites is at the assigned location and depth and the horizontal and vertical positioning systems that will be utilized.
3. Method of determining horizontal and vertical electronic positioning of dredge or dump scow during entire dredging operation at dredge site, disposal site and en route to and from disposal site.

4. Contractor's Dredging Quality Control Plan (DQCP) including:

    a. A description of the DQCP organization including, a chart showing lines of authority; and acknowledgment that the Contractor quality control staff shall conduct the inspections for all aspects of the work specified and shall report to the Contractor's Project Manager, or someone of higher authority, in the Contractor's organization.
    b. The name, qualifications, duties, responsibilities and authorities of each person assigned a quality control function.
    c. A copy of the letter to the DQCP manager; signed by an authorizing official of the firm, which describes the responsibilities and delegates the authorities of the DQCP manager; shall be furnished to the DQCP manager and shall be countersigned by the DQCP manager acknowledging receipt.
    d. Reporting procedures and methods used to obtain information for quality control forms, including the submittal of displacement and capacity charts for all scows.

After acceptance of the Dredging Operation Plan, the Contractor shall notify the Engineer in writing of any proposed changes. Proposed changes are subject to acceptance by the Engineer.

Solid Debris Management Plan: The Contractor shall submit a solid debris management plan 60 calendar days prior to commencement of work, a plan which describes measures to ensure that solid debris generated during any contract demolition or construction operation is retained and properly disposed of. At a minimum the plan shall include the following:

1. Source and expected type of debris;
2. Debris retrieval method;
3. Disposal method and site;
4. Schedule of disposal operations;
5. Debris containment method to be used, if floatable debris is involved.

All such debris shall become the property of the Contractor and shall be disposed of outside the State's right of way in accordance with Section 7-1.13 of the Standard Specifications. No such material shall be disposed of within Army Corps of Engineers and Bay Conservation and Development Commission jurisdictions. Material deemed to be of historical significance as determined by the Engineer shall become the property of the State and will be disposed of by the State.

Overflow: No overflow of dredged material or water will be allowed from the receiving barges, bins or dump scows during the dredging operations except as follows. Overflow will only be allowed if the Contractor includes provisions and operations acceptable to the Regional Water Quality Control Board, is included in the approved Storm Water Pollution Prevention Plan, and the material is designated for disposal at the disposal areas. Where overflow is allowed, overflow time shall be limited to 15 minutes per barge load per day and the discharge shall be below the water surface.

In the event the Contractor chooses to fill a receiving barge, bin or dump scow, the receiving vessel shall be located in an approved anchor site.

Overflow and Leakage Monitoring Requirements: Barges or dump scows having more than 10% loss in draft while transporting material to the disposal site shall be recorded on the daily report and shall not be used until repaired.

The Contractor shall provide equipment that will furnish a continuous printed record of readings and measurements of bulk density and mass flow rate for each pump. These records shall be provided to the Engineer as requested and approved in the Dredging Operation Plan. The Contractor shall provide a list of equipment that will provide the required records. In the event either velocity and/or displacement equipment breaks down during the dredging operation, the following actions shall be accomplished:

1. An alternative means of measurement shall be performed as approved.
2. Alternative measurements shall not exceed a duration of 72 hours after the equipment breakdown. Verification of repairs shall be provided to the Engineer in the form of receipts or other documentation.

For Clamshell Dredges, the Contractor shall monitor hull displacement of each scow loaded by the dredge. Monitoring shall be continuous from initial loading through discharge at the disposal site. The Contractor may use the general configuration in these special provisions for developing his system of monitoring displacement or submit his own method for approval. The method shall provide average hull displacement of each scow as specified. The data recorders shall store two minute averages of the one second input signals from the sensors. The Contractor shall provide and maintain throughout the duration of the contract, one data transfer unit with support software to the State within 30 Calendar days after award of the contract, which shall become State property upon completion of the contract. In the event the displacement monitoring equipment breaks down during the dredging operation for any of the scows, an alternative means of measurement shall be performed and results reported using a form. Alternative measurements shall not exceed a duration of 72 hours after equipment breakdown. If repairs to the primary equipment is not accomplished within this period, the scow shall not be used until repaired.

The Contractor shall submit the continuous recording records specified for clamshell dredge reports on computer diskettes. Data shall be submitted on 3-1/2" (1.44 MB) disks, operating under MS-DOS 3.1 or newer version. All data shall be recorded in ASCII text. Any alternatives submitted by the Contractor shall be subject to the approval of the Engineer.

Control and Monitoring Surveys: A short to medium range Electronic Positioning System (EPS) or Global Positioning System (GPS) shall be provided on all vessels involved in dredging operations. The EPS shall be established, operated and maintained by the Contractor during the period of the contract when dredging work is actively underway. The EPS using range-range methods shall display and record the vessel's location continuously during dredging and transport for disposal. A continuous graphic printout plotter and/or graphic monitor shall be provided on any dredge utilizing a range-range positioning system and a complete record copy of the position data (dredge track history) including date, time, coordinates and Root Mean Square (quality of position closure); and such record shall be submitted to the Engineer as part of the daily report. The Engineer shall have access to the monitoring equipment in order to observe its operation during the dredging work.

The EPS system shall be similar or equal in design, performance, accuracy, operating characteristics, and frequency to those identified in the following technical reference; which is available for purchase at the listed source, or which may be reviewed at the Army Corps of Engineers Construction-Operations Division, San Francisco District Office, 333 Market Street, San Francisco, California:

"Hydrographic Surveying" Department of the Army Engineering Manual No. 1110-2-1003, 28 February 1991 (or latest version). Available at:

USACE Publications Depot
2803 52nd Avenue
Hyattsville, MD 20781-1102

The Contractor shall be responsible for establishing the horizontal control to locate active and/or passive shore-based EPS transmitter/receiver devices. All control shall meet Third Order, Class 1, accuracy standards as defined in the publication "Standards and Specifications for Geodetic Control Networks" published by the Federal Geodetic Control Committee (and referenced) under chapter 2 of the Army Corps of Engineers Manual "Hydrographic Surveying". The Contractor shall obtain all right-of-entry permits and/or leases as required to operate and maintain shore-based electronic equipment on public/private property.

EPS calibration techniques shall conform to standard hydrographic surveying practice; consistent with minimization of systematic errors inherent to, and consistent with, the selected EPS system as specified under Chapter 6 of the Army Corps of Engineers manual "Hydrographic Surveying". The Contractor shall be responsible for accurate and reliable EPS calibration for the duration of this contract.

Transporting and Disposal: The Contractor shall transport and dispose of the dredged material in accordance with these special provisions and the conditions of the various permits the State has obtained for this contract.

During transport to the disposal sites, no material shall be permitted to overflow, spill, or leak out of the barges, bins or dump scows.

Tug boats are required to use an electronic positioning system (i.e., a miniranger system with at least two transponders or a Global Positioning System (GPS) with a minimum accuracy and precision of 8 meters for disposal operations. If the positioning system fails, all disposal operations shall cease until the navigational capabilities are restored.

The Contractor shall maintain daily records of dredging operations, transportation schedules, barge load volumes disposed, and exact location and time of disposal.

The tug captain shall maintain a copy of all weather reports and shall make wind and sea observations.

The Contractor shall observe all dredging operations and submit reports containing; a description of operations for each barge load, a checklist, a transit route map, a printout of coordinates from each way point and release point, a record of radio transmission, and facsimile from the tug captain on a daily basis.

The Contractor shall allow observers from the State and other appropriate independent observers as specified in permits and approved by the Engineer to be present on disposal vessels on trips to the disposal areas.

Development and implementation of a more sophisticated surveillance systems, which can be demonstrated to and approved by the Engineer to be effective and capable of being audited, may be substituted for one or more of the above provisions.

The Electronic Positioning System (EPS) and methods used for the dredge, as specified herein shall also be used to display and record the disposal vessel's location at one minute time intervals.

All of the above-mentioned documentation shall be submitted to the Engineer after each transportation and disposal events.

Upland Disposal: Landfill disposal shall be provided by the Contractor for the following dredged material:

1. Structure excavation (Type D) including existing rock and gravel backfill at the bell foundations.
2. Synthetic slurry used in the CIDH or CISS pile operations.
3. Material in contact with synthetic slurry used in the CIDH or CISS pile operations.
4. Waste concrete resulting from the CIDH and CISS pile operation.
5. Material resulting from the test boring operations.
6. Material resulting from the micropile operations.

The Contractor shall be responsible for locating upland disposal site(s) that meets appropriate requirements. Attention is directed to Sections "Water Pollution Control" and "Non-Storm Water Discharges" elsewhere in these special provisions regarding water pollution protection measures to be complied for any temporary upland receiving area prior to disposal to the approved upland landfill disposal site(s).

All dredged material shall be slurried in one of the following manners:

1. Pumped with a centrifugal pump prior to leaving the dredge site for the disposal site: or
2. The material shall pass through a debris grid, with a maximum opening size of 300 mm by 300 mm, which will cover the entire loading area of the dump scow. All material that does not pass through the grid will be considered solid debris and shall be disposed of as specified in "Upland Disposal" of this section. At a minimum all solid debris shall be removed from the grid and disposed of at the end of each 8 hour shift.

Each tug boat shall maintain a computer printout from GPS or other approved navigation system showing transit routes and disposal coordinates including the time and position of the disposal barge when the barge doors open and close.

If performance of the Contractors work is delayed as a result of scheduling disposal of dredged material at the disposal sites, and if in the opinion of the Engineer this delay impacts the controlling operation, an extension of contract time determined pursuant to the provisions of Section 8-1.07, "Liquidated Damages," of the Standard Specifications will be granted. No additional compensation will be allowed therefor.

Disposal Site Verification Log (DSVL): The Contractor shall submit a weekly log by 10:00 a.m. each Monday to the Engineer. The DSVL sheets attached to the Army Corps of Engineers Permit (Pages 1 & 2) shall be used to enumerate the work accomplished during the preceding week for submission to the Army Corps of Engineers, Regulatory Branch. The Vessel Traffic Control System will issue a confirmation number, which shall be included in the weekly log. If the DSVL is not submitted on Monday by 10:00 a.m., no work shall begin on the dredging operations for that week.

Hydrographic Surveys: The Contractor shall be responsible for providing an independent surveyor to perform the pre- and post-dredging and quality control surveys for performing the related computations and furnishing the required drawings.

The independent surveyor's equipment and work force shall be independent from the Contractors. The name of the surveyor and samples of previous hydrographic work shall be submitted to the Engineer for review and approval.

The surveyor shall first complete the hydrographic survey at a bell pier for review. Only upon approval by the Engineer shall the surveyor proceed with the remainder of the hydrographic survey. The Engineer shall be allowed to board all watercraft performing the hydrographic surveys.

The independent surveyor shall be required to document and certify in writing to the Engineer that he has at least three years of experience in hydrographic surveying of navigable channels and possess either a current land surveyor's or professional engineer's license valid in California and American Congress on Surveying and Mapping (ACSM) certification as an "Inshore Certified Hydrographic Surveyor." He shall provide documentation that modern electronic horizontal positioning and depth finding equipment are available for the surveys to be performed including DGPS (Differential Global Positioning System) capability and shall include as a minimum; the name, model, and year of manufacture of the electronic equipment; the electronic frequencies of the horizontal positioning equipment and the depth finding equipment; and the manufacturer's stated positioning accuracy and capability of the equipment proposed for usage. In addition, he shall document availability of a safe and suitable workboat for operation in the water where the surveys are to be performed, and that experienced staff are available for the operation of the workboat as well as the operation and calibration of the electronic positioning and depth finding equipment calibration. Survey procedures, data collection equipment, methods and densities, and equipment calibration for this work shall follow the criteria given in the hydrographic survey manual specified in Section "Dredging", elsewhere in these special provisions, for a Class I hydrographic survey. Survey line spacing shall not exceed the limits given in Table 3-1 of the hydrographic survey manual for a Class I hydrographic survey. Survey lines shall be referenced to the project horizontal and vertical datum. Cross sections shall be run at 10 meters center to center (c/c) and shall extend 10 meters past the slope-original ground intersect point.

The Contractor's hydrographic survey procedures (positioning modes, EPS calibration, accuracy requirements, depth measurement/calibration, and data reduction, adjustment, processing, and plotting) shall conform to industry standards identified in the hydrographic survey manual specified elsewhere in these special provisions. Horizontal location observations shall compensate for errors, geodetic corrections, and atmospheric variations. Data recordation, annotation, and processing procedures shall be in accordance with the hydrographic survey manual specified elsewhere. Failure to perform and process such surveys in accordance with the manual and these specifications will result in rejection and nonpayment for work performed. All vertical control shall be of second order accuracy, including levels for the setting of tide gage to NGVD elevation. An automatic electronic tide recording system shall be required during all surveying and dredging operations.

Survey data shall include tidal cycle(s) (whether ebb, flood or slack tide conditions) while performing surveys.

The Contractor shall conduct surveys using electronic system positioning method in accordance with the Hydrographic Survey Manual. The Contractor shall use an echo sounder to obtain soundings. The analog recording of soundings shall indicate a calibration check (bar check) of the echo sounding at the beginning and end of each analog paper change and at such times as necessary to ensure sounding accuracy. Echo sounder shall have a frequency of 200 kHz, with 3.5 degrees cone measured at 6 dB point. The top of the return signal trace shall be the point of interpretation of sounding. The bar check shall be taken at identical locations. Soundings shall be on NGVD datum. The excavation centerlines and slope toes shall be field marked on the fathogram chart during the data acquisition. The contract station, time of survey, tide height and direction that line is surveyed shall also be marked on the fathograms. Annotated survey data shall include tidal cycle(s), i.e., slack or slack tide conditions are occurring while performing surveys.

Field notes shall indicate the location of each sounding line, the date and the time (hour and minutes) each sounding line was taken and explanation for any line terminated early. The tide shall be recorded for each line surveyed and noted on the sections during the survey. Notes shall include tidal data, i.e., height of tide (Mean Lower Low Water Datum), bar checks, time of the tide readings and date and location of the tide gage used for each survey.

Bound field survey books shall be used to record all field data. Fully automated survey systems shall require a field log to supplement the data recorded on magnetic media.

The cross sections of hydrographic sounding line survey results shall be plotted at the scales specified in Table 3-1 of the hydrographic survey manual. Soundings shall be plotted on transparent sheets and show pay quantity excavation templates shown on the plans with survey cross-section. The Contractor's firm name shall be printed on each sheet along with contract name, number and date of survey. Plot scales shall be as approved by the Engineer.

The Contractor shall perform Pre-Dredging Surveys not earlier than 60 calendar days and not later than 30 calendar days before commencement of dredging. The Pre-Dredging Survey shall be completed with accuracy to within 30 mm which delineates the following areas to be dredged, with overdepth allowances, existing depths, estimated quantities to be dredged for the project, and estimated quantities for overdepth.

The Contractor shall perform hydrographic Quality Control Surveys thirty days after start of dredging and every thirty calendar days thereafter, and after any natural event that would create shoaling of previously dredged areas of the project (e.g., severe storms and earthquakes). These surveys shall verify that all foundation excavation dimensions are being obtained as specified. All surveys shall begin where dredging commenced and end as close as possible to last dredging position. The accuracy shall be consistent with the Pre-Dredging Survey above.

From the Quality Control Surveys, the Contractor shall compute quantities by the average end area method to the nearest cubic meter based on the sounding lines surveyed and the dredging section indicated on the plans. Tabular summaries shall be submitted to show standard depth, overdepth, and total dredging quantities both incrementally and cumulative per pier location.

The Contractor shall perform a Post-Dredging Survey within 15 calendar days of the last disposal activity at each pier prior to placing backfill (last being defined as that activity after which no further activity occurs for 15 calendar days), a survey with accuracy to one-tenth foot which delineates the following: areas dredged: dredged depths, actual quantities dredged for the project, and actual quantities of overdepth. The Post-Dredging Survey shall contain the dates of commencement and completion. The Contractor shall substantiate the total quantity dredged by including calculations used to determine the volume difference (in cubic meters) between the Pre- and Post Dredging Surveys and explain any variation in quantities greater than 15 percent beyond estimated quantities.

The quantities calculated from pre-dredging, quality control, and post-dredging surveys shall only be used for permit reporting purposes. Quantities from these surveys shall not be used for measurement of quantities for payment.

The Contractor shall submit all drawings, field notes and quantity computations within five calendar days after completion of any survey. The number of sets of drawings shall be as specified below. The Contractor shall mail or deliver drawings and computations to the Engineer for review and submission to the various agencies.

1. Three sets of transparent drawings for each survey.
2. Three sets of computer sheet printouts or calculation sheets for dredging quantities for each survey.
3. Three sets of cross sections for each survey.

The Contractor shall submit for each survey, the ASCII file of raw and corrected survey data. Data shall be on 3 1/2" (1.44 MB) disks, operating under MS-DOS 3.1 or newer version. The files shall have hydrosurvey information, in both raw and adjusted format. The raw data shall be original data from the hydrosurvey computer. The adjusted data shall be corrected to National Ocean Survey NGVD datum. The record of raw data shall be comma delimited and consist of the following information: index, "x" coordinate; "y" coordinate; "z" elevation; and time. Each adjusted record shall consist of the following information: index; "x" coordinate; "y" coordinate; "z" elevation; time; and tide. The index shall be the first entry, representing the sequence that each point was taken. The index shall be numerical, beginning with the number "one" and continuing until a 24 hour work effort is completed. Each day shall be in one file (one or more disks). This convention is applicable for both raw and adjusted data. Time shall be reported in Julian day and military hours and seconds. (For example, "17 March 1990, 9:00 a.m." would be "170390, 090000"). The recording distance between the hydrosurvey points shall be 3 meters or less. All data recorded shall be in ASCII test. Other Data collection formats will be considered if presented by the Contractor. Revisions in collection format will not be considered after the project has begun. All alternatives shall be approved by the Engineer.

The Contractor shall provide a complete listing of hydrographic equipment to be used on the project prior to the survey conference specified herein below.

At least five calendar days prior to performing any survey, the person responsible for that survey, the Contractor's chief surveyor and/or the independent surveyor, shall meet with the Engineer in a survey conference to outline the scope of survey and section interval. No survey work shall be performed until such conference has taken place.

The Department will retain an amount equal to 5 percent of the estimated value of the associated item of work performed during each estimate period in which the Contractor fails to complete the hydrographic surveys.

Payment

Structure excavation (bridge, underwater) shall be measured and paid in conformance with the provisions in "Earthwork" of these special provisions.

10-1.24 PILING

GENERAL

Piling shall conform to the provisions in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Foundation information is included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

Removal of underwater debris that is in conflict with construction work shown shall be as specified in "Existing Highway Facilities," of these special provisions.

Removal and relocation of materials from within the steel shells for construction of cast-in-steel shell concrete piling shall conform to the additional requirements of "Dredging" elsewhere in these special provisions.

Soil samples and rock cores are available for viewing. Contact the Toll Bridge Duty Senior at the office of the Toll Bridge Duty Senior at the District 4 Office, 111 Grand Avenue, Oakland, CA 94612, email: duty_senior_tollbridge_district04@dot.ca.gov, telephone (510) 286-5549.

Attention is directed to "Steel Pile Corrosion Monitoring and Protection Systems," of these special provisions regarding corrosion monitoring equipment to be placed in the piling.

Attention is directed to "Order of Work" and "Relations with United States Coast Guard" of these special provisions regarding redriving of existing test piles and certification procedures for welding.

Attention is directed to "Strong Motion (Seismic) Detection System," of these special provisions regarding hardware and sensors to be installed in piling.

The requirements in Section 49-1.03, "Determination of Length," of the Standard Specifications shall not apply.

Driven piling shall be installed and shall be of such length as required to obtain the specified pile tip elevation and to extend in to the pile cap, as shown on the plans.

All piles shall be clearly marked along their entire length in increments of 250 mm with more prominent markings every meter. Marking shall be made by white paint lines 50 mm wide. Markings shall be accurately placed on the pile with a tape measure that is at least 30 meters in length such that the intended measurement is true at the bottom of the marking. Markings shall be visible from all directions and shall indicate cumulative length from the pile toe.

Pile installation procedures shall consider the presence of soft soils that allow piles to penetrate significant distances under self-weight and the weight of the hammer, dense soils that result in hard driving, soils that gain strength during delays in driving, wind and wave excitation, pile batter, and tidal flow fluctuation.

DRIVING EQUIPMENT

Pile hammer energy input to the pile will be verified by the Engineer using dynamic monitoring.

Primary Hammer

The primary hammer shall be defined as a hydraulic impact hammer with a minimum manufacturer's rated energy of 1700 kJ. The Contractor shall maintain the primary hammer at the site and it shall be fully operational at all times during pile driving operations.

Secondary Hammer(s)

At the option of the Contractor (except for Piers E3 through E5), secondary impact hammers with a minimum manufacturer's rated energy of less than 1700 kJ may be used to install driven piling. Secondary impact hammers shall have a minimum manufacturer's rated energy of not less than 500 kJ for hydraulic hammers and not less than 750 kJ for air hammers. Said hammers shall have a penetration rate of not less than 3 mm per blow for continuous driving.

Secondary impact hammers shall have the capacity to operate with a minimum of 20 blows per minute at full stroke. Prototype impact hammers of a type still under development will not be permitted.

Diesel and steam impact hammers shall not be used to install driven piling.

Secondary hammers shall not be used to install driven piling at piers E3 to E5 below pile tip elevation –50 meters NGVD.

If piles do not meet the requirements of Pile Penetration Acceptance, as defined in this section, the Contractor shall replace the secondary hammer with the approved primary hammer and continue driving within 48 hours.

Jetting and drilling in conformance with Section 49-1.05, "Driving Equipment," of the Standard Specifications shall not be used.

At the option of the Contractor, vibratory hammers may be used to install piling to no deeper than pile tip elevation –35 meters NGVD.

PILE DRIVING TEMPLATE AND PILE HANDLING SUBMITTAL

The Contractor shall provide a pile driving template to maintain piling support and alignment during pile installation. Prior to installing driven piling, the Contractor shall submit to the Engineer for approval in accordance with the provisions in "Working Drawings," of these special provisions, working drawings for the pile driving template and pile handling procedures.

The Contractor shall allow the Engineer 50 working days after complete drawings and all supporting calculations are submitted for review of the pile driving template working drawings.

Pile handling shall conform to the recommendations in API RP2A "Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms."

Working drawings for the pile driving template and pile handling procedures shall include the following:

A. Details for installation and removal of the template.
B. Locations for use, if there is more than one template.
C. Details and equipment used for handling of pile including the use of temporary lifting or handling attachments and supporting brackets.

D. Details and methods for cutting the pile at the specified cut-off elevation and removing the pile head.
E. A list of all tasks required to install the piles and a written procedure for performing the work.
F. Details and equipment associated with the pile driving template including cranes and crane vessels, mooring systems and anchor patterns, transport barges, pile supports and fastenings.

Working drawings for the pile driving template and pile handling procedures shall be supplemented by calculations, and the calculations shall include the following:

A. Details and calculations demonstrating how the pile installation system will provide and maintain the specified axial and radial alignment of the pile, including pile batter, to within an angle of 1 in 100.
B. Details and calculations demonstrating adequate support and stability for the pile with the full operating weight and dynamic loading of the proposed hammer at the top of the pile.
C. Provisions to provide stability and maintain alignment during placement of the piles and in wind, wave and current conditions.
D. Provisions to prevent the pile from running under its own weight and the weight of the hammer, including, at a minimum, provisions to prevent the pile from penetrating below the top of the pile driving template or below water level.
E. Provisions for providing adequate work space for pile welding, cutting and inspection.
F. Provisions for ensuring the specified pile straightness, alignment, and support to prevent relative movement during field welding and to ensure that welding tolerances are met.
G. Method and equipment for monitoring pile alignment.
H. Calculation of pile stresses and deflections resulting from handling operations.

The pile driving template shall be removed after the installation of the piling. The pile driving template support piling shall be removed to at least 300 mm below original mudline. Procedures for installation and removal of the template and piles shall be included in the working drawing submittal.

DRIVING PILES

Pile heads to receive the hammer shall be square and smooth. The pile head face shall be perpendicular to the longitudinal axis of the pile. The maximum allowable deviation of any point on the pile head surface from a true perpendicular plane shall be 6 mm. Local deviations from a plane of best fit that are greater than 3 mm shall be ground smooth.

After driving, pile horizontal location, as measured at the centerline of the pile section, shall be within a radial distance of 150 mm, as measured at the cut-off elevation, from the location shown on the plans. Pile batter shall not deviate at a rate of more than 1 in 100 from the theoretical batter and the lateral alignment shown on the plans.

The Contractor shall survey each pile and record the top of pile location both vertically and horizontally and shall determine the pile's variance from the true line and design batter slope. Such variance shall be measured in two planes normal to each other. The top of pile location shall be surveyed immediately after each pile section is driven complete in place and also before a spliced pile section is driven. A second survey shall be carried out after all piles have been cut to their final elevations.

Pile surveying shall conform to "Construction Surveying," of these special provisions. All pile surveying data shall be submitted in writing to the Engineer at the completion of pile driving operations for a given work day.

A given pile that is driven to specified penetration and that fails to meet the alignment tolerances specified in this section will be rejected and replaced prior to driving further piles. Alternative corrective measures, if any, are subject to the prior approval of the Engineer and the cost of alternative measures shall be considered the sole responsibility of the Contractor.

Within 10 working days after the pile has been rejected, and prior to driving other piling, the Contractor shall revise his pile driving template. The Contractor shall submit to the Engineer for approval a plan for revised pile installation methods and this plan shall conform to the provisions in "Working Drawings," of these special provisions.

Revised pile template plans and pile handling shall also include the following:

A. A step by step description of the work to be performed, including revising pile driving template drawings and handling procedures as necessary.
B. A list of affected details and plan sheets.

The Engineer will notify the Contractor in writing when a complete plan has been received. The Contractor shall allow the Engineer 15 working days to review the revised pile installation plan after a complete submittal has been received.

REDRIVING EXISTING TEST PILES

At the locations shown on the plans, the Contractor shall redrive the three steel shell test piles previously installed on Contract No. 04-012084 as specified in "Order of Work," of these special provisions.

Redriving shall consist of using the primary hammer operating at its rated energy to advance the pile 250 mm or 670 blows, whichever occurs first.

Prior to redriving the existing test piles, the Contractor shall remove the navigation lighting assemblies and cover plates in accordance with "Existing Highway Facilities" of these special provisions. After redriving the piles, navigation lighting assemblies and cover plates shall be reattached to the piles and made fully operational.

PILE DRIVING REFUSAL

The requirements in Section 49-1.08, "Bearing Value and Penetration," of the Standard Specifications shall not apply.

Pile driving refusal shall be defined as the time when pile driving resistance, using the primary hammer operating at full rated energy according to the manufacturer's specifications meets one of the following conditions:

A. An average of 250 blows per 250 mm over a penetration of 1500 mm; or
B. 670 blows for 250 mm of penetration

If pile driving is interrupted for more than one hour, the above definition of refusal shall not apply until the pile has been driven 250 mm. During restart, or at any time, 670 blows in 125 mm shall be taken as pile driving refusal.

PILE DRIVING LOW RESISTANCE

If extremely low resistance to driving is experienced when driving within one meter of the specified pile tip elevation, the Engineer may modify the pile details shown on the plans.

When the Engineer directs the Contractor to modify the pile details shown on the plans, said work will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

PILE PENETRATION ACCEPTANCE

The requirements in Section 49-1.08 "Bearing Value and Penetration," of the Standard Specifications shall not apply.

Pile penetration acceptance shall be based on the following criteria:

A. Piles driven to the specified pile tip.
B. Piles that encounter refusal from continuous driving within 10 meters of the specified pile tip elevation for Piers E3, E4, and E5, and within 5 meters of the specified pile tip elevation for the remaining piers, will be accepted.

    1. Unless otherwise directed by the Engineer, piles shall be driven continuously throughout the final 10 meters above the specified pile tip elevation for Piers E3, E4, and E5, and throughout the final 5 meters above the specified pile tip elevation for the remaining piers. If driving refusal is encountered as a result of delays in pile driving occuring within these zones, the Contractor shall be responsible for soil plug removal down to an elevation not less than 7 meters above the specified pile tip elevation, splicing the pile (including all weld NDT) and any other measures necessary to advance the pile to the specified pile tip elevation shown on the plans.

C. For piles that encounter driving refusal at an elevation more than 10 meters above the specified pile tip elevation for Piers E3, E4, and E5, and at an elevation more than 5 meters of the specified pile tip elevation for the remaining piers, the Contractor shall remove the soil plug and continue driving the piles to the specified pile tip elevation. The Contractor's equipment and procedures shall be adequate to complete soil plug removal and resume driving within 48 hours. Soil plug removal shall not extend below an elevation that is 7 meters above the pile toe at the time of refusal.
D. Within 10 meters above the specified pile tip elevation for Piers E3, E4, and E5, and within 5 meters above the specified pile tip elevation for the remaining piers, if piles develop toe stresses in excess of 85 percent of the specified yield strength of the steel shell for Piers E3 through E5, or pile stresses in excess of 90 percent of the specified yield strength of the steel shell, as determined by the Engineer, pile driving shall be terminated and the pile will be accepted.
E. For piles that develop excessive driving stresses, as noted above, at an elevation more than 10 meters above the specified pile tip elevation for Piers E3, E4, and E5, and at an elevation more than 5 meters above the specified pile tip elevation for the remaining piers, the Contractor shall reduce the pile hammer stroke and continue driving the pile to the specified pile tip elevation. When pile driving stresses are excessive and hammer stroke cannot be reduced without encountering refusal, the Contractor shall remove the soil plug and continue driving the piles to the

specified pile tip elevation. Soil plug removal shall not extend below an elevation that is 7 meters above the pile toe at the time of refusal.

F. The Contractor shall provide a pile driving log at the completion of driving each pile or pile section. Upon completion of pile driving for a given pile, the Contractor shall allow the Engineer 48 hours to review the pile driving records. The Contractor shall not cut the top of the pile until the Engineer's review period is complete.

DRIVING SYSTEM SUBMITTAL

Prior to installing driven piling at any given pier, the Contractor shall provide a driving system submittal for driving at that pier, including driveability analysis, in conformance with the provisions in "Working Drawings," of these special provisions. A submittal shall be made for each eastbound and westbound pier. Technical data for all proposed driving systems (i.e., each hammer that may be brought onto the site) shall be included in the submittal.

The driving system submittal shall contain an analysis showing that the proposed driving systems will install piling to the specified pile tip elevation without soil plug removal and without overstressing the pile. Submittals shall include the following:

A. Complete description of soil parameters used, including soil quake and damping coefficients, skin friction distribution, percentage shaft resistance, and total soil resistance to driving.
B. List of all hammer operation parameters assumed in the analysis, including manufacturer's rated energy, fuel settings, stroke limitations, and hammer efficiency.
C. Driveability studies that are based on a wave equation analysis using a computer program that has been approved by the Engineer. Driveability studies shall model the Contractor's proposed driving systems, including the hammers, capblocks, pile cushions, and followers. The analyses shall consider a range of total soil resistance to driving and associated percentage shaft resistance for plugged and unplugged cases. The range of soil resistance to driving and percentage shaft resistance shall be determined for site conditions ranging from 10 meters above to 5 meters below the specified tip elevation shown on the plans. Separate analyses shall be completed at elevations above the specified pile tip elevations where difficult driving or pile splices are anticipated.
   Driveability analysis results shall include plots of the following:

   1. Maximum pile head and pile toe compressive stress versus blows per 250 mm.
   2.. Soils resistance to driving versus blows per 250 mm.

D. Details of equipment and procedures for removing the soil plug after successful pile driving and as a contingency in the case of driving refusal above an acceptable tip elevation.
E. Copies of all test results from any previous pile load tests, dynamic monitoring, and all driving records used in the analyses.
F. Completed "Pile and Driving Data Form," which is shown in these special provisions.
G. Estimated range of expected pile penetration due to self-weight and the weight of the hammer.
H. Written procedures for the pile driving and a pile installation schedule, including at a minimum the first and last pile at each footing.

The driving system submittal shall include the attached "Pile and Driving Data Form" completed for each hammer and driving system. The Contractor shall allow the Engineer 25 working days to review a driving system submittal.

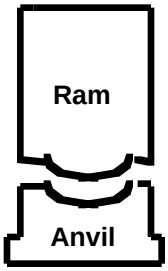
The Contractor shall use the driving system and installation methods described in the approved driving system submittal for each pier location. Any change in hammers from those submitted and approved by the Engineer shall also meet the requirements for driving system submittals. Revised and new driving system submittals shall be approved by the Engineer prior to using corresponding driving systems on production piling. The Contractor shall allow the Engineer 25 working days to review each revised and each new driving system submittal after a complete set has been received, as determined by the Engineer.

Approval of pile driving equipment shall not relieve the Contractor of his responsibility to drive piling free of damage to the specified penetration.

CALIFORNIA DEPARTMENT OF TRANSPORTATION
OFFICE OF TRANSPORTATION LABORATORY

PILE AND DRIVING DATA FORM

Structure Name :_____ Contract No.:_____
_____ Project:_____
Structure No.:_____ Pile Driving Contractor or Subcontractor____
Dist./Co./Rte./P.M.:_____ _____
(Pile Driven By)



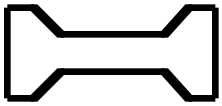
Hammer

Manufacturer:_____ Model:_____
Type:_____Serial No.:_____
Rated Energy:_____ at _____ Length of Stroke

Modifications: _____
_____
_____
_____
_____

Capblock (Hammer Cushion)

Material:_____
Thickness:_____mm Area:_____mm^2
Modulus of Elasticity - E:_____MPa
Coefficient of Restitution - e:



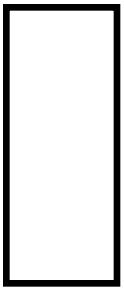
Pile Cap

Helmet
Bonnet
Anvil Block
Drivehead

Mass:_____kg

Pile Cushion

Material:_____
Thickness:_____mm Area: _____mm^2
Modulus of Elasticity - E:_____MPa
Coefficient of Restitution - e:_____



Pile

Pile Type:_____
Length (In Leads):_____m
kg/m.:_____Taper:_____
Wall Thickness:_____mm
Cross Sectional Area:_____ mm^2
Design Pile Capacity:_____kN
Description of Splice:_____
_____
Tip Treatment Description:_____

DISTRIBUTE one copy

- ☐ Translab, OSF Foundation Testing & Instrumentation
- ☐ Translab, OSF Structures Foundations
- ☐ Resident Engineer

Note: If mandrel is used to drive the pile, attach separate manufacturer's detail sheet(s) including mass (kg) and dimensions.

Submitted By:_____ Date:_____

Phone No.:_____

DYNAMIC MONITORING

Unless otherwise directed by the Engineer, the last 18 meters for each production pile, and each existing test pile will be monitored during driving (or redriving) for dynamic response to the driving equipment. Monitoring will be done by State forces using State-furnished dynamic pile analyzer monitoring instruments.

Monitoring attachments shall be fastened to the piles using the tapped holes shown on the plans. Each pile at piers E6 to E16 will be fitted with one set of attachments located on opposite sides of the pile. Each pile at piers E3 to E5 will be fitted with two such sets of attachments.

If the Contractor's driving system is such that monitoring instruments will be underwater, the Contractor shall notify the Engineer, in writing, at least 50 working days prior to commencement of driving operations.

The Contractor shall provide electric power (120-volt, 60 cycles stable power) for the State's monitoring equipment, access to the piles including a working platform, and shelter for State monitoring personnel and equipment.

Piles to be dynamically monitored shall be made available to State forces at least 8 hours prior to lifting. The pile shall be positioned so that State forces have safe access to the top 18 meters of the pile length for the installation of anchorages and control marks for monitoring. The Contractor shall rotate the piles on the blocks as directed by the Engineer.

Piles to be dynamically monitored shall be prepared and driven in accordance with the following:

A. The Engineer will determine if the Contractor's handling operations during lifting of the pile segment to be monitored are such that pile monitoring instrumentation can be bolted to the pile prior to lifting without damage to the instruments. If the Engineer determines that instruments cannot be mounted prior to lifting of the pile, operations shall be suspended for approximately 30 minutes before hammer placement. During this time the Contractor shall attach monitoring equipment onto the pile.
B. Prior to resuming driving operations, the Contractor shall connect electrical cables to the instrument package as approved by the Engineer.
C. Driving operations shall resume as directed by the Engineer. The Contractor's driving equipment shall provide sufficient clearances for monitoring instruments such that piles can be driven to the specified pile tip elevation without damage to the monitoring instruments.

Within 4 hours of completion of driving operations, the Contractor shall remove the cables and instrument package from the pile and deliver them to the Engineer. If monitoring instruments are underwater at the end of driving, the Contractor shall provide a diver and shall retrieve the cables and instruments.

The Contractor shall be responsible for damage to the State's cables and instruments caused by the Contractor's operations, and shall replace damaged cables or instruments in kind.

OPEN ENDED CAST-IN-STEEL-SHELL CONCRETE PILING

General

Cast-in-steel-shell concrete piling shall consist of open ended steel shells driven to the specified penetration and filled with reinforced cast-in-place concrete and shall conform to the provisions in Section 49-4, "Cast-in-Place Concrete Piles," of the Standard Specifications and these special provisions.

Attention is directed to "Steel Pipe Piling" of these special provisions.

In addition to driving, drilling or jetting within open ended steel shells to remove the soil plug may be necessary to obtain the specified penetration. The diameter of drilled holes shall be less than the clear inside diameter of the piling, including the shear rings. Jetting methods and procedures shall demonstrate that soil plug removal can be done at a predicted rate and in a controlled manner. Equipment or methods used for drilling or jetting shall not cause quick soil conditions, scouring, or caving of the hole and shall not damage the internal shear rings. If soil plug removal operations extend below the limit of the seal course concrete, as shown on the plans, the Contractor shall fill the void created by drilling or jetting with additional seal course concrete. Drilling or jetting shall not disturb the soil plug within 7 meters of the pile toe at any time during pile installation.

Concrete

At the Contractor's option, the Contractor may use either the 12.5-mm maximum combined aggregate grading or the 9.5-mm maximum combined aggregate grading. The grading requirements for the 12.5-mm maximum coarse aggregate and the 9.5-mm maximum coarse aggregate are shown in the following table:

Sieve Sizes	Percentage Passing Primary Aggregate Nominal Size			
	12.5 mm x 4.75 mm		9.5 mm x 2.36 mm	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
19 mm	100	100		
12.5 mm	82 - 100	80 - 100	100	
9.5 mm	X ± 15	X ± 22	X ± 15	X ± 20
4.75 mm	0 - 15	0 - 18	0 - 25	0 - 28
2.36 mm	0 - 6	0 - 7	0 - 6	0 - 7

In the table above, the symbol X is the gradation which the Contractor proposes to furnish for the 9.5-mm sieve size.

The gradation proposed by the Contractor for the 12.5-mm x 4.75-mm primary aggregate or for the 9.5-mm x 2.36-mm primary aggregate shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	Sieve Sizes	Limits of Proposed Gradation
12.5 mm x 4.75 mm	9.5 mm	40 - 78
9.5 mm x 2.36 mm	9.5 mm	50 - 85

The combined aggregate grading for the 12.5-mm x 4.75-mm primary aggregate nominal size or for the 9.5-mm x 2.36-mm primary aggregate nominal size shall be within the following limits:

Grading Limits of Combined Aggregate		
Sieve Sizes	Percentage Passing	
	12.5-mm Max.	9.5-mm Max.
19 mm	100	100
12.5 mm	90 - 100	90 - 100
9.5 mm	55 - 86	55 - 86
4.75 mm	45 - 63	45 - 63
2.36 mm	35 - 49	35 - 49
1.18 mm	25 - 37	25 - 37
600 µm	15 - 25	15 - 25
300 µm	5 - 15	5 - 15
150 µm	1 - 8	1 - 8
75 µm	0 - 4	0 - 4

The steel shells shall be installed open ended and shall have internal shear rings, as shown on the plans.

Steel Shells

The Contractor's attention is directed to "Steel Pipe Piling," of these special provisions.

Studs shall conform to "Steel Structures" of these special provisions.

Reinforcement

Reinforcement shall conform to the provisions in "Reinforcement," of these special provisions. Welded headed bar reinforcement shall conform to the provisions in "Welded Headed Bar Reinforcement," of these special provisions.

Construction

The Contractor shall submit to the Engineer for approval, a cleanout and inspection plan for open ended cast-in-steel-shell concrete piling. Care shall be taken during cleaning out of open ended steel shells to prevent disturbing the foundation material surrounding the pile and damaging the interior shear rings. The pile soil plug, as shown on the plans, shall not be cleaned out. Equipment or methods used for cleaning out steel shells shall not cause quick soil conditions or cause scouring or caving around or below the piles. The shell at the bottom of the concrete fill elevation shall be sealed in conformance with the provisions in Section 51-1.10, "Concrete Deposited Under Water," of the Standard Specifications. The sealed shell shall then be dewatered and cleaned out as specified herein. The Contractor shall maintain a hydrostatic head that is equal to the sea level on the soil plug until the seal course has been placed and allowed to cure for a period of time to be agreed by the Engineer.

Open ended steel shells shall be free of any soil, rock or other material deleterious to the bond between concrete and steel prior to placing reinforcement and concrete. Interior surfaces of open ended steel shells and shear rings shall be 100% clean.

Verification of pile cleanout shall be demonstrated by a video camera capable of inspecting any location within the steel shell. At the option of the Engineer, verification of pile cleanout shall be by either real-time viewing of the inspection by the Engineer or by the Engineer viewing a recorded inspection of mutually agreed sections of the pile. Recordings shall indicate the azimuth and depth of the camera.

Drilling fluid, except for water, shall not be used inside the pile during the cleanout process.

The Contractor shall allow the Engineer 15 working days for review of the cleanout and inspection plan.

Reinforcement shall be placed and secured symmetrically about the axis of the pile and shall be securely blocked to clear the sides of the steel shell and the shear rings, and blocked or suspended to clear the top of the seal course.

Concrete fill for cast-in-place concrete piles shall be placed continuously. No construction joints will be permitted.

Concrete fill for cast-in-place piles shall be placed by use of a tremie tube or tubes, each of which are at least 250 mm in diameter. A hopper shall be attached to the tremie tube(s). Concrete pumps may be used to deliver concrete to a hopper that feeds to the tremie tube(s). Pumping concrete directly down the tremie pipe will not be permitted. Internal bracing for the steel reinforcing cage shall accommodate the delivery tube system.

Delivery tubes shall be capped with a watertight cap, or plugged with a good quality, tight fitting, moving plug. The cap or plug shall be designed to release as the tube is charged with concrete. The tremie tube shall extend to the bottom of the hole before charging the tube with concrete.

STEEL PIPE PILING

General

Steel pipe piling shall consist of steel shells for open ended cast-in-steel-shell concrete piling. Steel pipe piling shall conform to the provisions in Section 49-5, "Steel Piles," of the Standard Specifications and these special provisions.

Attention is directed to "Welding" of these special provisions regarding welding of steel pipe. Unless otherwise specified, welding of any work performed in conformance with the provisions in Section 49, "Piling," of the Standard Specifications, shall be in conformance with the requirements in AWS D1.1.

Wherever reference is made to the following American Petroleum Institute (API) specifications in the Standard Specifications, on the project plans, or in these special provisions, the year of adoption for these specifications shall be as follows:

API Codes	Year of Adoption
API SPEC 2B	1996

All requirements of the codes listed above shall apply unless specified otherwise in the Standard Specifications, on the plans or in these special provisions.

Handling devices may be attached to steel pipe piling. Welds attaching these devices shall be aligned parallel to the horizontal axis of the pile and shall conform to the requirements of field welding specified herein. All handling devices shall be removed from the permanent piling when no longer needed. All remaining welds shall be ground flush. Prior to making attachments, the Contractor shall submit a plan to the Engineer that includes the locations, handling and fitting device details, connection details, welding and removal procedures. Attachments shall not be made to the steel pipe piling until the plan is approved in writing by the Engineer. The Engineer shall have 5 working days to review the plan. Should the Engineer fail to complete the review within this time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the plan, the delay will be considered a right of way delay as specified in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

For steel pipe piling, including any bar reinforcement in the piling, the time to be allowed for the Engineer to review the "Welding Report," specified in "Welding" of these special provisions, and respond in writing after all the required items have been received, shall be as follows:

Type of Welding	Review Time
Offshore field welding	24 hours
Bar reinforcement in piling	48 hours
All other pile welding	5 working days

Offshore field welding is defined as steel pipe pile splice welds made after stabbing the pile. No field welded steel pipe piling shall be installed, and no reinforcement in the piling shall be encased in concrete until the Engineer has approved the

above requirements in writing. Should the Engineer fail to complete the review and provide notification within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in notification, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

At the Contractor's option, a steel pipe pile may be re-tapped to prevent pile set-up; however, the field welded splice shall remain at least one meter above the work platform until that splice is approved in writing by the Engineer.

The Contractor shall provide durable enclosures at field splice locations to allow welding during inclement weather conditions in accordance with the requirements in "Welding," of these special provisions.

Fabricated Steel Pipe

Fabricated steel pipe is defined as pipe produced at a permanent facility where a variety of steel fabrication including roll forming and welding steel plate into pipe is performed, where this pipe is at least 19 mm in wall thickness, where this pipe is produced in conformance with API SPEC 2B, and where this fabrication can be done on a daily basis. Fabricated steel pipe is a specifically engineered product. (i.e., Fabricated steel pipe is engineered for a specific project.)

Fabricated steel pipe used for steel pipe piling shall conform to API 2B and the following requirements:

A. An API site license and API monogram are not required.
B. Weld filler metal shall conform to the requirements in AWS D1.5 for the welding of ASTM Designation: A 709, Grade 50 steel, except that the qualification, pretest, and verification test requirements need not be conducted if certified test reports are provided for the consumables to be used.
C. Steel pipe piles and shear rings shall be fabricated from plate conforming to the requirements in ASTM A709, Grade 50. Steel pipe piles shall be fabricated in accordance with API Specification 2B.
D. The sulfur content of steel pipe piles shall not exceed 0.05 percent, except where through-thickness is designated on the plans. Where through-thickness is designated on the plans, steel shall conform to the low sulfur and 20% reduction of area requirements in AWS D1.5, Section 12.4.4.1.
E. The acceptance criteria for visual inspection of pile welds shall be AWS D1.1 criteria for statically loaded structures, except within the "Plastic Hinge Zone" designated on the plans, where the criteria for cyclically loaded structures subject to tensile stress shall apply.
F. The thickness transition between the pile sections with different wall thickness shall be no steeper than 1:3.

Field Welding

Field welding of steel pipe piling is defined as welding performed after the certificate of compliance has been furnished by the fabricator and shall conform to the following requirements:

A. Prior to positioning any 2 sections of steel pipe to be spliced by field welding, the Contractor shall minimize the offsets of the pipe ends to be joined .
B. Welds made in the flat position or vertical position (where the longitudinal pipe axis is horizontal) shall be single-vee or double-vee groove welds. Welds made in the horizontal position (where the longitudinal pipe axis is vertical, or near vertical) shall be single-bevel welds. Joint fit-ups shall conform to the requirements in AWS D1.1 and these special provisions.
C. The minimum thickness of the backing ring shall be 6 mm, and the ring shall be continuous. Splices in the backing ring shall be made by complete penetration welds. Radiographic or ultrasonic testing in conformance with the requirements in AWS D1.1, Section 6, shall be used on one out of each 10 splice welds to assure soundness of backing ring splices prior to final insertion into a pipe end. Attachment of backing rings to pipe ends shall be done using a continuous fillet weld on the inside of the pile. After fitting to the second pipe, tack welding shall be done in the root area of the weld splice or to spacers. Minimum size and length of tack welds shall be as defined by AWS D1.1, Section 2.4.6. The gap between the backing ring and the steel pipe piling wall shall be no greater than 2 mm, except as follows:

    1. Gaps greater than 2 mm, but not exceeding 6 mm may be seal welded using E7018 SMAW.
    2. Gaps exceeding 6 mm shall be repaired by welding using E7018 SMAW, the weld groove shall be ground to provide the intended groove shape, and the area shall be inspected using magnetic particle testing prior to starting the groove weld.

    Locations where fit-up gaps exceed 2 mm shall be marked so that they can be referenced during NDT. Backing rings shall have a minimum width of 3 times the thickness of the steel pipe piling to be welded so that the ring will not interfere with the interpretation of the NDT.

D. For steel pipe with an outside diameter greater than 1.1 m, and with a wall thickness greater than 25.4 mm, the weld groove root opening tolerance may be increased to a maximum of 5 mm over the specified tolerance.

E. Weld filler metal shall conform to the requirements in AWS D1.5, Table 4.1 or 4.2, for the welding of ASTM Designation: A 709, Grade 50 steel, and shall be designated H4 or H8 by the manufacturer.

F. Prequalified welding procedures will not be permitted for pile splices. All field welding procedures shall be qualified by testing in conformance with the requirements in AWS D1.1 and these special provisions. Using the qualified WPS, a minimum of two additional weld mock-ups shall be required to qualify offshore field welding, and both shall use the State-Furnished pipe pile sections to simulate the field girth weld. All mock-up welding shall be performed outside in the enclosure that will be used during offshore installation. Both welds shall be made in the near horizontal position with the joint tending towards the overhead position to the maximum angle anticipated by pile batter. Each weld need not exceed 1 m in length, and all passes shall be stopped and restarted at the same location in the middle of the weld. The first weld shall be prepared and welded using the proposed production weld joint detail and welding parameters. The second weld shall simulate the most onerous combination of weld root opening, root face and backing ring gap anticipated for field fit-up, as agreed with the Engineer. The out-of-tolerance fit-up shall be repaired and accepted per these specifications before completing the weld. The completed welds shall be examined by the ultrasonic testing (UT) procedure proposed for production joints, and any significant indications shall be marked for sectioning to confirm the UT results prior to mechanical testing the weldment. Qualification tests shall include all tests required by AWS D1.1, macroetch sections of the center stop-start location and all areas marked during UT, and Charpy V-Notch tests at -18°C of the weld metal and heat affected zone. The tests shall meet 27 Joules minimum average and 20 Joules minimum individual.

G. The welding filler materials (wire/electrode and flux, if used) shall be considered an essential variable for welding procedure qualification. Any change in the filler material brand name or type shall require requalification of the welding procedure.

H. GMAW shall not be used for field welding.

I. For field welding, including attaching backing rings and making repairs, the preheat and interpass temperature shall be in conformance with AWS D1.1, Table 3.2, Category C; and the minimum preheat and interpass temperature shall be 66°C, regardless of the pipe wall thickness or steel grade. In the event welding is interrupted, preheating to 66°C must occur before welding is resumed. For welds with required preheat temperatures greater than 66°C, preheat temperatures shall be achieved and maintained using electric resistance heating bands for the entire length of the weld. The heaters shall be controlled by attached thermocouples at spacings not exceeding 2 m. For these welds, the minimum preheat temperature shall be maintained continuously from beginning to completion of the entire weld, even if welding is interrupted.

J. Welds shall not be water quenched. Welds shall be allowed to cool unassisted.

K. Stray current corrosion of the structure shall be avoided during installation at the site. Welding machines shall be placed on the structure being welded. Where this is not practical, the insulated welded power source output "ground" lead shall be connected directly to the work at a location close to the weld being made and shall not be permitted to touch the water. The minimum total cross sectional area of the return ground cable(s) shall be 645 circular mm per 1000 amperes per 30.5 m of cable. Grounding sufficiency shall be periodically monitored by simultaneously measuring the potential of the structure being welded and that holding the welding machines using a standard calomel electrode (SCE), Ag-AgCl or other reference electrode approved by the Engineer. A change in potential reading of 10% or more shall indicate insufficient grounding.

NONDESTRUCTIVE TESTING FOR STEEL PIPE PILING

Steel pipe piling shall receive nondestructive testing (NDT) in conformance with these special provisions.

Nondestructive Testing of Welds made at a Fabrication Facility

Twenty-five percent of each longitudinal and 100 percent of each circumferential weld made shall receive NDT by either radiographic, radioscopic, real time imaging systems or ultrasonic methods that are in conformance with the requirements in AWS D1.1. The acceptance and repair criteria shall conform to the requirements in AWS D1.1, Section 6, for statically loaded structures under tensile stress, except within the "Plastic Hinge Zone" designated on the plans, where the criteria for cyclically loaded nontubular connections subject to tensile stress shall apply. If repairs are required in a portion of a weld not 100 percent examined by NDT, additional NDT of the same type shall be performed. The additional NDT shall be made on both sides of the repair for a length equal to 10% of the length of the pipe outside circumference. After the additional NDT is performed, and if more repairs are required, then the entire splice weld shall receive NDT.

Nondestructive Testing of Field Welds

Prior to performing ultrasonic NDT on field welds, the Contractor's welding inspection personnel shall have passed Caltrans' Ultrasonic Test. Field welding is defined as welding performed after the Certificate of Compliance has been furnished to the Engineer by the fabricator or manufacture for said materials. Information regarding the Caltrans Ultrasonic (titled "Notification of California Department of Transportation Qualification Requirement for Ultrasonic Testing Personnel) is included in the "Information Handout," available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract and Site of Work," of the Standard Specifications. This test includes both written and practical examinations.

Splices made by field welding steel pipe piling shall receive NDT as follows:

UT shall be used for each field weld, including splices that are made onto a portion of the steel pipe piling that has been installed and any repair made to a splice weld. UT shall be performed over the full length of weld. In addition, Magnetic Particle testing (MT) shall be used for 100% of the root pass of all field welds unless otherwise directed by the Engineer. The acceptance criteria shall conform to the requirements in AWS D1.1, Section 6, for statically loaded nontubular connections subject to tensile stress. UT shall be performed in accordance with a written procedure that shall be reviewed by the Engineer before use. The UT procedure shall address the unambiguous interpretation of indications from the weld root and backing and shall describe the treatment of root fit-up repairs. The procedure shall define all measurements and/or marking that may be required prior to the start of welding. This procedure shall be demonstrated during weld mock-up qualification to verify its effectiveness in differentiating root and repair conditions.

MEASUREMENT AND PAYMENT (PILING)

The first paragraph of Section 49-6.01, "Measurement," of the Standard Specifications shall not apply.

The length of furnish pile to be paid for shall be the total length of the pile, as shown on the plans, measured along the centerline, from the specified pile tip of the pile to the plane of the pile cut-off. If the Contractor elects to furnish piling longer than the piling shown on the plans, no adjustment will be made to the length of piling to be paid and payment will be based on the length of pile shown on the plans.

Payment for cast-in-place concrete piling shall conform to the provisions in Section 49-6.02, "Payment," of the Standard Specifications except that, when the diameter of cast-in-place concrete piling is shown on the plans as 600 mm or larger, reinforcement in the piling will be paid for by the kilogram as bar reinforcing steel (bridge).

The sixth paragraph of Section 49-6.02, "Payment," of the Standard Specifications shall not apply.

If steel shells are fabricated more than 480 airline kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impractical and extremely difficult to ascertain and determine the actual increase in such expenses, it is agreed that payment to the Contractor for furnishing steel shells will be reduced $17 per meter of length of steel shell.

The contract unit price paid for redrive existing 2.438 meter steel pipe pile shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in redriving the existing steel shell test piles, including removing and reattaching navigation lighting and cover plates, and cutting off and disposing of the piles after redriving, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for cleaning out the open ended steel shells prior to installing reinforcement and filling with concrete, for disposing of materials removed from the inside of the pile, and for placing seal course concrete and dewatering the open ended steel shells, as shown on the plans, as specified in these special provisions, and as directed by the Engineer, shall be considered as included in the contract unit price paid for drive pile, and no additional compensation will be allowed therefor.

Full compensation for soil plug removal to obtain the specified penetration, for disposing of this material, and for filling the void created by soil plug removal with seal course concrete shall be considered as included in the contract unit price paid for drive pile of the types shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for conforming to the provisions in "Steel Pipe Piling" and "Nondestructive Testing" of these special provisions shall be considered as included in the contract prices paid for the various items of work involved, and no additional compensation will be allowed therefor.

Full compensation for providing access and working platforms for the Engineer, additional pile length necessary for monitoring, dewatering during monitoring, and for installing and removing the instruments from the pile shall be considered as included in the contract unit price paid for drive pile of the types shown in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for providing access and working platforms for the Engineer, dewatering during monitoring, and for installing and removing the instruments from the pile shall be considered as included in the contract unit price paid for redrive existing 2.438 meter steel pipe pile and no separate payment will be made therefor.

Full compensation for driving system submittals shall be considered as included in the contract unit price paid for drive pile of the types shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for furnishing and installing welded studs shall be considered as included in the contract unit price paid for drive pile of the types shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for supply of electrical power for dynamic monitoring shall be considered as included in the contract unit price paid for drive pile of the types shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

10-1.25 TEMPORARY TOWERS

Temporary towers; shown on the plans for Spans E3E, E3W, E17E and E17W; shall be designed and constructed by the Contractor in conformance with the requirements in Section 49, "Piling," and Section 51-1.06, "Falsework," of the Standard Specifications and these special provisions.

Temporary towers shall include jacking assemblies and appurtenant items necessary to jack and support the superstructure, and compensate and maintain the proper roadway alignment and profile.

GENERAL

Attention is directed to the following sections of these special provisions regarding permit restrictions and regulations that may impact temporary tower design and construction:

A. Relations with Coast Guard
B. Relations with Regional Water Quality Control Board
C. Relations with United States Fish and Wildlife Service
D. Relations with California Department of Fish and Game
E. Relations with National Marine Fisheries Service
F. Maintaining Traffic
G. Relations with Bay Conservation Development Commission

Temporary tower foundation information and piling design procedures (including example calculations) are included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

TEMPORARY TOWER PILING

Piling shall be driven steel pipe piles.

The requirements in Section 49-1.03, "Determination of Length," of the Standard Specifications shall not apply.

Driven piling shall be of such length as required to develop the minimum bearing value, as defined in "Mininum Bearing Criteria" of this section, obtain the design penetration and to extend into the pile cap, as shown on the approved working drawings.

DRIVING EQUIPMENT

Diesel hammers shall not be used.

Jetting and drilling in conformance with Section 49-1.05, "Driving Equipment," of the Standard Specifications shall not be used.

MINIMUM BEARING CRITERIA

The maximum bearing value for piles supporting temporary towers shall not exceed 1.8 MN.

The first two paragraphs in Section 49-1.08 "Bearing Value and Penetration," of the Standard Specifications shall not apply.

Driven piles shall be driven to the design tip elevation and a minimum bearing value of not less than the design loading shown on the approved working drawings, unless otherwise specified in these special provisions or permitted in writing by the Engineer.

If piles do not satisfy the minimum bearing value at the design tip elevation during initial driving, the Contractor shall demonstrate that piles meet the minimum bearing value by redriving the piles in accordance with the following:

A. At pile locations selected by the Engineer, a minimum of two pile redrives shall be performed on at least 25 percent of the piles at each temporary tower location. If minimum bearing value is not met after two pile redrives, piles shall be driven a minimum of one meter before being re-evaluated for minimum bearing.
B. Setup periods for pile redrives shall be determined by the Engineer based on the Contractor's selected pile type and design length. In no case shall the time elapsed between the end of initial pile driving and the first pile redrive, and between pile redrives be less than 7 working days for a given pile.

PILE REDRIVES

Pile redrives shall consist of the following:

A. The pile shall be advanced a minimum of 75 mm during each redrive;
B. The redrive blow count shall be taken as the average blow count over the first 50 mm of driving. Blow count per quarter meter will be extrapolated from the blow count over the first 50 mm;

PILE ACCEPTANCE

Temporary tower piles, at a given tower location, shall be considered acceptable when the following conditions are met:

A. Piles are driven to the design tip elevation shown on the approved working drawings and meet the requirements for minimum bearing value in "Minimum Bearing Criteria" of this section.
B. Piles that encounter refusal from continuous driving within 3 meters of the approved design pile tip elevation shall also be accepted.

For piles that encounter driving refusal at an elevation more than 3 meters above the approved design tip elevation, the Contractor shall notify the Engineer in writing. The Contractor shall evaluate these piles and propose alternative pile installation techniques or design modifications. Possible alternative pile installation techniques include using a higher capacity hammer and removal of the soil plug for open-ended piling. Possible design modifications include use of dynamic monitoring (done by the Contractor) in conjunction with redriving. No additional compensation will be allowed for developing and using alternative pile installation methods.

The Contractor shall provide a pile driving log at the completion of driving each pile.

TEMPORARY TOWER DESIGN

Temporary towers shall consist of steel braced frames with bolted connections. Timber walkways and decks will be permitted. At the option of the Contractor, temporary tower pile caps may be made of reinforced concrete.

Cable bracing will not be permitted.

The first paragraph of Section 51-1.06A "Falsework Design and Drawings," of the Standard Specifications shall not apply.

Timber connections shall be designed in conformance with the procedures, stresses and loads permitted in the Falsework Manual as published by the Department of Transportation, Division of Structures, Office of Structure Construction.

The construction equipment loads shall be the actual weight of the construction equipment, material and personnel, but in no case shall be less than 960 N/m2 of deck surface area.

Temporary towers shall be designed in accordance with the following criteria/codes:

Subject	Design Code or Reference	Year
Structural Steel	AISC-LRFD	Current Edition
Structural Steel – Tubular Members	API RP2A	Current Edition
Concrete	AASHTO-LRFD Bridge Construction Code	Current Edition
Wind Loads	ASCE 7-98	1998
Falsework	State of California Dept. of Transportation – Falsework Manual	Current Edition

In case of a difference between code clauses, the more stringent clause, as determined by the Engineer, shall apply.

Design of temporary towers shall account for any change in the loads imposed on the tower by the bridge superstructure due to jacking operations, prestressing, time-dependent effects and construction sequence of the bridge.

Temporary towers shall be designed to adequately support the bridge without imparting distortion or exceeding the allowable stresses in the bridge. Allowable stresses in the orthotropic box transition span shall not exceed the allowable values given in AISC. Allowable stresses in the concrete segments shall not exceed the values recommended by AASHTO/ASBI for precast segmental bridges.

The Contractor shall ensure the stability of the tower as well as the supported bridge structure at all times during construction. The connection between the jacks at the top of the tower and the bridge superstructure shall be capable of transmitting lateral shear loads through the use of restraining keys or other such means. All jacking operations shall be submitted to the Engineer for his approval at least two weeks before the start of such operations.

The total design settlement of temporary towers shall not exceed 25 mm.

The twentieth paragraph of Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications shall not apply.

The design of temporary towers shall be based on assumed loads that are equal to or greater than those described in this section.

Approximate dead load reactions from the bridge superstructure, based on the assumed construction sequence, are shown on the plans.

The design of the temporary towers shall conform to both the service and ultimate limit state criteria set in these special provisions as well as in the referred codes.

The Contractor shall be responsible for the proper evaluation of the falsework materials and design of the falsework to safely carry the actual loads imposed.

The fifth and sixth paragraphs of Section 51-1.06A(1), "Design Loads," of the Standard Specifications shall not apply.

Vertical Loads

Temporary towers and their foundations shall be designed to carry the anticipated total effective tower load.

The total effective tower load shall include, at a minimum, the following:

A. Tower and foundation, including piles, pile caps, and fenders;
B. Load from supported bridge; and
C. Contractor's equipment and live load.

Seismic Design Loads

Temporary towers shall be designed to resist horizontal seismic loads applied to the tower system in combination with the appropriate vertical loads covering all significant construction stages. Significant construction stages are those which produce maximum stress in one or more members. The seismic analyses shall consider the interactions of the tower system with the bridge superstructure at all appropriate stages as well as the hydrodynamic added mass associated with the submerged tower foundation and fenders.

Seismic demands shall be determined using the site-specific temporary tower response spectra (5% damped) contained in the Information Handout, and shall be applied in any horizontal direction. Pushover analyses of the tower systems shall be carried out based on displaced shapes determined form modal analyses of the tower systems and bridge superstructure. The target displacements for the pushover analyses shall be established from the modal analyses and the displacement spectrum.

The seismic performance of the tower system shall result in the bridge superstructure remaining undamaged and not stressed excessively. The temporary tower system shall remain serviceable and capable of carrying the design loads. Tower vertical load carrying members and connections shall remain elastic. Yielding of the structural steel bracing members will be permitted. Yielding of the extreme fibers of the structural steel piles will be permitted subject to a maximum of 2% strain.

Vessel Impact Design Loads

Temporary towers shall be designed for accidental vessel impact and coincident wind, wave and current loads in accordance with API RP2A.

Attention is directed to the AASHTO Guide Specification and Commentary for Vessel Collision Design of Highway Bridges (1991) regarding design for accidental impact.

Temporary towers shall be designed to resist loads from impact of the Contractor's equipment. At a minimum, temporary towers shall be designed to resist an impact load of 7.6 MN, acting between elevation +7.6 m and –1.8 m NGVD, without collapse.

The rake of the bow of a 76 m x 14 m hopper barge shall be used to determine whether the impact force will occur on the fenders and foundation or whether the vessel will impact the tower substructure.

Temporary towers shall not be used for mooring the Contractor's vessels unless they are specifically designed for mooring loads including the effects of the eccentric application of these loads.

WORKING DRAWINGS

The Contractor shall submit to the Engineer working drawings and design calculations for temporary towers, in conformance with the requirements in "Working Drawings," of these special provisions. The Contractor shall allow the following times, after notification is received from the Engineer, for the review of temporary tower working drawings and design calculations:

Location	Review Time
E3E and E3W	50 Working Days
E17E and E17W	50 Working Days

The Contractor's temporary tower working drawings shall include a pile installation schedule that is in conformance with "Progress Schedule (Critical Path)," of these special provisions.

The fourth, fifth, six and seventh paragraphs of Section 51-1.06A "Falsework Design and Drawings," of the Standard Specifications shall not apply.

When several temporary tower drawings or calculations are submitted simultaneously, or additional drawings or calculations are submitted for review before the review of previously submitted drawing or calculation has been completed, the Contractor shall designate the preferred sequence in which the plans and calculations are to be reviewed. The time to be provided for the review of any drawings and calculations in the sequence shall be not less than the review time specified above for that plan, plus two weeks for each plan of higher priority which is still under review.

Working drawings for temporary towers shall include the following:

A. Complete details showing the proposed construction sequence;
B. Concrete placing diagram;
C. Methods for erection;
D. Methods and plans for release of tower to superstructure connections.
E. Descriptions of equipment and associated loads, including the loads shown on the plans;
F. Complete details for all jacking operations, providing grade adjustment to compensate for anticipated settlement, and ensuring proper fit up;
G. Complete details and descriptions of the displacement monitoring system described in these special provisions;
H. Details and descriptions of equipment and methods proposed for monitoring the erection, position, settlement and deflection of temporary towers; and
I. Schedule of taking displacement measurements.
J. Pile Data Table including the design loads, bearing value, and required pile tip elevations.
K. Details for alternative pile installation techniques in case pile refusal is encountered more than 3 meters above the design penetration. Techniques shall include the effects on bearing value and any design modifications.

Design calculations for temporary towers shall include, at a minimum, the following:

4. Summary of computed stresses in the temporary towers. Computed stresses shall include effects from any grade adjustment assumed by the Contractor to insure proper grade and fit up.
5. Assessment of lateral stiffnesses and significant periods of vibration of the temporary towers system.
6. Calculations for providing grade adjustment to compensate for anticipated settlement and ensure proper fit up.
7. All jacking operations.
8. Calculation of pile setup period(s).
9. Calculation of pile alignment and location tolerances.
10. Refusal criteria
11. Driving system submittal
12. Dynamic monitoring equipment and setup
13. Design pile length
14. Schedule

Temporary Tower Driving System Submittal

The Contractor's temporary tower working drawings shall include a pile installation schedule that is in conformance with "Progress Schedule (Critical Path)," of these special provisions.

Prior to installing driven piling at a given temporary tower location, the Contractor shall provide a driving system submittal for that tower location, including a driveability analysis, in conformance with the provisions in "Working Drawings," of these special provisions. Technical data for all proposed driving systems (i.e., each hammer that may be brought onto the site) shall be included in the submittal.

The driving system submittal shall be based on the soil profiles shown in the Information Handout and shall contain an analysis showing that the proposed driving systems will install piling to the Contractor's design tip elevation, as shown on the approved working drawings without overstressing the piles. Submittals shall include the following:

A. Complete description of soil parameters used, including soil quake and damping coefficients, skin friction distribution, percentage shaft friction, and total soil resistance to driving.

B. List of all hammer operation parameters assumed in the analysis, including manufacturer's rated energy, fuel settings, stroke limitations, and hammer efficiency.
C. Driveability studies that are based on a wave equation analysis using a computer program that has been approved by the Engineer. Driveability studies shall model the Contractor's proposed driving systems, including the hammers, capblocks, pile cushions, followers and driving shoes, as well as determine driving resistance and pile stresses for assumed site conditions. For open-ended steel pipe piles, soil resistance to driving shall be computed for both plugged and unplugged cases. The range of soil resistance to driving and the percentage shaft resistance shall be determined for site conditions ranging from 5 meters above to 5 meters below the Contractor's design tip elevation shown on the approved working drawings. Separate analyses shall be completed at elevations above the design tip elevations where difficult driving or pile splices are anticipated. Driveability analysis results shall include plots of the following:

    1. Maximum pile head and pile toe compressive stress versus blows per 250 mm.
    2. Soil resistance to driving versus blows per 250 mm.

D. Copies of all test results from any previous pile load tests, dynamic monitoring, and all driving records used in the analyses.
E. Completed "Pile and Driving Data Form," which is shown in these special provisions.
F. Estimate of pile penetration due to self-weight and the weight of the hammer.

The Contractor shall use the driving system and installation methods described in the approved driving system submittal for each temporary tower location. Any change in hammers from those submitted and approved by the Engineer shall also meet the requirements for driving system submittals. Revised and new driving system submittals shall be approved by the Engineer prior to using corresponding driving systems on temporary tower piling. The Contractor shall allow the Engineer 15 working days to review each revised and each new driving system submittal after a complete set has been received, as determined by the Engineer.Approval of pile driving equipment shall not relieve the Contractor of his responsibility to drive piling free of damage to the design penetration.

TEMPORARY TOWER PILE DYNAMIC MONITORING

In addition to the provisions regarding dynamic monitoring in "Pile Acceptance," of this section, for temporary towers piles with a bearing value greater than 900 kN, the Contractor shall conduct dynamic monitoring of pile driving and conduct penetration and bearing analyses based on a wave equation analysis. Piles shall be monitored over the last 1/3 of the design pile length, as shown on the working drawings. Said analysis shall be signed by an engineer who is registered as a Civil Engineer in the State of California and submitted to the Engineer prior to completion of temporary tower erection.

The Contractor's monitoring equipment shall be capable of generating a continuous computer printout of monitoring results.

Each pile to be dynamically monitored shall be fitted with one set of attachments located on opposite sides of the pile.

MANUFACTURED ASSEMBLIES

Manufactured assemblies shall conform to the provisions in Section 51-1.06A(2), of the Standard Specifications and these special provisions.

All jacks shall be equipped with a load cell for determining the jacking force. Pressure gages shall have an accurately reading dial at least 150 mm in diameter. Each jack shall be calibrated by a private laboratory approved by the Transportation Laboratory within 6 months prior to use and after each repair, unless otherwise directed. Each jack and its gage shall be calibrated as a unit with the cylinder extension in the approximate position that it will be at final jacking force and shall be accompanied by a certified calibration chart. Load cells shall be calibrated and provided with an indicator by which the jacking force is determined.

Jacks for temporary towers shall be load-rated for at least 125% of the design service loads.

CONSTRUCTION

The construction of temporary towers shall not start until the Engineer has reviewed and approved the drawings for that location.

The Contractor shall be responsible for monitoring the erection, position, settlement and deflection of temporary towers in accordance with the requirements of this section and submitting logs of these deflections and settlements to the Engineer. Deflection logs shall be provided to the Engineer within 12 hours of recording the measurements.

The third paragraph of Section 51-1.06B, "Falsework Construction," of the Standard Specifications shall not apply.

Welding, welder qualification, and inspection of welding for all steel members shall conform to the requirements of AWS D1.1.

Prior to erecting bridge members on the temporary towers, an engineer for the Contractor who is registered as a Civil Engineer in the State of California shall inspect the temporary towers, including grade adjustment and displacement monitoring systems, for conformity with the working drawings. The Contractor's registered engineer shall certify in writing that the temporary towers, including grade adjustment and displacement-monitoring systems, substantially conform to the working drawings, and that the material and workmanship are satisfactory for the purpose intended. A copy of this certification shall be submitted to the Engineer and shall be available at the site of the work at all times.

Grade adjustment operations shall be carefully controlled and monitored to prevent imparting distortion and excessive stresses that would damage the structure.

Adequate means shall be employed to prevent unplanned lateral and longitudinal movement of the temporary tower during jacking. The temporary towers, jacks, and the superstructure shall be stable during all phases of the operation.

The jacking system shall be designed such that pressure loss of any hydraulic system cannot cause movement after jacking operations. This may be by means of a mechanical lock off of the jacks, replacement of the jacks by supports that can be cast in, or alternative methods.

The Contractor's jacking methods shall include provisions for blocking up the superstructure from the temporary towers such that the gap between the temporary tower and the superstructure during all phases of the jacking operation does not exceed 25 mm.

No more than 150 mm of shimming will be permitted at any jacking location.

Temporary towers shall be protected from damage during construction.

Fenders and navigation lighting for temporary towers shall conform to the requirements in "Relations with Coast Guard" of these special provisions. Temporary towers shall not be used as a mooring.

MEASUREMENT AND PAYMENT

Section 49-6, "Measurement and Payment," of the Standard Specifications shall not apply.

The contract lump sum price paid for temporary towers, of the types listed in the Engineer's Estimate, shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in temporary towers, complete in place, including designing, constructing, and maintaining,temporary towers, furnishing and driving piles, driving system submittals, monitoring and redriving piles, necessary grade adjustment and displacement monitoring, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.26 PRESTRESSING CONCRETE

Prestressing concrete shall conform to the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications and these special provisions.

The first paragraph in Section 50-1.05, "Prestressing Steel," of the Standard Specifications is amended to read:

· Prestressing steel shall be high-tensile wire conforming to the requirements in ASTM Designation: A 421, including Supplement I; high-tensile seven-wire strand conforming to the requirements in ASTM Designation: A 416; or uncoated high-strength steel bars conforming to the requirements in ASTM Designation: A 722, including all supplementary requirements. The maximum mass requirement of ASTM Designation: A 722 will not apply.

The second paragraph in Section 50-1.11, "Payment," of the Standard Specifications is amended to read:

· The contract lump sum prices paid for prestressing cast-in-place concrete of the types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in furnishing, placing, and tensioning the prestressing steel in cast-in-place concrete structures, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

In addition to the requirements specified in Section 50-1.05, "Prestressing Steel," of the Standard Specifications, epoxy-coated seven-wire prestressing steel strand shall be grit impregnated and filled in conformance with the requirements in ASTM Designation: A 882/A 882M, including Supplement I, and the following:

A. The coating material shall be on the Department's list of approved coating materials for epoxy-coated strand, available from the Transportation Laboratory.
B. The film thickness of the coating after curing shall be 381 µm to 1143 µm.
C. Prior to coating the strand, the Contractor shall furnish to the Transportation Laboratory a representative 230-g sample from each batch of epoxy coating material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

D. Prior to use of the epoxy-coated strand in the work, written certifications referenced in ASTM Designation: A 882/A 882M, including a representative load-elongation curve for each size and grade of strand to be used and a copy of the quality control tests performed by the manufacturer, shall be furnished to the Engineer.
E. In addition to the requirements in Section 50-1.10, "Samples for Testing," four 1.5-m long samples of coated strand and one 1.5-m long sample of uncoated strand of each size and reel shall be furnished to the Engineer for testing. These samples, as selected by the Engineer, shall be representative of the material to be used in the work.
F. Epoxy-coated strand shall be cut using an abrasive saw.
G. All visible damage to coatings caused by shipping and handling, or during installation, including cut ends, shall be repaired in conformance with the requirements in ASTM Designation: A 882/A 882M. The patching material shall be furnished by the manufacturer of the epoxy powder and shall be applied in conformance with the manufacturer's written recommendations. The patching material shall be compatible with the original epoxy coating material and shall be inert in concrete.

Epoxy-coated prestressing steel strand shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the strand from exposure to sunlight, salt spray, and weather. For stacked coils, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation around the strand to prevent condensation under the covering. Epoxy-coated strand shall not be stored within 300 m of ocean or tidal water for more than 2 months.

Corrosion inhibitors as specified in Section 50-1.05, "Prestressing Steel," of the Standard Specifications, shall not be required for epoxy-coated strand.

In addition to the requirements of the thirteenth paragraph of Section 50-1.08, "Prestressing," of the Standard Specifications, when epoxy-coated prestressing steel strand is used, the steel shall not be cut or released until the temperature of the concrete surrounding the strand is less than 65°C, and falling.

After final fabrication of the seven-wire prestressing steel strand, no electric welding of any form shall be performed on the prestressing steel.

GENERAL

Prestressing concrete shall consist of the following items as designated in the Engineer's Estimate:

A. Prestressing, Longitudinal (Frame 1 through Frame 4)
   1. Cantilever Tendons
   2. Top Span Tendons
   3. Bottom Span Tendons
   4. Continuity Tendons

B. Prestressing, Transverse
   1. Transverse Tendons in Mid-Span Closures, Pier Tables, and Hinge Segments
   2. Transverse Tendons in Pier Table Diaphragms
   3. Transverse Tendons in Hinge Diaphragms

C. Prestressing, High Strength Bars
   1. Vertical High Strength Bars in Pier Tables and Pier Table Diaphragms
   2. High Strength Bars in Hinge Segments and Hinge Diaphragms
   3. High Strength Bars for Bikepath Connections

WORKING DRAWINGS AND SUBMITTALS

The Contractor shall submit prestressing working drawings in conformance with the provisions in "Working Drawings" elsewhere in these special provisions. Working drawings and supplement shall be submitted for all prestressing operations including permanent and temporary prestressing.

In addition to the requirements in Section "Working Drawings" elsewhere in these special provisions, the Contractor shall submit the substantiating calculations for prestressing steel system and method of stressing proposed by the Contractor whether or not it differs in any respect from that shown on the plans.

Working drawings shall include the following:

A. Required jacking force and elongation of tendon and prestressing bar at the time of tensioning.
B. Details of local reinforcement in the concrete to resist anchorage stresses including the reinforcement shown on the plans, required by the anchorage manufacturer, and designed by the Contractor.
C. Detailed grouting plan for each tendon or bar including the following:

1. Types and locations of inlet and outlet vents
2. Types and sizes of grout hoses and connections
3. Direction of grouting
4. Sequence of vent closing

A supplement to working drawings shall include the following:

A. Stress in anchorage and distribution plates.
B. Stress-strain curves of the prestressing steel to be used.
C. Seating losses.
D. Losses due to both vertical and horizontal angle changes.
E. Characteristics of the prestressing system to be used such as curvature and wobble friction coefficients, anchor set, and relaxation curves.
F. Force diagrams indicating tendon forces after friction losses, anchor set losses, and elastic shortening based on the characteristics of the prestressing system to be used.
G. The locations and the connections of vents to be placed.
H. The stressing sequences of all tendons.
I. The grouting sequences for all ducts.
J. Supplement to detailed grouting plan including the following:

1. Type, quantity, and brand of grout materials
2. Grout physical property test laboratory and frequency.
3. Type of grouting equipment needed, including capacity in relation to demand and working condition, as well as provisions for back-up equipment and spare parts
4. Duct cleaning methods prior to grouting
5. Mixing and pumping procedures
6. Procedures for handling blockages, including flushing of ducts
7. Procedures for possible regrouting
8. The names of the persons in responsible charge of the grouting operation, including their relevant experience and skill

K. Detailed grouting quality control plan including the following:

1. Inspection of grout materials to ensure the specified type and quantity
2. Inspection of grout equipment to ensure satisfactory condition
3. Inspection of ducts to ensure that they are free of water, debris, and other obstructions
4. Inspection of ducts to ensure that no grout leakage between adjacent ducts in joint areas
5. Temperature measurement of air, water, and concrete elements to ensure compliance with the grout manufacturer's recommendations
6. Inspection of all grout packages for evidence of age and dampness, such as lumps and hardened pieces

L. Detailed field grouting test plan covering test setup, equipment, falsework, materials, ducts, vents, anchorages, prestressing steel, grouting procedures, dissection procedures, and examination procedures. The Contractor shall also submit calculations for the falsework used in the test.

At the Contractor's option, the Contractor may submit a separate prestressing working drawing submittal for prestressing work for offsite precast concrete work.

After complete working drawings and supplement are submitted to the Engineer, the Contractor shall allow the Engineer 60 working days to review and approve the working drawings and supplement. No stressing operation shall be permitted without the Engineer's approval of the working drawings and supplement.

If after a submittal has been approved, the Contractor submits a revised prestressing working drawing submittal, the Contractor shall allow the Engineer 10 working days to review the revised submittal.

The Contractor shall submit the following certified test reports:

A. Certified calibration charts of each jack and gauge to be used.
B. Test reports of concrete creep and shrinkage, and modulus of elasticity specified elsewhere in these special provisions.

MATERIALS

The Contractor shall provide the Engineer all Certificates of Compliance for materials used in prestressing and grouting construction.

Anchorages and Distribution.—Anchorages shall be set in a plane normal to the axis of the tendons such that uniform bearing on the concrete is assured. Anchorages shall be furnished with a steel reinforcing spiral for those tendons having a prestressing force greater than 1350 kN.

Ducts.—Embedded ducts, other than steel pipe, shall be corrugated.

Steel pipe ducts for future tendons shall conform to the requirements of ASTM Designation: A53, Type E or S, Grade B, standard weight, galvanized.

Ducts for multi-strand tendons shall be a diameter that provides an inside area at least 2.5 times the net area of the prestressing steel.

Duct spacing shall be detailed in the working drawings such that there is sufficient concrete between parallel ducts to prevent interconnections between ducts during grouting operations. Ducts shall have a minimum clear spacing of 25 mm, or shall be placed in bundles and grouted simultaneously as a group.

Bonding and Grouting.—The compressive strength of the grout shall not be less than 45 MPa at 28 days.

Grout for prestressing tendons and bars shall be a prepackaged grout mix with non-bleeding characteristics. Grout shall not contain aluminum powder or any other gas forming agent that produces carbon dioxide, oxygen, or air. The prepackaged grout system shall be mixed in accordance with the manufacturer's recommendations and shall conform to the requirements of specified physical properties stated herein as determined by the following standard and modified ASTM test methods:

Property	Test Value	Test Method
Total Chloride Ions	Max 0.08% by weight of cementitious material	ASTM C1152
Fine Aggregate (if utilized)	Max Size No. 50 Sieve (300 micron)	ASTM C33
Volume Change	0.0% Shrinkage @ 24 hrs. +0.3% max. @ 28 days	ASTM C1090[A]
Expansion	2.0% max. for up to 3 hrs.	ASTM C940
Compressive Strength 28 day (Average of 3 cubes)	45 MPa	ASTM C942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C953
Fluidity Text Efflux Time from Flow Cone (a) Immediately after mixing	Min. 20 Sec Max. 30 Sec or Min. 9 Sec Max. 20 Sec	ASTM C939 Modified ASTM C939[B]
(b) 30 minutes after mixing with remixing for 30 sec	Max. 30 Sec or Max. 30 Sec	ASTM C939 Modified ASTM C939[B]
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C940[C]
Permeability @ 28 days	Max. 2500 coulombs at 30 V for 6 hours	ASTM C1202

A. Modify ASTM C1090 to include verification at both 24 hours and 28 days.
B. Grout fluidity shall meet either the standard ASTM C939 flow cone test or the modified test described herein. Modify the ASTM C939 test by filling the cone to the top instead of to the standard level. The efflux time is the time to fill a one-liter container placed directly under the flow cone.
C. Modify ASTM C940 to conform to the wick induced bleed test described below:

1. Condition dry ingredients, mixing water, prestressing strand and test apparatus overnight at 21 to 25C.

2. Insert 800 ml of mixed conditioned grout with conditioned water into the 1,000 ml graduated cylinder. Mark the level of the top of the grout. Wrap the strand with 50 mm wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut.
3. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning. Insert completely a 0.5 m length of conditioned, cleaned, ASTM A416, 7 wire strand 12.7 mm diameter into the 1,000 ml graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder (using a centralizer). Mark the level of the top of the grout.
4. Store the mixed grout at the temperature range listed above in Item 1.
5. Measure and record the level of the bleed water every 15 minutes for the first hour and hourly afterward for 3 hours using the procedure outlined in ASTM C940.
6. Calculate the bleed water, if any, at the end of the 3 hour test period and the resulting expansion in accordance with the requirements in ASTM Designation: C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height.

No additional admixtures shall be added to the prepackaged grout, unless otherwise recommended by the manufacturer and approved by the Engineer.

The prepackaged grout shall be tested by the Contractor's independent laboratory. Unless otherwise directed by the Engineer, the prepackaged grout shall be tested prior to start of grouting and no more than 6 months interval thereafter.

Prepackaged grout shall be used in accordance with the manufacturer's recommendations. Expired grout as specified by manufacturer's published shelf life shall not be used.

Vents.—Vents shall consist of inlets and outlets. The inner diameter shall be at least 20 mm and the length shall extend sufficiently out of the concrete member to allow proper closing of the vent.

Vent shall be placed:

A. At the anchorage of the tendon
B. At the high point of the duct when the vertical distance between the highest and lowest point is more than 0.5 m
C. At the low point of looped tendons and continuity tendons
D. At major changes in the cross-section of the duct, such as coupler and trumpet area of anchorage

FIELD GROUTING TESTS

The Contractor shall perform field grouting tests as specified herein and in accordance with all prestressing operations shown in the approved working drawings and supplement. Field grouting tests shall be scheduled in advance of production grouting.

The field grouting tests shall be performed on a full scale looped tendon duct including anchorages, supported on the falsework simulating the condition of looped tendon designated A1 at Hinge B Diaphragm A as shown on the plans. The duct to be tested shall include a minimum of two splices using the same system as the duct splice system used at the precast concrete segment joints for match cast construction.

The Contractor shall design and detail the falsework to ensure that no movements or settlements shall occur during the grouting tests. Unstressed strands as shown on the plans shall be placed inside the ducts prior to the testing.

The Contractor shall provide injection feed tubes at the low points of looped tendon duct and grout shall be injected from these injection feed tubes bottom-up.

Not less than 3 days after grouting, the Contractor shall remove the duct and anchorages for a thorough examination of grout and prestressing steel. The Engineer shall be allowed 3 working days to examine the grout and prestressing steel prior to making sections. The Contractor shall take sections to examine voids and void ratios in the sections. A minimum of 7 sections shall be cut at each of the following locations:

A. Two anchorage sections
B. Two duct curvature sections
C. Bottom of duct
D. Two other sections at locations selected by the Engineer

At least 2 working days prior to the field grouting test and dissection, the Contractor shall notify the Engineer of the time and location of the field grouting test and dissection. The Contractor shall ensure that the Engineer witnesses test and dissection.

No later than 10 working days after dissection, the Contractor shall submit to the Engineer for approval a report describing the field grouting test including any variations from the test plan and its findings. The report shall document all voids in the grout with respect to size, location, and any presence of free moisture or corrosion.

The acceptance criteria of field grouting tests shall be as follows:

A. No leakage of grout at the duct splice during and after grout pumping operation.
B. No voids larger than 5% of the inside diameter of the duct in any of the cut sections.

The Contractor shall allow the Engineer 10 working days to review the results and report for field grouting test. If the test results fail to meet any of the acceptance criteria, as determined by the Engineer, the field test will be rejected. The Contractor shall revise the prestress working drawings and conduct additional field grouting tests based on the revised procedures, methods, and equipment.

CONSTRUCTION

Stressing.—Post-tensioning forces shall not be applied until at least 12 hours for cast-in-place deck joints between precast segments, and 3 days for other concrete members after the last concrete has been placed in the member to be prestressed and until all concrete has attained the specified compressive strength as shown on the plans.

Prestressing steel shall be cut by an abrasive saw within 20 to 40 mm from the anchoring device. Flame cutting of prestressing steel shall not be allowed.

In the event that more than 2 percent of the number of wires in a tendon break during the tensioning operation, the tendon shall be removed and replaced.

The Contractor shall submit to the Engineer a system of tendon identification, individually and in groups, the sequence of all tendons to be stressed to expedite the tasks of the Contractor and the Engineer in identifying and tracking the installation and stressing of the post-tensioning.

At least 20 working days prior to the start of prestressing, the Contractor shall submit a sample prestressing log for the Engineer's approval. This shall provide for the recording of the following data (at both ends of tendons, when appropriate):

A. Dates of tendon installation and stressing
B. Tendon identification
C. Tendon location
D. Tendon size
E. Tendon length
F. Strand or bar identification
G. Duct type and diameter (ID, OD)
H. Anchorage type
I. Tendon elongation and slippage (theoretical)
J. Gage pressure
K. Master gage pressure, if used
L. Jacking force (per calibration curve)
M. Anchor set (theoretical)
N. Jack and gage identification
O. Dates of tendon installation and stressing (actual)
P. Tendon length (actual)
Q. Jacking force (actual)
R. Tendon elongation and slippage (actual)
S. Anchor set (actual)
T. Wire or strand breakage, if observed
U. Corrosion inhibitor, if used, date inserted
V. Dates of grouting
W. Grout volume placed
X. Grout pressure
Y. Remarks
Z. Signatures of persons conducting the stressing and grouting operations

For each tendon, at least 2 working day prior to prestressing operation, the Contractor shall submit the partial prestressing log including the records listed above from A through N to the Engineer for review. No stressing operation shall be permitted without the Engineer's approval. The Contractor shall submit the full prestressing log to the Engineer within 3 working days after the prestressing of the tendon is complete.

The stressing method shall permit the jacking force and tendon elongation to be measured at all times; the tendon elongation shall be measured to an accuracy of ±2 mm. For a tendon to be immediately acceptable the measured jacking

force in the tendon shall be within ±5% of the value shown on the plans, and simultaneously the measured tendon elongation shall be within ±7% of the theoretical value (calculated from the measured stress-strain curves and friction coefficients).

Based on actual characteristics of the prestressing system to be used, if the Contractor's calculated jacking forces are different from that shown on the plans, the Contractor shall adjust the jacking forces to match the required tendon force diagrams as shown on the plans.

If the Contractor fails to meet these tolerance requirements, the Engineer may suspend further stressing operations and the Contractor shall review the stressing records for the out of tolerance tendons, discover the discrepancy, and propose a solution for approval by the Engineer. The proposed solution shall include the necessary steps to improve the accuracy of stressing. No compensation will be made for any costs incurred or for delay in completing the stressing operations resulting from failure to meet the tolerance requirements.

Grouting.—Before grouting operations begin, the Contractor shall conduct a joint meeting within San Francisco Bay area between the Contractor, the Contractor's grouting crew, and the Engineer. At the meeting, at least the grouting operation plan, the field grouting test report, approved working drawings and supplement, grouting operation procedures and details, responsibilities of each individual, and required tests shall be discussed. A copy of meeting minutes shall be provided to the Engineer prior to grouting operation. The Contractor shall not commence grouting operations without conducting this joint meeting.

At the Contractor's option, a separate grout meeting may be held for off-site precast concrete prestressing work.

Supervisory personnel, materials and equipment used, and grout procedures for production grouting shall be the same as those to be used in the field grouting tests. Changes in supervisory personnel, materials, equipment, and procedures will be allowed only after a written approval by the Engineer is given.

The grouting equipment shall utilize gravity feed to the pump from a hopper attached to and directly over it. The hopper shall be kept at least partially full of grout at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct. The grouting equipment shall be capable of continuously grouting the longest tendon in no more than 30 minutes. The pump shall have seals adequate to prevent introduction of oil, air, and other foreign substance into the grout and to prevent loss of grout or water. The grouting equipment shall be capable of continuously and mechanically mixing and producing a grout free of lumps and undispersed cement.

The Contractor shall use positive displacement type grout pumps capable of producing an outlet pressure of at least 1 MPa, with seals adequate to prevent oil, air or other foreign substances entering into the grout and to prevent loss of grout or water. The Contractor shall place a pressure gauge having a full-scale reading of no more than 2 MPa at some point in the grout line between the pumping outlet and the duct injection inlet.

The Contractor shall provide back up grouting equipment and independent back up power supply to ensure that grout placement can continue if the primary equipment or power supply fails.

The grout shall be continuously agitated until it is pumped. Prepackaged grout system shall be mixed in accordance with the manufacturer's recommendations.

Batches shall be placed within 30 minutes of the start of mixing.

All grout vents shall be open before grouting starts. The Contractor shall provide injection and ejection vents with positive shut-offs. Grout shall be allowed to flow from the first vent after the inlet pipe until all residual flushing water and entrapped air has been removed, at which time the vent shall be capped or otherwise closed. Remaining vents shall be closed in the same manner. A continuous flow of grout at a rate between 5 and 15 meters of duct per minute shall be maintained. If a one-way flow of grout cannot be maintained as outlined above, the grout shall be immediately flushed out of the duct with water.

The pumping pressure at the injection vent shall not exceed 1 MPa for oval ducts nor 1.7 MPa for circular ducts. Normal operations shall be performed at approximately 500 kPa. If the actual grouting pressure exceeds the maximum allowed, the injection vent shall be closed and the Contractor shall inject the grout at the next vent that has been, or is ready to be, closed as long as a one way flow is maintained. The Contractor shall not inject grout into a succeeding vent from which grout has not yet flowed. Bottom-up grouting shall be performed from the low points for all continuity and hinge diaphragm looped tendons.

The Contractor shall perform fluidity tests on each tendon measuring the grout efflux time at injection inlets prior to placing and at discharge outlets prior to shut-off. The measured efflux time at inlets and outlets shall conform to the limits shown on grout property table of these special provisions. The Contractor shall ensure that the tendon duct is completely filled with grout, by closing the ejection and injection vents in sequence, respectively, under pressure.

Positive shut-offs at the vents shall not be removed or opened until the grout has set. In temperatures below 0°C degrees, the ducts shall be free of water to avoid damage to ducts due to freezing. The temperature of the concrete or air surrounding the tendon shall be 2°C or higher from the time grout is placed until the minimum compressive strength of 5.5 MPa, as determined from tests on 50 mm cubes cured under the same condition as the in-place grout, is obtained. Grout shall not be above 32°C during mixing or pumping. If necessary, the mixing water shall be cooled.

Vertical or nearly vertical tendon grout tubes shall be terminated in reservoirs at the uppermost point. The reservoirs shall have a sufficient capacity to store all bleed water to enable its reabsorption into the grout. The reservoirs shall be maintained until the grout is set and the bleed water absorbed. Top vertical post-tensioning anchorages shall have additional holes for regrouting top part of the tendons if necessary.

Ends of steel vents shall be removed at least 25 mm below the concrete surface after the grout has set. Ends of plastic vents shall be removed to the surface of the concrete after the grout has set. All miscellaneous materials used for sealing grout caps including paper, tie wire, duct tape, etc. shall be removed before carrying out further work to protect end anchorages or filling in concrete anchorage blockouts.

When friction must be reduced, water soluble oil or graphite shall be used as a lubricant. The chemical composition of either water soluble oil or graphite shall not be deleterious to the steel or concrete, and either substance used shall be flushed, and the duct shall be blown dry with oil-free air.

If a water soluble lubricant is applied to the prestressing steel, the tendon shall be flushed, and the water shall be totally drained from within the tendon and it shall be blown out to dry the prestressing steel and the inside surfaces of the duct.

Within 4 hours after stressing and prior to grouting, the Contractor shall protect tendons against ingress or water, corrosion or harmful effects of debris, by temporarily plugging or sealing all vents and placing the grout caps over the wedge plate until the tendon is grouted.

The Contractor shall record the progress of grouting operations for each tendon and submit a written report to the Engineer within 72 hours after grouting. This report shall include:

A. The quantities and types of materials used
B. Discussions of problems encountered during grouting and steps taken to resolve them
C. The maximum pumping pressure at inlet
D. Temperature measurement of air, water, cement, prepackaged material, mix grout, and concrete member in the duct shall also be recorded and reported. The report shall indicate whether all applicable parameters were within allowable limits of these special provisions

The Contractor shall complete the grout operation within 30 calendar days after prestressing steel is stressed. Failure to grout the tendons within 30 calendar days will result in stoppage of the affected work.

For enclosures of prestressing anchorages, tight fitting forms shall be installed and held in place securely against the previously placed concrete. For transverse diaphragm post-tensioning pockets at the fascia, side openings will be required in the forms. At expansion joint end recesses, access holes through the top slab may be used.

Concrete with a water cement ratio of 0.35 and with a high range water reducer providing a ball penetration value between 90 mm to 115 mm, shall be poured behind the forms and cured. At deck slab transverse post-tensioning pockets, dry packed mortar may be used to fill the pockets, after epoxy paint is applied. Mortar shall conform to the application requirements of the manufacturer and to the requirements in Section 51-1.135, "Mortar," of the Standard Specifications.

All excess materials and fluids generated from the grouting operation shall be collected, contained and removed from the structure and disposed of in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Transverse and vertical prestressing of precast concrete segments shall be paid as specified in "Furnish Precast Concrete Segment," elsewhere in these special provisions.

The contract lump sum price paid for prestressing, longitudinal for various frames as listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials (including standard steel pipes for future tendons), tools, equipment and incidentals, and for doing all work involved in furnishing, placing, tensioning, and grouting the prestressing steel in concrete structures, including cantilever tendons, span tendons, and continuity tendons, complete in place, as shown on the plans, as specified in Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for prestressing, transverse shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in furnishing, placing, tensioning, and grouting the prestressing steel in concrete structures, including transverse tendons in mid-span closure segments, pier tables, hinge segments, pier table diaphragm, and hinge segment diaphragm, complete in place, as shown on the plans, as specified in Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for prestressing, high strength bars shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in furnishing, placing, tensioning, and grouting the prestressing steel in concrete structures, including vertical high strength bars in pier tables, vertical high strength bars in hinge segments, and high strength bars for bikepath connections, complete in place, as shown on the plans, as specified in Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for field grouting tests shall be considered as included in the types of prestressing listed in the Engineer's Estimate and no separated payment will be made therefor.

Unstressed prestressing steel placed in the structure, at locations shown on the plans, will be measured and paid for as bar reinforcing steel.

10-1.27 CONCRETE STRUCTURES

Portland cement concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

The sixth paragraph in Section 51-1.09, "Placing Concrete," of the Standard Specifications is amended to read:

· Vibrators used to consolidate concrete containing epoxy-coated bar reinforcement or epoxy-coated prestressing steel shall have a resilient covering to prevent damage to the epoxy-coating on the reinforcement or prestressing steel.

Concrete mix designs for precast and cast-in-place concrete shall be submitted within 25 working days after Notice to Proceed.

Shotcrete shall not be used as an alternative construction method for reinforced concrete members

Construction joints in precast concrete walls shall not be permitted.

The concrete temperature during curing shall not exceed 65°C.

The Contractor shall submit the creep and shrinkage test results to the Engineer for proposed mixture. These tests shall conform to ASTM Designation: C512 and shall be conducted within 6 months of the review and acceptance by the Engineer of the concrete mixes and in 6 months intervals thereafter. The test results shall be submitted in both printed form and electronic media. Electronic media shall be presented in a tab-delimited format on 90 mm diskette with a capacity of at least 1.4 megabytes. The Engineer will notify the Contractor in writing when the creep and shrinkage test results have been determined to be complete. After the creep and shrinkage test results have been received, the Contractor shall allow the Engineer 25 working days to review the submittal. Superstructure concrete shall not be placed until the Engineer reviews and approves the test results. Creep and shrinkage cylinders shall be retained and the results shall be reported at age after loading of 1 year.

SUPERSTRUCTURE CONCRETE

Superstructure concrete including precast concrete segments, pier tables, closure concrete, and cast-in-place deck joints shall conform to the following requirements:

The concrete mix for the superstructure concrete shall be designed to achieve the following additional properties:

A. Modulus of Elasticity: The modulus of elasticity of portland cement concrete shall be at least 35,600 MPa at 28 days when tested in accordance with the requirements in California Test 522. The samples shall be moist-cured for 7 days, followed by air drying at 23°C and 50% relative humidity until test age. The modulus shall also be reported at 3, 7, 56 and 90 days. Test specimen size shall be same as compressive strengths. Test results shall be based on the average of three test specimens at each age.
B. Creep: The specific creep coefficient, as determined in accordance with the requirements in ASTM Designation: C 512, after 365 days of loading, shall not exceed 75 millionths/MPa. Test specimens shall be 152 x 305 mm cylinders and shall be moist-cured for 7 days, followed by air drying at 23°C and 50% relative humidity. Test cylinders shall be loaded at 28 days to a stress of 20% to 40% of the 56-day design compressive strength shown on the plans but not less than 20% nor greater than 40% of the measured strength at 28 days. For submittal of prequalification data, coefficients after 28, 56 and 90 days of loading shall be submitted and used to predict the coefficient at 365 days based on the procedures of CEB-FIP Model Code for Concrete Structures, by the Comite Euro-International de Beton. Mix design approval shall be contingent upon the 365 day creep coefficient satisfying the stated requirement.
C. Shrinkage: The shrinkage strain of Portland cement concrete shall not exceed 0.045% after 180 days of drying in accordance with the requirements in ASTM Designation: C 157. Sample size shall be 100 x 100 x 285 mm. Samples shall be moist-cured for 7 days followed by air drying at 23°C and 50% relative humidity. Shrinkage strain shall be calculated as the change in strain from the beginning of drying at 7 days.

Concrete testing shall be performed by the Contractor's independent test laboratory. The laboratory shall be accredited or inspected for conformance to the requirements in ASTM Designation: C 1077 and approved by the Engineer. All testing shall be performed by ACI certified technicians. In addition to the requirements of Section 90-9, "Compressive Strength," of the Standard Specifications, concrete for the superstructure shall have the following additional testing performed by the Contractor's independent testing laboratory:

A. Three samples taken from the first precast segment of each cantilever shall be tested for modulus of elasticity in accordance with ASTM C 469, "Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression." The results shall be reported as an average of the three samples. Samples shall be moist-cured for 3 days and then tested to determine 3-day results.
B. Two samples taken from the first precast segment of the first four cantilevers, and the first segment of every fourth cantilever thereafter, shall be tested for creep in accordance with the requirements in ASTM Designation: C 512, "Standard Test Method for Creep of Concrete in Compression." Creep data shall be presented both as specific creep (creep strain/applied creep load) and creep coefficient (creep deformation as a ratio to initial elastic deformation). The test cylinders shall be loaded at 28 days to a stress of 20 to 40% of the 56-day design compressive strength shown on the plans but not less than 20% nor greater than 40% of the measured strength at 28 days. Coefficients after 28, 56 and 90 days under load shall be submitted and used to predict the coefficient at 365 days based on the procedures of CEB-FIP Model Code for Concrete Structures, by the Comite Euro-International de Beton.
C. Samples taken from the first segment of each cantilever shall be tested for shrinkage in accordance with the requirements in ASTM Designation: C 157. Sample size shall be 100 x 100 x 285 mm. The samples shall be moist-cured for 7 days followed by air drying at 23°C and 50% relative humidity. Shrinkage strain shall be calculated as the change in strain from the beginning of drying at 7 days.
D. Three full size 150 x 300 mm and three 102 x 203 mm reserve cylinders shall be taken for each segment placed. The cylinders shall be stored near the segments and shall be kept for the duration of the project. Cylinders shall be stripped from their molds when formwork at the corresponding segment is stripped. Thereafter, specimens shall be stored at the fabricator's site and protected from rain and direct sunlight. Each cylinder shall be clearly identified as to segment number and date cast using permanent markers and they shall be stored in such a way that specific cylinders are easily retrievable. At the completion of the project any cylinders not requested by the Engineer shall become the property of the Contractor and shall be removed and disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Right of Way," of the Standard Specifications.

During concrete placement of cast-in-place deck joints as shown on the plans, the temperature difference between maximum temperature in the CIP deck joint concrete and temperature in the adjacent segments shall not exceed 22°C. Concrete temperature at any time during curing shall not exceed 55°C. Shrinkage shall be less than or equal to 0.03 percent after 28 days of air storage per ASTM C 157. Sample size shall be 100x100x285 mm. The samples shall be moist cured for 7 days by air drying at 23°C and 50% relative humidity. Shrinkage strain shall be calculated as the change in strain from the beginning of drying at 7 days.

The Contractor's proposed concrete mix design submittals shall include test results for ball penetration (or slump), air content, freshly mixed concrete unit weight, and the results of compressive strength at 1, 3, 7, 28, 56, and 90 days, modulus of elasticity at 3, 7, 28, and 56 days, shrinkage after 1, 3, 7, 14, and 28 days of air storage, and creep coefficients after 28, 56 and 90 days of loading.

At the Contractor's option, shrinkage-reducing admixtures may be used.

Falsework at closure placements shall be supported from the box girders on each side of the closure joint and locked together vertically, longitudinally, and transversely so that the applied concrete closure loads will apply equally to both sides of the closure. Falsework shall not be removed until the closure concrete has attained the compressive strength as shown on the plans and bottom span tendons are stressed.

Cast-in-place closure concrete shall be placed during a time of minimum daily differential temperatures between the top and bottom slabs of the superstructure or as directed by the Engineer.

The Contractor shall submit to the Engineer, for approval, the closure procedure, including jacking or restraints and forces applied to the structure. The closure procedure shall also include geometry control, tendon stressing, and counterweights, if required. The submittal shall be made at least 15 working days prior to the concrete placement.

LIGHTWEIGHT CONCRETE

Lightweight portland cement concrete shall consist of portland cement, lightweight coarse aggregate, fine aggregate, admixtures (if used), and water. Lightweight concrete shall be proportioned and mixed as specified in these special provisions.

Following concrete elements shall be lightweight concrete as shown on the plans:

A. Concrete panels for precast concrete segments and pier tables
B. Cast-in-place concrete for closure segments
C. Footing concrete in-fill

Lightweight Concrete Panel and Cast-In-Place Concrete for Closure Segments

The fine aggregate portion of the lightweight concrete mix shall consist of natural sand or manufactured sand fine aggregate, or a combination thereof, as required to comply with the air-dry unit mass requirements of these special provisions.

Lightweight concrete shall have not less than the 28-day compressive strength shown on the plans. Compressive strength shall be determined from test cylinders sampled, molded, cured, and tested in conformance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications.

Prequalification by the submission of certified test data or trial batch test reports in conformance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications will be required for lightweight concrete.

The prequalification data or reports required herein and the proposed mix design, based on the recommendations of the lightweight aggregate manufacturer, shall be furnished to the Engineer, in writing, not less than 42 days in advance of placing lightweight concrete. The mix design shall list the type, brand, mass, and absolute volume of each ingredient for each type and strength of concrete proposed for use. The mass for each aggregate shall be reported in a surface dry condition, including moisture absorbed in the aggregate, or oven-dry condition, or for the condition proposed for use, and shall be adjusted at the time of batching to compensate for surface moisture and for absorbed moisture. The batching equipment shall be subject to approval by the Engineer. The mix design shall be accompanied by written verification that arrangements have been made for the Engineer to obtain samples as required for testing purposes. Samples of lightweight aggregates will not exceed 230 kg for each separate grading.

The absolute volume of coarse aggregate shall be limited to that volume which permits the mixing, transporting, placing, consolidating, and finishing of the concrete without segregation. For site-cast concrete, the absolute volume of coarse aggregate shall not exceed 0.37-cubic meter per cubic meter of concrete.

The air-dry unit mass of lightweight concrete furnished for each mix design used shall be a single mass, selected by the Contractor, within the limits of 1940 to 2040 kg per cubic meter for concrete which is to be prestressed, and within the limits of 1670 kg to 1760 kg per cubic meter for non-prestressed concrete. The freshly mixed concrete unit weight shall be less than or equal to 2.07 Mg/m^3. The Contractor shall furnish certified copies of the manufacturer's test reports showing the fresh concrete unit mass that is anticipated to result in the air-dry unit mass selected by the Contractor. The unit mass of fresh concrete produced for use in the work shall not vary from the mass shown in the test report by more than 65 kg per cubic meter. The unit mass of fresh concrete shall be determined in conformance with the requirements in California Test 518. The air-dry unit mass shall be determined in conformance with the requirements in ASTM Designation: C 567, except that the drying time shall be 90 days.

Lightweight aggregates shall conform to the requirements in ASTM Designation: C 330, and the following requirements:

A. Lightweight aggregates shall be rotary kiln expanded shale, clay or slate having a surface sealed by firing. The coarse aggregate shall not be crushed after firing except that aggregate that is 19 mm in size and smaller, may be crushed to the extent necessary to produce the required coarse aggregate grading. The final coarse aggregate size shall not exceed 19 mm.
B. The splitting tensile strength and the drying shrinkage requirements of ASTM Designation: C 330 shall not apply.
C. The shrinkage characteristics of lightweight aggregates shall be such that the drying shrinkage of lightweight concrete produced therefrom, when tested in conformance with the requirements in California Test 537, shall be not more than 0.040-percent after 14 days of drying.
D. Lightweight aggregates shall have not more than 5 percent loss when tested for soundness in conformance with the requirements in California Test 214.
E. Natural sand and manufactured sand fine aggregates, portland cement, water, and admixtures shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications.

Proportioning of lightweight concrete shall conform to the provisions in Section 90-5, "Proportioning," of the Standard Specifications and to these special provisions.

Lightweight concrete shall have good workability and other properties such that proper placement, consolidation, and finishing are obtained.

The aggregates shall be uniformly pre-wetted or presaturated in such a manner that uniform penetration of the concrete will be maintained. Presaturation by thermal, vacuum, or equivalent methods will be required for lightweight aggregate in concrete that is to be pumped.

Portland cement, aggregates, water, and admixtures shall be proportioned to produce lightweight concrete containing not less than 350 kg of cement per cubic meter. Penetration of lightweight concrete produced for use in the work shall conform to the provisions in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications. The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures," of the Standard Specifications, except that the Contractor may provide for a total air content of freshly mixed concrete of not more than 6 percent.

Penetration measurements will be made by a lightweight ball penetrator in conformance with the requirements in California Test 533.

The air content of the freshly mixed lightweight concrete will be determined in conformance with the requirements in ASTM Designation: C173.

Lightweight fine aggregate and natural or manufactured sand shall be batched by mass. Lightweight coarse aggregate shall be batched either by mass or by volumetric methods. If volumetric methods are used, the batching equipment shall include provisions whereby the Engineer may check the mass of each size of aggregate in the batch.

After acceptance by the Engineer, materials and batch proportions shall not be altered during the work, except as necessary to maintain the approved cement factor and unit mass. The cement content of individual batches for use in the work shall be not more than 9 kg per cubic meter less than, nor more than 15 kg per cubic meter greater than the approved cement factor.

Mixing and transporting lightweight concrete shall conform to the provisions in Section 90-6, "Mixing and Transporting," of the Standard Specifications.

Lightweight concrete shall be placed, finished, cured, and protected in conformance with the provisions in Section 51, "Concrete Structures," and Section 90, "Portland Cement Concrete," of the Standard Specifications.

Each trial batch shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications. The quantities of trial batch lightweight concrete will not be included in any contract item of work, and full compensation for furnishing, producing, and disposing of trial batches shall be considered as included in the contract price paid for the item of lightweight concrete involved, and no additional compensation will be allowed therefor.

Lightweight concrete will be measured and paid for in conformance with the provisions in Section 90-11, "Measurement and Payment," of the Standard Specifications.

The concrete temperature during curing shall not exceed 65°C.

The Contractor's proposed concrete mix design shall be submitted to the Engineer for approval. The submittals shall include the test results for ball penetration, air content, freshly mixed concrete unit weight, air-dry unit weight, and the test results for compressive strength at formwork release, 1, 3, 7, 28, 56, and 90 days.

The Contractor shall cast at least one trial panel in full scale as designated by the Engineer at the precast concrete plant to demonstrate panels cast with the proposed mix. Design materials and procedures used in the trial panel shall be identical to those proposed to be used in production. The trial panel shall be made sufficiently before production panels are cast to demonstrate that design compressive strength can be achieved, the segments can be cast without segregation of the concrete and the required surface finish as specified in Section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications has been obtained. The cylinders shall be cured and tested in the same manner as acceptance cylinders in a production mode. Test results for ball penetration, freshly mixed concrete unit weight, air-dry unit weight, and compressive strengths at concrete ages of 1, 3, 7, 28, 56 and 90 days shall be submitted. The final mix design will not be approved until the trial panel is approved by the Engineer.

After approval by the Engineer, the trial panel shall not be used in the production and shall be used as a standard of finish for the production panels.

Initial application of heat shall not begin until the concrete has reached its initial set as determined by ASTM C 403. Panels shall be maintained wet until placed in the formwork for the segments.

Calcium chloride and corrosion inhibitors shall not be used.

Footing Lightweight Concrete In-Fill

Lightweight concrete in-fill shall be a low-density concrete made with portland cement, water, and air with or without aggregate, mineral admixtures, and chemical admixtures.

Lightweight concrete in-fill shall have a freshly mixed concrete unit weight at point of placement equal to or less than 800 kilograms per cubic meter, and shall be pumpable and self-compacting.

Total cementitious material content shall be minimized consistent with development of required properties.

At the Contractor's option, the aggregate may consist of perlite or vermiculite in conformance with the requirements in ASTM C 332, Group I; polystyrene; or other low density aggregates in conformance with the requirements in ASTM C 332, Group II.

Concrete using foaming agents shall be tested in conformance with the requirements of ASTM Designation: C 796.

Lightweight concrete in-fill temperatures at any time shall not exceed 65°C.

MASS CONCRETE

Portions of structure that are mass concrete include piles, pile cap structural concrete (except lightweight concrete), pier columns, pier table diaphragms, and pier table soffits. Mass concrete shall conform to the requirements of Section 90, "Portland Cement Concrete," of the Standard Specifications, "Concrete Structures" of these special provisions. Mass concrete construction shall include modeling, providing temperature control and monitoring during placement.

After the mass concrete pour has been topped out and finished it shall be revibrated and refinished. Revibration shall extend below the top mat of reinforcement and shall be done as late as the concrete will again respond to vibration. For concrete pours without top reinforcement, revibration shall extend to a depth of 150 mm.

The Contractor shall control the internal and surface temperature of mass concrete during curing to prevent thermal cracking due to heat generation and dissipation. Temperature modeling and temperature monitoring shall be required for the placement of mass concrete. The maximum internal temperature of the mass concrete once placed shall not exceed 65°C and the maximum temperature difference between any surface of the mass concrete and the hottest portion will be controlled as described in the "Thermal Control Plan" of these special provisions to prevent cracking.

The concrete temperature shall be monitored by thermocouples placed into the concrete, as required in "Thermal Control Plan" of these special provisions. Use of ice, liquid nitrogen, insulated curing blankets, insulated forms, cooling pipes and other measures may be necessary to satisfy the temperature requirements.

Thermal Control Plan.—For each mass concrete structure component, prior to commencing any mass concrete placement, the Contractor shall submit a Thermal Control Plan to the Engineer for approval. The Thermal Control Plan shall include the following:

A. The length and method of curing
B. The procedures to control maximum concrete temperature at time of placement
C. The report of thermal modeling, temperature sensor types and locations
D. Data acquisition method
E. Proposed method of controlling temperature differentials
F. Provisions for field measures to ensure meeting the maximum concrete temperature and temperature differentials requirements
G. Mix design

Concrete temperatures shall be monitored at the centroid of concrete, on at least two outer faces, on at least two corners, on the top surface, and for pile caps, at the geometric center of the bottom face of the concrete pour. The air temperature shall also be recorded. Temperature readings shall be automatically recorded on an hourly basis. A redundant set of sensors shall be installed near the primary set. Provision shall be made for recording the redundant set, but records of the redundant sensors need not be made if the primary set is operational. Temperature monitoring may be discontinued when the maximum allowable temperature difference is greater than the difference between the interior concrete temperature and the average daily temperature for three consecutive days. Wiring from thermocouples that must be cast into the concrete shall be protected to prevent damage. Wire runs shall be as short as possible. Temperature monitoring equipment shall be capable of printing and data storage and shall be able to download monitoring data to a computer. Data shall be downloaded and submitted daily to the Engineer. During monitoring, should the specified maximum internal temperature of the mass concrete be exceeded or the maximum allowable temperature difference between any surface of the mass concrete and the hottest portion be exceeded, the Contractor shall take immediate measures to correct the situation as specified in the Thermal Control Plan. Failure to meet the temperature requirements of the specifications will be cause for rejection of the concrete.

Demonstration Pours.—The Contractor shall cast at least one mock-up for the pier column and pier table diaphragm as shown on the plans to demonstrate adequacy of hydration and thermal properties of concrete predicted by the thermal control plan. The mock-ups shall demonstrate that the procedures in the thermal control plan to be used will eliminate thermal cracking and conform to the temperature requirements in these special provisions.

After the final Thermal Control Plans are submitted, the Contractor shall allow the Engineer 20 working days for review and approval.

Full compensation for conforming to the above requirements shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

FALSEWORK

Falsework shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

The first and second paragraph in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications are amended to read:

· The Contractor shall submit to the Engineer working drawings and design calculations for falsework proposed for use at bridges. For bridges where the height of any portion of the falsework, as measured from the ground line to the soffit of the superstructure, exceeds 4.25 m; or where any individual falsework clear span length exceeds 4.85 m; or where provision

for vehicular, pedestrian, or railroad traffic through the falsework is made; the drawings shall be signed by an engineer who is registered as a Civil Engineer in the State of California. Six sets of the working drawings and 2 copies of the design calculations shall be furnished. Additional working drawings and design calculations shall be submitted to the Engineer when specified in "Railroad Relations and Insurance" of the special provisions.

· The falsework drawings shall include details of the falsework erection and removal operations showing the methods and sequences of erection and removal and the equipment to be used. The details of the falsework erection and removal operations shall demonstrate the stability of all or any portions of the falsework during all stages of the erection and removal operations.

The seventh paragraph in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications is amended to read:

· In the event that several falsework plans are submitted simultaneously, or an additional plan is submitted for review before the review of a previously submitted plan has been completed, the Contractor shall designate the sequence in which the plans are to be reviewed. In such event, the time to be provided for the review of any plan in the sequence shall be not less than the review time specified above for that plan, plus 2 weeks for each plan of higher priority which is still under review. A falsework plan submittal shall consist of plans for a single bridge or portion thereof. For multi-frame bridges, each frame shall require a separate falsework plan submittal.

Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications is amended by adding the following paragraphs:

· If structural composite lumber is proposed for use, the falsework drawings shall clearly identify the structural composite lumber members by grade (E value), species, and type. The Contractor shall provide technical data from the manufacturer showing the tabulated working stress values of the composite lumber. The Contractor shall furnish a certificate of compliance as specified in Section 6-1.07, "Certificates of Compliance," for each delivery of structural composite lumber to the project site.

· For falsework piles with a calculated loading capacity greater than 900 kN, the falsework piles shall be designed by an engineer who is registered as either a Civil Engineer or a Geotechnical Engineer in the State of California, and the calculations shall be submitted to the Engineer.

The first paragraph in Section 51-1.06A(1), "Design Loads," of the Standard Specifications is amended to read:

· The design load for falsework shall consist of the sum of dead and live vertical loads, and an assumed horizontal load. The minimum total design load for any falsework, including members that support walkways, shall be not less than 4800 N/m^2 for the combined live and dead load regardless of slab thickness.

The eighth paragraph in Section 51-1.06A(1), "Design Loads," of the Standard Specifications is amended to read:

· In addition to the minimum requirements specified in this Section 51-1.06A, falsework for box girder structures with internal falsework bracing systems using flexible members capable of withstanding tensile forces only, shall be designed to include the vertical effects caused by the elongation of the flexible member and the design horizontal load combined with the dead and live loads imposed by concrete placement for the girder stems and connected bottom slabs. Falsework comprised of individual steel towers with bracing systems using flexible members capable of withstanding tensile forces only to resist overturning, shall be exempt from these additional requirements.

The third paragraph in Section 51-1.06B, "Falsework Construction," of the Standard Specifications is amended to read:

· When falsework is supported on piles, the piles shall be driven and the actual bearing value assessed in conformance with the provisions in Section 49, "Piling."

Section 51-1.06B, "Falsework Construction," of the Standard Specifications is amended by adding the following paragraphs:

· For falsework piles with a calculated loading capacity greater than 900 kN, the Contractor shall conduct dynamic monitoring of pile driving and conduct penetration and bearing analyses based on a wave equation analysis. These analyses shall be signed by an engineer who is registered as a Civil Engineer in the State of California and submitted to the Engineer prior to completion of falsework erection.

· Prior to the placement of falsework members above the stringers, the final bracing system for the falsework shall be installed.

Section 51-1.06C, "Removing Falsework," of the Standard Specifications is amended by adding the following paragraph:

· The falsework removal operation shall be conducted in such a manner that any portion of the falsework not yet removed remains in a stable condition at all times.

In addition to the provisions in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications, the time to be provided for the Engineer's review of the working drawings for specific structures, or portions thereof, shall be as follows:

Structure or Portion of Structure	Total Review Time - Weeks
Pier Table Construction	12
Piers	4

Welding and Nondestructive Testing

Welding of steel members, except for when fillet welds are used where load demands are less than or equal to 175 N/mm for each 3 mm of fillet weld, shall conform to AWS D1.1 or other recognized welding standard. The welding standard to be utilized shall be specified by the Contractor on the working drawings.

Splices made by field welding of steel beams at the project site shall undergo nondestructive testing (NDT). At the option of the Contractor, either ultrasonic testing (UT) or radiographic testing (RT) shall be used as the method of NDT for each field weld and any repair made to a previously welded splice in a steel beam. Testing shall be performed at locations selected by the Contractor. The length of a splice weld where NDT is to be performed, shall be a cumulative weld length equal to 25 percent of the original splice weld length. The cover pass shall be ground smooth at the locations to be tested. The acceptance criteria shall conform to the requirements of AWS D1.1, Section 6, for cyclically loaded nontubular connections subject to tensile stress. If repairs are required in a portion of the weld, additional NDT shall be performed on the repaired sections. The NDT method chosen shall be used for an entire splice evaluation including any required repairs.

For all field welded splices and previously welded splices, the Contractor shall furnish to the Engineer a letter of certification which certifies that all welding and NDT, including visual inspection, are in conformance with the specifications and the welding standard shown on the approved working drawings. The letter of certification shall be signed by an engineer who is registered as a Civil Engineer in the State of California and shall be provided prior to placing any concrete for which the falsework is being erected to support.

ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the provisions in Section 51-1.12H, "Elastomeric Bearing Pads," of the Standard Specifications and these special provisions.

The table in the ninth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications is amended to read:

Tensile strength, percent	-15
Elongation at break, percent	-40; but not less than 300% total elongation of the material
Hardness, points	+10

COST REDUCTION INCENTIVE PROPOSALS FOR PRECAST CONCRETE SEGMENTS

Except as provided herein, precast concrete segments shall be constructed in conformance with the details shown on the plans, the provisions in Sections 50, "Prestressing Concrete," and Section 51, "Concrete Structures," of the Standard Specifications, and in Sections "Furnish Precast Concrete Segment," and "Erect Precast Concrete Segment," elsewhere in these special provisions.

If the Contractor submits cost reduction incentive proposals for precast concrete segments, the proposals shall be in accordance with the provisions of Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications, the provisions in "Cost Reduction Incentive Proposals" elsewhere in these special provisions, and these special provisions.

The Engineer may reject any proposal which, in the Engineer's judgment, may not produce a structure which is at least equivalent to the planned structure.

Prior to submitting a cost reduction incentive proposal (CRIP) the Contractor shall make a conceptual submittal sufficient for the Engineer to judge the quality of the CRIP to be proposed. As a minimum the conceptual submittal shall include:

A. A detailed description of the construction method or proposed change, with conceptual drawings and preliminary design calculations.
B. Itemization of redesigns necessary to accommodate the change or method in accordance with the project specific design criteria and these special provisions.
C. A construction schedule showing completion of the project within the required number of working days.
D. Evidence of the Contractor's experience using the method, if applicable.
E. An estimate of the net construction cost savings.

Conceptual design submittals shall be made in accordance with the requirements for submitting CRIPs of these special provisions except that all conceptual submittals shall be made in 10 copies. The Contractor shall allow the Engineer 20 working days for review of a conceptual design for precast concrete segments. If the Contractor's conceptual design submittal is approved by the Engineer, the Contractor may submit the CRIP in accordance with the requirements of these special provisions. Approval of a conceptual submittal in no way constitutes approval nor guarantees future approval of the Contractor's CRIP.

CRIP submittals shall conform to "Working Drawings," elsewhere in these special provisions. The CRIP submittal shall include proposed revisions to the contract plans, design calculations (including calculations for camber, deck profile for each stage of construction, and falsework.) Calculations shall be independently checked, and these check calculations shall be included in the submittal.

Each CRIP shall be submitted prior to completion of 25 percent of the contract working days and sufficiently in advance of the start of the work that is proposed to be revised by the CRIP to allow time for review by the Engineer and correction by the Contractor of the CRIP plans and calculations without delaying the work. The Contractor shall allow a minimum of 50 working days for the review of a CRIP. In the event that several CRIPs are submitted simultaneously, or an additional CRIP is submitted for review before the review of a previously submitted CRIP has been completed, the Contractor shall designate the sequence in which the CRIPs are to be reviewed. In this event, the time to be provided for the review of any proposal in the sequence shall be not less than the review time specified herein for that proposal, plus 2 weeks for each CRIP of higher priority which is still under review.

No extension of time nor delay will be granted for a CRIP.

Permits and approvals required of the State have been obtained for the structures shown on the plans. Proposals which result in a deviation in configuration may require new permits or approvals. The Contractor shall be responsible for obtaining the new permits and approvals before the Engineer will reach a decision on the proposal. Delays in obtaining permits and approvals will not be reason for granting an extension of contract time.

All proposed modifications shall be designed in conformance with the bridge design specifications, procedures currently employed by the Department, and the project design criteria. The project design criteria are included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications. The proposal shall include all related, dependent or incidental changes to the structure and other work affected by the proposal. The proposal will be considered only when all aspects of the design changes are included for the entire structure. Changes, such as additional reinforcement and changes in location of reinforcement, necessary to implement the CRIP after approval by the Engineer, shall be made at the Contractor's expense.

Modifications may be proposed in the following:

A. Segment lengths
B. The amount and location of reinforcing steel
C. The amount and location of prestressing force in the superstructure
D. Erection method for various heavy lift and the erection sequences.

A modification with regard to method of construction, post-tensioning system, or erection differing in any respect from the structure as designed and detailed on the plans shall comply with the following:

A. All permanent post-tensioning anchorage systems shall be located within the deck slab, within the girder webs, within reinforced stressing blocks, or within diaphragms. Temporary post-tensioning anchorages shall be located within the deck slabs, in diaphragms or reinforced stressing blocks inside the box. Temporary external post-tensioning anchorage systems may be located outside the box girders and removed to restore the girder to the original cross section after use.
B. A precast, match-cast proposal shall utilize the multiple shear key concept. Single shear keys shall not be used.

C. The proposed post-tensioning tendon profile shall be compatible with the minimum bending radius shown on the plans. The Contractor's design friction and wobble coefficients shall not exceed the coefficients shown on the plans.

Modifications proposed to the minimum amount of prestressing force which must be provided by full length draped tendons are subject to the provisions in "Prestressing Concrete" of these special provisions.

No modifications will be permitted in (1) the thickness of box girder webs, deck slabs, and the bottom slabs, (2) the span lengths or longitudinal profile, (3) the exterior dimensions of the box girder. Fixed connections at the tops and bottoms of piers as shown on the plans shall not be eliminated.

The Contractor shall be responsible for determining construction camber and obtaining the final profile grade as shown on the plans.

MEASUREMENT AND PAYMENT

Measurement and payment for concrete in structures shall conform to the provisions in Section 51-1.22, "Measurement," and Section 51-1.23, "Payment," of the Standard Specifications and these special provisions.

Full compensation for mass concrete temperature modeling and monitoring, and demonstration pours shall be considered as included in the contract prices paid for the various item of concrete work involved and no separate payment will be made therefor.

Full compensation for creep and shrinkage tests shall be considered as included in the contract price paid for the various items of concrete work involved and no separate payment will be made therefor.

The contract price paid per cubic meter for furnish precast concrete panel (precast segment, lightweight) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing and furnishing lightweight precast concrete panel for precast concrete segment, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for furnish precast concrete panel (pier table, lightweight) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing and furnishing lightweight precast concrete panel for pier table at the site of the work complete and ready for erection, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for erect precast concrete panel (pier table, lightweight) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in erecting lightweight precast concrete panel for pier table, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for furnish precast concrete wall (bridge footing) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing and furnishing precast concrete wall, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for erect precast concrete wall (bridge footing) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in erecting precast concrete wall, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for furnish precast concrete fender modules shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing and furnishing precast concrete fender modules, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for erect precast concrete fender modules shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in erecting precast concrete fender modules, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per cubic meter for structural concrete, bridge footing (lightweight) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing lightweight concrete in-fill, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Cast-in-place lightweight concrete for segment closures will be measured and paid for as structural concrete, bridge.

If precast lightweight concrete panels are fabricated more than 480 airline kilometers from both Sacramento and Los Angeles, additional precast facility inspection expenses will be sustained by the State. Whereas it is and will be impractical and extremely difficult to ascertain and determine the actual increase in such expenses, it is agreed that payment to the Contractor for furnishing precast concrete lightweight panels will be reduced $5 per cubic meter of precast lightweight concrete panel.

10-1.28 CONCRETE STRUCTURES (SERVICE PLATFORMS)

Portland cement concrete structures (service platforms) shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and "Concrete Structures" elsewhere in these special provisions and these special provisions.

Shotcrete shall not be used.

10-1.29 FURNISH PRECAST CONCRETE SEGMENT

Furnish precast concrete segment shall conform to the details shown on the plans, the provisions in "Concrete Structures" and "Precast Concrete Quality Control" elsewhere in these special provisions, and these special provisions.

Attention is directed to "Lightweight Concrete," elsewhere in these special provisions regarding requirements for precast lightweight concrete panels that are set into the forms for precast concrete segments.

Attention is directed to "Construction Surveying," elsewhere in these special provisions. Geometry control for furnishing precast concrete segments shall conform to "Construction Surveying," except that the portion of the Survey Plan for geometry control for furnish precast concrete segments shall be incorporated into the Casting Manual as specified herein.

GENERAL

This work shall consist of performing all operations necessary to construct precast concrete segments including manufacturing, storage, and transportation of the segments to the bridge site. The segments shall be furnished complete including all concrete, transverse prestressing steel, bar reinforcing steel, miscellaneous metal, utility ducts, prestressing steel ducts, anchorages, and other appurtenances in connection therewith.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with "Working Drawings," elsewhere in these special provisions. Working drawings shall include complete details, information, and substantiating calculations for the methods, materials, equipment, and procedures the Contractor proposes to use in constructing, handling, storing, and transporting the precast concrete segments.

Working drawing submittals shall include the following:

A. Segment formwork and falsework plans including support for precast panels during casting of the segment.
B. Casting cell foundation plans.
C. Form drawings.
D. All other supplementary plans and similar data required to successfully accomplish the work.
E. Substantiating calculations for the design of falsework, casting equipment, and formwork including the number of uses prior to replacement.
F. Substantiating calculations for other temporary construction which may be required and which will be subject to calculated stresses.
G. Fully and accurately dimensioned views showing the geometry of each segment including all projections, recesses, notches, openings, blockouts, and other pertinent details.
H. Details and dimensions of the anchorage system for the post-tensioning system.
I. Details of nonprestressed steel reinforcing that include size, spacing, and location including any special reinforcing steel required but not shown on the plans.
J. Details of size and type of ducts for all post-tensioning tendons and their horizontal and vertical profiles including the duct support locations.
K. Details and locations of all other items to be embedded in the segments such as inserts, lifting devices, and post-tensioning hardware. All Contractor added inserts shall be identified for use.
L. Composite placing drawings to scale and in sufficient detail to show the relative positions of all items that are to be embedded in the concrete and their embedment depth. Such embedded items include the prestressing ducts, vents, anchorage reinforcement and hardware, reinforcing steel, anchor bolts, earthquake restrainers, deck joint seal assemblies, drainage systems, utility conduits. Drawings shall show enough details to ensure that there will be no conflict between the planned positions of any embedded items, and that the concrete cover will be adequate.
M. Details of handling and storing segments.
N. Segment shipping and handling plans.

A supplement to the working drawings shall include the following:

A. The Contractor's proposed methods of geometry controls for the casting operation and a quality control plan for geometry control. This submittal shall be in the form of a "Casting Manual" and shall include the following:

1. A detailed exposition of the geometry control theory for casting.
2. A detailed narrative of the step-by-step geometry control procedure.
3. Detailed calculation forms, and a set of sample calculations for geometry controls, including sample input and output of computer programs.
4. Identifications of all measuring equipment, procedures, and qualifications of personnel who will carry out geometry control.
5. A production schedule with rates of production and number of casting units.
6. All geometry control operations necessary for casting and in agreement with the Contractor's chosen methods of casting and erecting.
7. The provisions to protect instruments from construction activities and to minimize the effects of wind and temperature variations on the accuracy of readings.
8. The casting manual shall be coordinated with the erection method in the erection manual utilizing the same control points on each segment.

B. Calculations of creep, shrinkage, and concrete modulus of elasticity in accordance with the recommendations of CEB-FIP Model Code 1978 for Concrete Structures. These calculations shall be adjusted to reflect the results of the materials tests required for structural concrete specified elsewhere in these special provisions.
C. A casting curve prepared in accordance with the actual material properties (as calculated above), casting and erection dates, erection sequence, loads, and construction schedule proposed by the Contractor. The casting curve shall be of sufficient accuracy to allow the determination of control point settings for accurately casting the segments. The preparation of the casting curve shall recognize all deviations from a straight line and shall include all deviations associated with the required alignment and deformations due to dead load, future superimposed dead loads, erections loads, post-tensioning forces, secondary moments, creep, and shrinkage at day 10,000.
D. Method of mixing and placing grout in accordance with the current schedule; equipment description and capacity (including standby flushing equipment); and mix design.
E. Methods of vibration during the concrete placement, including complete placing plan, the number of lifts, lift height, crew size, number of vibrator or vibration devices, and coordination of vibration and cure.
F. Type of cure and schedule for cure.
G. Schedule of form removal.

After a complete submittal has been received (as determined by the Engineer), the Contractor shall allow the Engineer 50 working days to review the complete submittal.

MATERIALS

Prestressing steel, ducts, anchorages, and grout shall conform to the provisions in "Prestressing Concrete" of these special provisions.

Lightweight concrete shall conform to the provisions in "Lightweight Concrete" of these special provisions.

Reinforcement shall conform to the provisions in "Reinforcement" of these special provisions.

Miscellaneous metal shall conform to the provisions in "Miscellaneous Metal (Bridge)" of these special provisions.

TOLERANCES

Finished segment tolerances shall conform to Table 9-1 of Division II – Construction Specifications of the AASHTO *Guide Specifications for Design and Construction of Segmental Concrete Bridges, Second Edition, 1999* and as specified herein. Tolerance for overall depth of segment shall be ±6 mm.

Dimensions from segment to segment shall be adjusted to compensate for any deviations within a single segment so that the overall alignment of the completed structure will conform to the dimensions shown on the plans and approved working drawings with supplement.

Overall cumulative tolerances shall conform to the erection tolerances specified elsewhere in these special provisions.

HANDLING, STORAGE, AND SHIPMENT

Care shall be exercised in the handling of segments to prevent damage to them. Handling shall be done only by using devices intended for this purpose as shown on the approved working drawings and supplement. Segments shall not be lifted until a minimum compressive strength of 45 MPa is reached. Segments shall be stored with the deck level in the upright position for superstructure segments. Segments shall be firmly supported on a bearing system under the webs at calculated safe locations as shown on the approved working drawings and supplement. The number of support locations shall be three

for each segment during handling, storage, and shipment. The bearing system shall be designed to prevent twist or warping of the segments during the entire period of storage, transportation, and handling. The segments shall not be stacked vertically.

The Contractor shall inform the Engineer in writing at least 10 working days prior to shipment of each segment to allow for inspection. No segment shall be shipped without the Engineer's inspection and approval. Repairs to minor spalls or chipped areas on the match cast joint surfaces shall be made in the match cast position. The Contractor shall record all repairs on the drawings and shall submit all repair records and drawings to the Engineer no more than 2 working days after the repairs are complete. The faces of all match cast joints shall be thoroughly cleaned of laitance, bond breaking compound, and other foreign material by wire brushing or light sand blasting. Upon arrival at the bridge site, each segment shall again be inspected. If any damage has occurred during shipment that could impair the structural or other function of the segment, such damage shall be cause for rejection of the segment.

SEQUENCING AND SCHEDULING

The Contractor's CPM schedule shall contain at least the following activities for the production of precast segments:

A. Working drawing review
B. Form fabrication
C. Set up of precasting yard
D. Form assembly
E. Segment casting and curing period for each segment
F. Stressing of transverse prestressing tendons and vertical prestressing bars for each segment
G. Grouting of tendon and bar ducts for each segment
H. Shipment schedule for each segment

The following milestone dates shall be noted on the schedule:

A. Set up staging area
B. Set up casting yard
C. Deliver forms
D. Forms operational
E. Deliver batch plant
F. Batch plant operational
G. Initial working drawing submissions (all major items)
H. Start segment casting
I. Finish segment casting

The Contractor's CPM schedule shall include monthly inventory of precast segments in the storage yard and shall be submitted to the Engineer monthly. Changes to projected inventory shall be included in the monthly updates.

The casting curves and erection elevations are dependent on the erection sequence and the erection schedule. When modifications are made to the erection sequence or the erection schedule, the Contractor shall submit to the Engineer revised casting curves and erection elevations with revised erection sequence and the erection schedule.

CASTING REQUIREMENTS

The segments shall be match-cast so that a segment is cast against the preceding segment to produce a matching interface that will permit re-establishment of the cast geometry at the time of erection. Each segment shall be given a distinct erection mark indicating its location and order in the erection sequence. This mark shall be placed on each segment before it is removed from the casting cell. Abutting edges of adjacent segments shall be match marked. Erection marks shall be shown on the erection plans as specified elsewhere in these special provisions.

Before any segment concrete placement, the Contractor shall erect the lightweight concrete panels to the positions as shown on the plans. The erection of the lightweight concrete panels shall be incorporated into the Contractor's falsework and formwork plans in order to successfully construct the concrete segments.

Where sections of forms are to be joined, maximum offset shall be 1.5 mm for flat surfaces and 3 mm for corners and bends.

Tolerances for casting of the precast segments are specified elsewhere in these special provisions. If the Contractor fails to meet these tolerances, the Contractor shall grind the surfaces (if cover is sufficient after grinding) to meet the tolerance or replace the segments. All correction work including the replacement of segments if necessary shall be at the Contractor's expense.

Dimensions from segment to segment shall compensate for deviations within a single segment so that the overall dimensions of the completed structure will conform to the dimensions shown on the plans.

Creep, shrinkage, and concrete modulus of elasticity shall be computed in accordance with the recommendations of CEB-FIP Model Code 1978 for Concrete Structures (Comité Euro-international du Béton Fédération Internationale de la Précontrainte) as adjusted to reflect the results of materials test required for structural concrete specified elsewhere in these special provisions.

All material to be encased within the concrete segment shall be placed and supported in the position as shown on the plans and approved working drawings. Provisions for all projections, recesses, notches, openings, blockouts, and the like shall be made in accordance with the plans and shown on the approved working drawings with supplement. The match-cast segment shall not be twisted. The abutting surface of the bulkhead segment shall be covered with a thin film of a bond breaker consisting of flax soap and talc, or other suitable material as approved by the Engineer. The soap and talc mixture shall be 5 parts flax soap and 1 part talc. The acceptability of a material other than soap and talc shall be determined prior to casting of the segments by demonstration of a large specimen that has a facial area of at least 1.2 meter by 1.2 meter.

Immediately before and after segment casting (before bond breaking), the geometry of the segment shall be recorded from the approved control points. Instruments used for the horizontal and vertical geometry control shall be mounted on rigid permanent platforms with sufficient height to sight on all control points. A minimum of two permanent benchmarks shall be established on line with the instrument mounting pad in the casting yard. Prior to beginning casting operations using the short line method, horizontal and vertical control points shall be established on the fixed bulkhead. The alignment, elevations, and shape of the fixed bulkhead shall be checked by readings on these control points each time the geometry of adjoining segments is checked. If any settlements or distortions beyond tolerance occur, casting with these forms shall be discontinued until the distortion is corrected.

Immediately after casting of a segment is completed, the length of the segment along the line of each web shall be measured and recorded and references for horizontal and vertical control shall be established as follows:

A. Horizontal control shall include a wire stirrup on the horizontal control line at both ends of the segment. A line not more than 0.3 mm in width shall be scribed or a punchmark placed in a permanent manner into each stirrup. Wire stirrups shall be stainless steel.
B. Vertical control shall include a flat head bolt, with a pin hole in the head, approximately flush with the surface of the concrete over each web at both ends of the segment. Bolts shall be stainless steel.

The following additional requirements shall apply to geometry control for short line casting of segments.

A. The instruments used to measure elevations shall be precision levels equipped with parallel plate micrometers capable of obtaining first order control and one piece Invar rods with centering point bases.
B. The instruments used to make horizontal measurements shall be one-second theodolites.
C. A centerline offset measuring tool shall be directly calibrated in intervals of 0.6 mm and offset measurements shall be observed in an accuracy of 0.3 mm.
D. The set-up position of two adjacent segments before casting shall be independently determined by the Contractor and the Engineer. Casting shall not begin until these surveys agree within the following tolerances:

    1. Elevation: 0.6 mm on any control point
    2. Horizontal: 0.6 mm on a segment centerline offset
    3. Twist error: 0.9 mm

E. After cast observations shall be independently determined by the Contractor and the Engineer. They shall be checked until the independent observations agree within the following tolerances:

    1. Elevation: 0.3 mm on any control point
    2. Horizontal: 0.3 mm on a segment centerline offset
    3. Twist error on elevation control points: 0.3 mm (with 0.6 mm maximum on a random error)

F. Within 5 working days of casting all data from the geometry control, including theoretical and actual reading prior to and following casting the segment (but prior to form release) shall be submitted to the Engineer.

The concrete finish shall be Class 1 Surface Finish as specified in the section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications. The Contractor shall cast a test panel for use as a standard of finish. Minimum dimensions for the test panel are 2.0 m by 2.0 m.

When work is in progress, the Engineer shall be provided continuous access to the monitoring instruments, control devices, and casting operations. The Contractor shall submit all recorded data to the Engineer in a timely manner as requested by the Engineer.

EMBEDDED ITEMS

No reinforcing steel or other embedded items shall be cut and removed for installation and alignment of stressing ducts. Any bar that cannot be fabricated to clear the conduits shall be replaced by equivalent area of steel using bars with equal or smaller diameter. Modified working drawings shall be submitted to the Engineer for approval in accordance with the provisions in "Working Drawings," elsewhere in these special provisions. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 50 mm. In the plane of the steel perpendicular to the nearest surface of concrete, cover to the bars shall not be reduced from plan placement by more than 10 mm unless approved by the Engineer.

Metal ducts shall be supported at intervals of not more than 1.2 meters. At the segment joints, ducts shall be connected by rigid mandrels. Ducts shall not be displaced during casting. The tolerance on the location of the tendons shall be 10 mm at any point and in any direction except that the tolerance shall be 3 mm at the segment ends. The Contractor shall provide additional supports at segment joints to maintain segment alignment at bulkhead.

After installation in the forms, the ends of the ducts shall at all times be sealed to prevent entry of water and debris. Ducts shall be tied in position, inspected, and repaired prior to placing of the concrete. Following concrete placement and prior to shipment and erection, the Contractor shall demonstrate to the Engineer that all empty ducts are free of mortar and water, and are unobstructed and undamaged.

CONCRETE PLACEMENT

Concrete shall not be deposited into forms until the entire set-up of the forms, reinforcement, ducts, and anchorages has been inspected and approved by the Engineer.

Concrete shall not be dropped more than 1.2 m, unless confined by closed chutes or pipes. Formwork shall not be considered as chutes.

Concrete shall be placed in horizontal layers not more than 450 mm thick. Each layer shall be placed, compacted, and consolidated before the preceding layer has taken initial set.

Immediately after the work of placing concrete is halted, all accumulations of mortar splashed upon the remaining exposed reinforcement and surfaces of forms shall be removed before the concrete takes its initial set. Water shall not be applied to concrete surfaces for this purpose. The cleaning operations shall not cause breakage of the concrete-steel bond.

The concrete shall be consolidated by means of vibrators together with other equipment necessary to perform the work. Internal vibrators shall have a minimum frequency of 8,000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. At least 2 stand-by vibrators in working condition shall be provided for emergency use in case of malfunction. The use of external vibrators for consolidating concrete is permitted and shall be required when the concrete is inaccessible for adequate consolidation. When external vibration is used, the forms shall be constructed sufficiently rigid to resist displacement or damage. Placement and vibration of concrete shall be done with care and in such a manner as to avoid displacement of reinforcing, conduits, and other items to be fixed in place.

No construction joints or cold joints shall be permitted within a segment. Any interruption of more than 30 minutes in the continuous placement of concrete in a segment shall be cause for rejection of that segment.

FORM REMOVAL

Weight-supporting forms shall remain in place until the concrete has reached the strength for form removal. For precast segments this strength shall be a minimum of 25 MPa compressive strength as evidenced by test cylinders made by the Contractor and cured in the same manner as the segment. Care shall be exercised in removing the forms to prevent spalling and chipping of the concrete.

DAMAGED OR DEFECTIVE SEGMENTS

Isolated defects are defects or damages that occur randomly and infrequently, as determined by the Engineer.

Recurring defects are defects or damages of the same general type and nature, which continue to be found in the same general location of the segments at an unacceptable frequency, as determined by the Engineer.

All segments cast will be jointly inspected by the Engineer and the Contractor after casting, after moving to storage from the casting machine, and before and after erection. All segment defects shall be identified and categorized during this inspection. The Contractor shall examine the defects and within 5 working days, propose to the Engineer, in writing:

A. The measures that the contractor shall take to prevent recurring defects in future segments.
B. The method of repair of all defects discovered as a result of the inspection as required herein.

If recurring defects continue following implementation of the Contractor's preventive measures, or as detected at any time during the construction, the Engineer will suspend the operations producing such defective segments.

The Engineer will determine what constitutes damage or defect, whether the damage or defect is isolated or recurring, and will categorize the damage or defects. Three categories of defects are recognized by the Engineer for this purpose:

A. Cosmetic:
   Cosmetic defects or damages are those which do not affect the ability of the segment to resist construction or service loads or reduce the life expectancy of the structure. This category of defect includes a superficial discontinuity such as hairline cracks, small cracks, small spalls or small honeycombed areas, or any defect that does not extend beyond the centerline of any reinforcing steel, or to any elements of the post-tensioning system.
   Cosmetic defects of other types and causes may also be designated by the Engineer.
   Repair of cosmetic defects shall be made in such a manner that the aesthetics and the integrity of the segment surface is restored.
B. Structural:
   This category of defect shall include any defect which will impair the ability of the segment to adequately resist construction or service loads or reduce the life expectancy of the structure. Any defect or damage which extends beyond the centerline of any reinforcing steel or into any element of the post-tensioning system or occurs in the top slab portion of the segment is considered a structural defect.
   Examples of such defects include cracks, large spalls and honeycombed areas, major segregation or breakage of concrete; however, structural defects of other types and causes may be designated by the Engineer.
   The Contractor shall be responsible for construction load analysis, service load analyses and life expectancy determinations.
   Repair of structural defects shall be such that the aesthetics and structural integrity of the segment shall be completely restored to a condition to be expected had the defect or damage not occurred.
C. Rejectable:
   A rejectable defect is any defect or damage, as determined by the Engineer, which will impair the ability of the segment to adequately resist service loads or construction loads, or will reduce the life expectancy of the structure and which cannot be successfully repaired such that the structural integrity is completely restored. Any segment with a rejectable defect will be deemed unacceptable and shall be removed from the work and replaced by the Contractor at no additional cost to the State.
   Damaged or defective segments may also be rejected by the Engineer for the following reasons:

   1. Failure of the Contractor to submit proposed repair procedures.
   2. Failure of the Contractor to execute the repair according to the approved procedure.
   3. Rejection of the proposed repair procedure or repair by the Engineer.
   4. Failure of the Contractor to provide the required certification or demonstration that the repair was successful and that the defect no longer exists, as required below.
   5. Failure of the Contractor to eliminate recurring defects.
   6. Determination by the Engineer that the work or materials used in the work does not meet other requirements of the Contract Documents and is not acceptable.

Cosmetic repairs shall only be made following procedures prepared by the Contractor, submitted in writing to and approved by the Engineer. The Contractor's repair procedure shall identify those areas required to be repaired prior to post-tensioning, and those that must be repaired after post-tensioning. The Contractor shall allow the Engineer 5 working days to review and approve for each and any subsequent cosmetic repair procedure.

Structural repairs shall be made following procedures prepared by the Contractor. The repair procedures shall be signed and sealed by the Contractor's Engineer who is registered as a Civil Engineer in the State of California. The Contractor shall submit the repair procedures, in writing, to the Engineer for approval. The Contractor shall allow the Engineer 15 working days to review and approve for each and any subsequent structural repair procedure. The repair procedures shall include the following:

A. A detailed description and sketch of the defect.
B. The magnitude and type of the most critical construction loading and service life condition to which the defective area will be subjected.
C. Detailed reinforcement requirements, material types, surface treatments, curing methods and general repair procedures proposed. The procedure shall clearly indicate those areas required to be repaired before erection, and those areas to be repaired after erection.

D. The specific nondestructive testing method and procedure by which the Contractor shall demonstrate to the Engineer that the defect no longer exists and the segment has been restored to a condition to be expected had the defect or damage not occurred.

Repairs to the shear keys along the webs shall be made after the segments have been erected. When 20 percent or more of the shear keys in a web have been damaged such that they cannot effectively transfer the shear across the joint, as determined by the Engineer, then the damaged shear keys shall be repaired after the segments have been erected and initially stressed together with no more than 10 percent of the final prestressing force applied across the joint. After the repair has been completed and obtained a minimum compressive strength of 17.5 MPa, the final prestressing force may be applied across the joint.

No repairs shall be made until the repair procedure has been approved by the Engineer. No extension of time will be made for the submittal, review and construction of repairs. No compensation will be made for any costs incurred or for delay in completing the work resulting from repairing damaged or defective segments.

DEMONSTRATION SEGMENT POURS

The Contractor shall cast at least one full scale demonstration segment at the precast concrete plant to demonstrate that the segments can be cast with the proposed mix. The first demonstration segment shall be Segment 1W at Pier 16 Eastbound. Design materials and procedures used in the demonstration segment shall be identical to those proposed to be used in production. The demonstration segment shall be constructed after creep and shrinkage tests for the proposed mix are complete. The demonstration segment shall be made sufficiently before production segments are cast to demonstrate that design compressive strength can be achieved and that segments can be cast without segregation of the concrete. The cylinders shall be cured and tested in the same manner as acceptance cylinders in a production mode. Test results for ball penetration, freshly mixed concrete unit weight, and compressive strengths at concrete ages of 1, 3, 7, 28, 56 and 90 days shall be submitted within 3 working days for each test. Failure to meet any of the acceptance criteria will result in the rejection of the demonstration segment. If the demonstration segment is rejected by the Engineer, the Contractor shall cast additional demonstration segments until all acceptance criteria are met. Final mix design approval will not be given until the design concrete compressive strength has been achieved from a successful demonstration segment. The successful demonstration segment may be used in production.

MEASUREMENT AND PAYMENT

Furnish precast concrete segment will be measured by cubic meter in accordance with the dimensions shown on the plans.

No payment will be made for precast concrete segments that fail to meet any of the acceptance criteria.

No compensation will be made for additional concrete, reinforcement, and any other costs incurred or for delay in completing the work resulting from replacing rejected segments.

The contract price paid per cubic meter for furnish precast concrete segment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing, furnishing, storing, and transporting precast concrete segment to the site of the work, and furnishing the casting complete in place, as shown on the plans, as specified in the Standard Specifications and these provisions, and as directed by the Engineer.

Full compensation for transverse and vertical prestressing of precast concrete segments shall be considered as included in the contract price paid per cubic meter for furnish precast concrete segment and no additional compensation will be allowed therefor.

Furnishing lightweight concrete panels will be measured and paid for as specified in "Lightweight Concrete," elsewhere in these special provisions.

Erect lightweight concrete panels will be measured and paid for as specified in "Erect Precast Concrete Segment," elsewhere in these special provisions.

10-1.30 ERECT PRECAST CONCRETE SEGMENT

Erect precast concrete segment shall conform to the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

Prestressing steel, ducts, anchorages, and grout shall conform to the provisions in "Prestressing Concrete" of these special provisions.

Attention is directed to "Construction Surveying," elsewhere in these special provisions. Geometry control for erecting precast concrete segments shall conform to "Construction Surveying," except that the portion of the Survey Plan for geometry control for erect precast concrete segments shall be incorporated into the Erection Manual as specified herein.

GENERAL

This work shall consist of furnishing all labor, equipment, and materials and performing all work involved in erecting precast concrete segments, including all erection equipment, and temporary prestressing steel for erection as shown on the plans and approved working drawings and supplement.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," elsewhere in these special provisions. Working drawings shall include complete details, information, drawings, and substantiating calculations of the methods, materials, equipment, and procedures that the Contractor proposes to use in erecting the segments.

Working drawing submittals shall include the following:

A. Erection sequences and plans including the incorporation of hinge erection and deck pour connection construction between the adjacent segments.
B. Temporary and permanent prestressing sequences.
C. Erection equipment details, including mass of equipment and attachment of equipment to the structure.
D. Diagrams showing support locations on the structure for equipment for each construction stage, including all interfacing of equipment with permanent structure.

A supplement to the working drawings shall include the following:

A. The Contractor's proposed methods of geometry controls for the erection operation. This submittal shall be in the form of an "Erection Manual" and shall include the following:

    1. A detailed exposition of the geometry control theory for erection.
    2. A detailed narrative of the step-by-step geometry control procedure during erection.
    3. A step-by-step segment erection procedure with all erection operations including, but not limited to, the following:

        a. All operations relating to erection equipment, falsework, movement of equipment, and counterweights.
        b. Erection equipment support details including locations of supports and the design loading at each support.
        c. Stressing of temporary post-tensioning bars.
        d. Closure operations including any partial stressing across the closure during concrete curing, location and size of shim blocks, main post-tensioning tendon sequences, stressing loads and elongations.
        e. Survey of segment alignment and elevations before, during, and after the segment is erected
        f. The field survey control methods to be employed for setting the initial and subsequent segments and other relevant operations.

    4. Measuring equipment, procedures, locations of control points established on each segment during the casting operation, and qualifications of personnel who will carry out geometry control.
    5. Detailed calculation forms and a set of sample calculations for geometry control.
    6. A table of elevations and alignments required at each stage of erection at the check points established for casting controls. Stages for which theoretical positions of control points are to be computed shall include the segment in place prior to applying post-tensioning and the segment with post-tensioning applied.
    7. Calculations of control point elevations and alignment for each stage of erection taking into account the final deck elevations as shown on the plans, the as-cast profile, and the calculated deflection for each stage of erection.
    8. An erection schedule with rates of production and number of erection units.
    9. All geometry control operations necessary for erection and in agreement with the Contractor's chosen methods of erection including erection survey, elevations, and alignment control.
    10. The erection manual shall be coordinated with the casting manual utilizing the same control points established on each segment during the casting operation.

B. Method of mixing and placing grout in accordance with the proposed schedule; equipment description and capacity (including standby flushing equipment); and mix design.
C. Independently checked calculations for erection equipment and temporary construction loading for each erection stage including:

1. Equipment loads
2. Erection loads
3. Temporary construction supports and loading conditions
4. Stresses induced during temporary construction conditions
5. Stresses induced during erection
6. Stresses from equipment connections to the structure

D. Substantiating documents for experienced and qualified personnel with at least 2 years experience in concrete segmental box girder construction who shall operate the instrument and supervise the entire erection operation.
E. Certified test reports of epoxy workability, gel time, contact time, compressive and shear strengths, and working temperature range tests specified elsewhere in these special provisions.
F. Epoxy application plan in conformance with requirements in section, "Epoxy Bonding Material for Precast Segments," elsewhere in these special provisions.
G. All other supplementary plans, procedures, materials, and similar data required to successfully erect the segments.
H. The Contractor's proposed load testing programs for erection equipment, including special equipment for cantilever erection.
I. Erection Safety Plan detailing procedures for safe lifting operation. This document shall name the person or persons in responsible charge of lifting operations and shall include their qualifications and experience.
J. If the Contractor proposes to deviate from the previously approved erection manual, the Contractor shall submit a revised erection manual to the Engineer for approval. The Contractor shall allow the Engineer an additional 60 working days to review the submittal.

After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 50 working days to review the submittal.

TOLERANCES

The erection tolerances shall be as follows:

A. Maximum differential offset between outside faces of adjacent segments in the erected position, including the roadway deck, shall not exceed 6 mm.
B. Transversely, the completed segmental span shall not deviate from the theoretical cross slope of the roadway by more than 0.001 radians, measured curb-to-curb, at any point along the span.
C. Longitudinally, the angular deviation from the theoretical slope change between two successive segments shall not exceed 0.0030 radians.
D. Dimensions from segment to segment shall be adjusted so as to compensate for any deviations within a single segment so that the overall dimensions of the completed structure will conform to the dimensions shown on the plans such that the accumulated maximum error should not exceed 1/1000 of the span length for either vertical profile and/or horizontal alignment. Deviations exceeding the erection tolerances listed above which are discovered during the match-casting operation shall be identified by after-cast surveys at the casting site before the matched-castings are separated. Corrections for these deviations shall be submitted to the Engineer prior to casting the next match-cast segment.

The erection of precast segments by cantilever method shall conform to these special provisions and the following special requirements:

A. During erection by the cantilever method, the maximum loads as shown on the plans and approved working drawings and supplement shall not be exceeded.
B. The horizontal and vertical location of the control points for the first typical segments adjacent to the pier table shall be within 6 mm of the position required by the approved erection plans and the slopes across these segments shall not exceed 0.001 radians of angular deviation from the theoretical values for horizontal and vertical grades.
C. The alignment and elevations of the cantilevers shall be checked by the Contractor and the Engineer, independently and concurrently (within one hour of each other) on each day that segments are to be erected. The measurements made by the Engineer and the Contractor shall agree to within 6 mm and be within the allowable tolerance from the theoretical values as specified elsewhere in these special provisions. If the measurements between the Engineer and the Contractor do not agree within 6 mm or the measurements are not within the allowable tolerance, the erection operation shall be temporarily suspended until the discrepancies are resolved.
D. The survey for geometry control shall be supervised by an engineer who is registered as a Land Surveyor or as a Professional Engineer in the United States.

E. To guard against false reading due to temperature differentials, readings shall only be taken when all portions of the box section are stabilized at the same temperature. The Contractor shall use precautions in devising methods to guard against these possible false readings and corresponding adjustments due to temperature differentials.
F. If measured elevations deviate out of tolerance from the table of elevations, the Engineer will suspend further erection of superstructure segments and the deviated out-of-tolerance segments will be rejected. The Contractor shall submit to the Engineer for approval a mitigation plan for restoration or replacement for each rejected segment, and this plan shall conform to the provisions in "Working Drawings," elsewhere in these special provisions. Prior to submitting this mitigation plan, the Engineer will hold a restoration feasibility meeting with the Contractor to discuss the feasibility of restoring rejected segment to its designed elevation and alignment. The Engineer will consider the magnitude and the location of the deviations, and the design information for the segment. This information will be made available to the Contractor, if appropriate, for the development of the mitigation plan. If the Engineer determines that it is not feasible to restore the rejected segment, the Contractor shall not include restoration as a means of mitigation and shall proceed with the submittal of a mitigation plan for replacement of the rejected segment. No additional payment or extension of time shall be due to the Contractor as a result of this suspension for unacceptable erection deviation.

After erection, final post-tensioning, final corrections and adjustments are complete, superstructure shall conform to the grade and alignment shown on the plans and approved working drawings and supplement.

The closure joint forms shall provide tolerances as specified for erection for mid-span closure joints.

EQUIPMENT

Erection equipment and other temporary construction shall conform to the following requirements:

B. Prior to use of any equipment such as a launching gantry, hoist, crane, a beam and winch, or other lifting device specifically fabricated for the purpose of lifting precast segments, the Contractor shall demonstrate by a full scale load test that the equipment is capable of supporting a load equal to 125 percent of the weight of the heaviest segments to be lifted. The Contractor shall submit to the Engineer for review the proposed load testing program with written approval from the equipment designer. The Contractor shall notify the Engineer in writing at least 5 working days prior to commencing any load test to allow witnessing of the load test. The equipment shall not be installed on the bridge until the load testing has been successfully completed.
C. Observation of load testing of erection trusses or erection equipment or review and approval of design drawings and calculations covering erection trusses or erection equipment by the Engineer shall in no way relieve the Contractor of any responsibility under the contract for the successful erection of segments in conformity with the requirements of the plans and specifications.

SEQUENCING AND SCHEDULING

The Contractor's CPM schedule shall contain at least the following activities for precast segment erection:

A. Pier table construction
B. Erection equipment fabrication
C. Erection equipment assembly
D. Segment erection
E. Stressing of cantilever tendons
F. Grouting of cantilever tendons
G. Superstructure jacking operation
H. Hinge erection
I. Closure pour construction
J. Stressing of continuity tendons
K. Stressing of span tendons
L. Grouting of continuity tendons and span tendons
M. Release of closure falsework

The following milestone dates shall be noted on the schedule:

A. Submittal of working drawings and supplement to the Engineer
B. Deliver erection equipment
C. Start each pier table construction
D. Start and end of each segment erection

E. Start grouting for each segment
F. Completion of each cantilever construction
G. Start closure of each cantilever
H. Start stressing of continuity tendons and span tendons
I. Start superstructure jacking for each frame
J. Completion of each frame construction
K. Start hinge erection for each hinge location

The casting curves and erection elevations are dependent upon the erection sequence and Contractor's schedule. Therefore, the Contractor shall produce and submit revised erection elevations and casting curves upon a change of erection sequence or schedule. The submittal of revisions shall conform to the provisions in "Working Drawings," elsewhere in these special provisions. The Contractor shall allow the Engineer 20 working days to review the revised erection elevations and casting curves.

APPLICATION OF EPOXY BONDING AGENT

Epoxy bonding material shall conform to the requirements in Section "Epoxy Bonding Material for Precast Segments" elsewhere in these special provisions.

Before applying epoxy, the interfaces shall be clean and free from laitance and bond breaking material. Oil, diesel residue, and other materials that may affect bond shall be removed. The surfaces shall have no free moisture on them. Free moisture shall be considered to be present if a rag wiped over the surface gathers any dampness.

The Contractor shall shade the interfaces from direct sunlight, rain, and run-off water for at least one hour before the epoxy resin is applied and until after the designated prestress load has been applied.

Application of epoxy shall begin immediately after a batch has been mixed. Applications shall be to a nominal thickness of 1.5 mm on both faces. No epoxy shall be applied after the specified gel time has elapsed. Epoxy shall not be applied within 15 mm of any duct. The Contractor shall ensure that epoxy does not extrude into ducts.

Immediately after one face is covered with epoxy, the unit shall be brought into position and the designated prestress applied. The Contractor's construction scheme shall provide for a minimum contact pressure of 0.28 MPa compression over the entire joint of precast concrete segments while the epoxy is curing in the joint. The Contractor shall plan the erection and post-tensioning operations such that, for the particular formulation of epoxy bonding agent being used, the time elapsing between initial mixing of the components for the first batch of epoxy bonding agent and application of the minimum contact pressure of 0.28 MPa compression shall not exceed 70 percent of the contact time. Prior to beginning erection, the Contractor shall submit to the Engineer for review, details covering how compliance with this 0.28 MPa contact pressure and the time limit will be achieved during erection of segments.

For superstructure segments, the compressive force across a joint (contact pressure) shall be accomplished through temporary or permanent post-tensioning. The specified contact pressure shall be continuously maintained across a joint.

The Contractor shall internally "swab" the ducts at the match cast joint after temporary prestressing to smooth out any extruded epoxy within the duct. When slow-set epoxy is used, the swab shall be passed after each new segment is erected through all the segments adjacent to uncured epoxy. Excess epoxy squeezed from the joint shall be captured and not allowed to freefall from the structure. If specified minimum contact pressure is not attained within the contact time, the segments shall be pulled apart and all the epoxy on both interfaces removed with spatulas and a suitable solvent that will remove all remaining epoxy. No epoxy shall be applied to the joint until 24 hours after the solvent has been used.

The contact time shall be counted starting from initial mixing to application of 0.28 MPa contact pressure unless the manufacturer's instructions direct otherwise. All excess epoxy after jointing shall be cleaned from outer faces in such a way as not to damage or stain the concrete face.

Application of epoxy bonding agent during erection of superstructure segments shall be permitted only when the substrate temperatures of the mating surfaces are between 5°C and 40°C. An artificial environment may be provided to maintain the substrate temperature within the permissible limits by use of an enclosure heated by circulating warm air or by radiant heaters. Localized heating shall be avoided and the heat shall be provided in a manner that prevents surface temperatures greater than 35°C during the epoxy hardening period. Direct flame heating of concrete shall not be permitted.

The Contractor shall keep a record of each joint with the following details:

A. Span number and joint number for superstructure construction
B. Time of mixing first batch of epoxy bonding agent applied to the joint
C. Date and time of jointing
D. Time of applying specified contact pressure to the joint
E. Batch numbers of resin and hardener
F. Maximum temperature of mix

G. Weather conditions (temperature and humidity shall be continuously recorded on site)
H. Submittal number of relevant tests

Within 3 working days after each segment is erected, the Contractor shall furnish to the Engineer a copy of the joint detail materials and operation records.

In the event that water seepage through the deck slab at an epoxy precast segment joint becomes evident, the Contractor shall take measures to seal the joint such as applying a gravity feed low viscosity concrete crack sealer or epoxy pressure injection. Proposed methods for sealing leaking segment joints shall be submitted to the Engineer for approval prior to the sealing operation. Gravity fed sealers shall not be used after the concrete wearing course has been placed. No additional payment will be made for sealing leaking segment joints.

FINAL CLEAN UP

Before Final Acceptance, the Contractor shall clean the interior of the concrete box girders of all rubbish, excess materials, loose concrete, grout, dirt, and debris. The interior of the box girders shall then be swept out. The final clean up shall be performed after all work on the interior of the box girders, including grouting of all tendons and electric work, and other utilities are installations have been completed.

MEASUREMENT AND PAYMENT

Erect precast concrete segment will be measured by cubic meter as shown on the plans and in the Engineer's Estimate.

The contract price paid per cubic meter for erect precast concrete segment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in erecting precast concrete segment, at the site of the work including testing equipment, complete in place, as shown on the plans, as specified in the Standard Specifications and these provisions, and as directed by the Engineer.

Full compensation for erection of precast lightweight concrete panels that have been cast into the precast concrete segments shall be considered as included in the contract price paid per cubic meter for erect precast concrete segment and no separate payment will be allowed therefor.

10-1.31 JACK SUPERSTRUCTURE

Jacking superstructure at Frames 1, 2, and 3 shall conform to the details and construction sequences shown on the plans and to these special provisions.

GENERAL

Superstructure jacking shall consist of performing all operations necessary to jack superstructure horizontally including fabrication and erection of the jacking frame, installation of hydraulic jacks, monitoring forces and displacements during jacking, release of jacks, and removal of the jacking frame at the locations Frames 1, 2, and 3 as shown on the plans and as specified in these special provisions.

The jacking system shall be designed for 125% of estimate forces as shown on the plans and shall take into account for Frame 1 horizontal curvature. The Contractor shall design the jacking system to ensure no tension occurs in the closure concrete during the entire jacking operation including removal or destressing of the jacks.

The jacking system shall be designed such that pressure loss of any hydraulic system can not cause movement during casting of closure concrete. This may be by means of a mechanical lock off of the jacks, replacement of the jacks by supports that can be cast in, or alternative methods. The Contractor shall design the guide beams and strong backs to control the longitudinal and transverse alignment.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," elsewhere in these special provisions. Working drawings shall include complete details, information, drawings, and substantiating calculations of the methods, materials, equipment, and procedures the Contractor proposes to use in jacking superstructure.

Working drawing submittals shall include the following:

A. Proposed superstructure jacking methods, procedures, sequences, and schedules. The procedures shall incorporate the closure concrete placement in conformance with the details shown on the plans and shall include the following:

    1. Installation of jacks
    2. Monitoring of force and displacement
    3. Installation of closure formwork
    4. Concrete placement in jacking windows if concrete is cast in stages

5. Curing of concrete
6. Removing jacks
7. Stressing span tendons and continuity tendons

B. Jack support frame details including stability truss, cross bracing, and strong backs.
C. Guide beam details.
D. Local reinforcement or section widening required for the jacking.
E. All other supplementary plans and similar data required to successfully accomplish the work.

A supplement to the working drawings shall include the following:

A. List of equipment required for the Contractor's proposed methods to successfully jack superstructure including jack types, capacities, and number of jacks with cut sheets certifying the jack capacities and the specifications for any other equipment required.
B. The Contractor's proposed methods of stabilizing or locking up the jacks after target displacements have been attained.
C. Substantiating calculations of structure stress and stability requirements at every stage for jacking including closure concrete, the jacking frame and its components. The calculations shall include both local and global stress calculations for the adjacent cantilevers during and after jacking up to the stressing of the permanent post-tensioning in the span. Local stress calculation shall be provided for the bearing area for the jacks.
D. Quality control program.
E. Substantiating documents for experienced and qualified personnel who will be supervising the jacking operation. The segment erection supervisor may be acceptable supervisor for supervising the jacking operation.
F. Sample data record form during the jacking operation.
G. Other Procedures, reports, and materials data called for elsewhere in these special provisions.

After complete working drawings and supplement have been received, the Contractor shall allow the Engineer 30 working days to review the complete submittal.

CONSTRUCTION

The Contractor's attention is directed to the alignment tolerance requirements in the Section, "Erect Precast Concrete Segment," elsewhere in these special provisions.

Immediately before beginning jacking operations, installation and preparation of the jacking system and the equipment for stabilizing, guiding and aligning the adjacent segments shall be signed off by the same engineer that signed the working drawings and supplement.

During the jacking operation, the Contractor shall observe the structure movements and record the jacking force, longitudinal displacement, and transverse displacement. The records shall be submitted to the Engineer for review.

The bearing area for the jacks shall not include any post-tensioning ducts.

If the Contractor proposes to place the closure concrete in multiple stages, the minimum concrete pour of the first stage shall be no less than the window shown on the plans or approved working drawings and supplement.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for jack superstructure for various frames as listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in jacking superstructure, complete in place, as specified in the Standard Specifications and these special provisions, and as directed by the Engineers.

10-1.32 SEALING JOINTS

Joints at the bottom of pier access casings shall be sealed in conformance with the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

Where polyurethane seals are shown on the plans, a silicone sealant conforming to the provisions in Section 51-1.12F, "Sealed Joints," of the Standard Specifications may be used.

Within 24 hours of installing the joint seal, the surfaces to be sealed shall be washed with potable water and then dried.

10-1.33 MODULAR JOINT SEAL ASSEMBLIES

Modular joint seal assemblies shall consist of supporting elements, supports, sealing elements, and anchorage elements and shall be designed, fabricated, inspected, tested, and installed as shown on the plans and approved working drawings and supplement, and as specified in the Standard Specifications and these special provisions.

MANUFACTURER

Modular joint seal assemblies shall be a Maurer Sohne Swivel-Joist Expansion Joint manufactured and supplied by:

THE D.S. BROWN COMPANY
300 E. CHERRY STREET
NORTH BALTIMORE, OHIO 45872

TEL: (419) 257-3561
FAX: (419) 257-2200

Maurer Sohne Swivel-Joist Expansion Joints are the only modular joint seal assemblies known to the State that meet the requirements of this contract. Preliminary working drawings and technical data for each hinge location for the Maurer Sohne Swivel-Joist Expansion Joints by D.S. Brown have been submitted, reviewed, and determined to be satisfactory by the Engineer.

Maurer Sohne Swivel-Joist Expansion Joints consist of supporting elements, supports, sealing elements, and anchorage elements. Supporting elements include edge beams, center beams, and support bars. Supports include sliding plates, sliding springs, and sliding bearings. Anchorage elements include carriageway anchors at the edge beams, anchor studs at the support boxes, and support boxes. Center beams slide on obliquely arranged swiveling support bars, resting on elastic bearings. The arrangement of the support bars and the type of connection between the support bar and the center beams assure equal spacing of the center beams.

D.S. Brown has agreed to furnish Maurer Sohne Swivel-Joist Expansion Joints and other services described in these special provisions at the guaranteed prices as shown in the following table:

Hinge Location	Model No.	Guaranteed Price
Hinge BW	DS1040B	$944,980
Hinge BE	DS1040B	$944,980
Hinge CW	DS960B	$866,030
Hinge CE	DS960B	$866,030
Hinge DW	DS560B	$529,300
Hinge DE	DS560B	$529,300

The guaranteed prices include design and fabrication of modular joint seal assemblies, prototype and proof testing of assemblies (including fabricating and furnishing test specimens, components of assemblies, and any appurtenances necessary for testing), delivery of assemblies to the Contractor's near site staging yard, inspection and installation consultation by a qualified representative of the manufacturer at the job-site during installation of all assemblies, and final inspection by the manufacturer of installed assemblies. The guaranteed prices also include working drawings and supplements, quality control for both the final products and test specimens, and the product warranty as specified elsewhere in these special provisions. The guaranteed prices do not include installation of modular joint seal assemblies and watertight tests. The guaranteed prices do not include sales taxes.

The above prices include sales taxes and will be guaranteed for orders placed with D.S. Brown on or before July 1, 2002. The total price will be increased 10 percent for orders placed with D.S. Brown after July 1, 2002 and on or before July 1, 2005.

Use of the Swivel-Joist Expansion Joints is contingent on approval of the contract specific working drawing submittal and successful performance of the Swivel-Joist Expansion Joints under prototype and proof testing.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in Section "Working Drawings" elsewhere in these special provisions, and these special provisions.

Working drawings shall include complete details, information, and drawings of the modular joint seal assembly and anchorage components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use.

Working drawing submittals shall include the following:

A. Fabrication plans including all details, elevations, and sections of the modular joint seal assembly for each hinge location as shown on the plans. All dimensions and design tolerances shall be specified. The plans shall identify the proposed location for cutting of central beams and edge beams to accommodate the removal and replacement of the modular joint seal assembly as specified in Section "General Design Requirements" of these provisions.
B. Fabrication plans including all details, elevations, and sections of the modular joint seal assembly for dynamic testing specimen. All dimensions and design tolerances shall be specified.
C. All ASTM or other material designations.
D. Sections showing all materials composing the modular joint seal assembly with complete details of all individual components including welded splices and connections.
E. PTFE bonding methods and details.
F. Installation plans including methods, materials, equipment, sequence, lifting mechanisms and locations, details of temporary anchorage during setting, temperature adjustment devices, opening dimensions relative to temperature, installation details at curbs, seal installation details, and other procedures that the Contractor proposes to use for installation of the modular joint seal assemblies.
G. Plan for achieving watertightness including details related to performing the watertightness test as specified in these special provisions.
H. Details and material designations pertinent to the corrosion protection system and list of coating system for modular joint seal assemblies identifying galvanizing, and cleaning and painting for all steel components.
I. Anchorage components including concrete blockout details and any additions or rearrangements of the reinforcing steel from that shown on the plans.
J. Storage plans for manufacture storage, interim storage, and on-site storage details including temporary support for the modular joint seal assemblies.
K. Shipping plans including the handling during the transportation of the modular joint seal assemblies. Each shipment of the modular joint seal assembly materials shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-l.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.

A supplement to the working drawings shall include the following:

A. Complete design and independent design check calculations including the assumptions and methods used in analyses and design of each modular joint seal assembly and its components. The design and independent check calculations shall include the fatigue design and load factor design of all structural elements including all springs and bearings, connections, and splices conforming to the requirements shown on the plans, the Standard Specifications, and these special provisions.
B. The quality control plan (QCP). The QCP of the modular joint seal assembly shall conform to the requirements in "Quality Control" of these special provisions and shall include descriptions, details, and procedures for the fabrication and installation of the modular joint seal assemblies, except that the portion of the QCP for welding shall be submitted separately in conformance with "Welding Quality Control" in these special provisions.
C. Names and addresses of test facilities, time schedule for various testing, and qualifications of personnel performing the test as specified in these special provisions.
D. Details, procedures, and schedules of fatigue testing for modular joint seal assemblies conforming to the section, "Fatigue Testing of Metallic Structural Components and Connections," of these special provisions. The fatigue testing plan shall include drafted, annotated illustrations of the test apparatus and equipment included in the testing program. The fatigue testing plan shall also include certifications that all testing equipment has been calibrated no longer than 12 months prior to testing.
E. Details, procedures, and schedules of durability testing of elastomeric support bearing for modular joint seal assemblies conforming to the section, "Durability Testing of Elastomeric Support Bearing," of these special provisions. The durability testing plan shall include drafted, annotated illustrations of the test apparatus and equipment included in the testing program. The durability testing plan shall also include certifications that all testing equipment has been calibrated no longer than 12 months prior to testing.
F. Details, procedures, and schedules of dynamic testing for modular joint seal assemblies conforming to the section, "Dynamic Testing," of these special provisions. The dynamic testing plan shall include drafted, annotated illustrations of the test apparatus and equipment included in the testing program. The dynamic testing plan shall also include certifications that all testing equipment has been calibrated no longer than 12 months prior to testing.

G. Details, procedures, and schedules of proof testing for modular joint seal assemblies conforming to the section, "Proof Testing," of these special provisions. The proof testing plan shall include drafted, annotated illustrations of the test apparatus and equipment included in the testing program. The proof testing plan shall also include certifications that all testing equipment has been calibrated no longer than 12 months prior to testing.
H. Manufacturer's certificate of compliance for all PTFE sheeting, PTFE fabric, elastomer, and modular joint seal assembly sealing elements.
I. Certified test reports confirming that the springs and bearings meet the design load requirements.
J. Time line outlining milestones as specified in "Time Line" of these special provisions. The milestones the Contractor proposed shall be in accordance with the provisions in Section, "Progress Schedule (Critical Path)" elsewhere in these special provisions.
K. The manufacturer of the modular joint seal assemblies shall submit 6 bound copies of the inspection, maintenance, and replacement manual to the Engineer for the joint inspection, maintenance, and replacement. This manual shall include:

1. Recommended frequency for joint inspection and maintenance schedule over the period of design life.
2. Procedures and details to perform the joint inspection and maintenance.
3. List of indication of joint or its component defects and the associated method to repair, if any.
4. Part replacement plan to facilitate replacement of parts subject to wear. This plan shall include a list of parts, instructions for maintenance inspection, acceptable wear tolerances, methods for determining wear, procedures for replacing worn parts, and procedures for replacing seals.
5. Recommended life expectancy for each component of the modular joint seal assemblies.
6. Procedures and sequences for modular joint seal assemblies replacement including locations of temporary support, expected number of traffic lane closure, and any other requirements to replace the modular joint seal assemblies.
7. Contacts, telephone numbers, and email addresses for maintenance and inspection questions.

The working drawings and supplement shall be stamped and signed by an engineer who is registered as a Civil Engineer in the United States. This registered Civil Engineer shall be an employee of the modular joint seal assembly manufacturer.

After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal. No fabrication of test specimen and test fixtures of the modular joint seal assembly shall begin until complete working drawings and supplement are reviewed and a preliminary approval is given, in writing, by the Engineer.

After the Engineer issues a preliminary approval in writing to the Contractor for the submitted working drawings and supplement, the Contractor shall begin conducting the prototype tests for the modular joint seal assemblies.

Within 10 working days after the prototype tests have been successfully completed, the Contractor shall submit the following documents to the Engineer for final approval:

A. Test records, results, certified test reports, and all other relevant test information
B. Revised plans, procedures, or any other modifications
C. Calculations for "Expected Friction Force" of all the production joint seal assemblies when subject to proof testing as specified in the section "Proof Testing" of these special provisions. The calculations should clearly indicate the extrapolation equations and assumptions applied in the process of establishing the expected friction force.
D. Three copies of Geometry Tolerance Control Plan including the following:

1. For each essential element as defined in the section "Dynamic Testing" of these provisions, a target dimensional tolerance from its theoretical size.
2. Description of procedures to be used to check the target dimensional tolerances of the essential elements during the fabrication process.
3. For completed assembly, define a target tolerance on out-of-line alignment of pivoting pins, unevenness of welded stirrup heights, unevenness of height of installed sliding bearings and sliding springs.
4. Description of procedures to be used to check the target tolerances of the completed assembly during the fabrication process

The Contractor shall allow the Engineer 30 working days to review each of the certified test reports for the prototype tests, any Contractor proposed modifications to previously submitted working drawings and supplement, the expected friction force calculations, and the geometry tolerance control plan. If the Engineer requests additional information or calculations, the Contractor shall allow the Engineer additional 10 working days to review. No fabrication of modular joint seal assembly shall begin until all certified test reports and complete expected friction force calculations are reviewed and the final approval

is given, in writing, by the Engineer. Within 5 working days after final approval by the Engineer, the Contractor shall submit to the Engineer 7 copies of approved expected friction force calculations and geometry tolerance control plan.

After completion of proof testing, the Contractor shall submit the proof test reports as specified in Section "Proof Testing" of these special provisions.

Upon completion of installation, the Contractor shall submit to the Engineer certification stating that each modular joint seal assembly was installed in accordance with the approved working drawings and supplements installation procedure.

The Contractor shall provide to the State of California as a condition of acceptance of the modular joint seal assembly for incorporation into the work, a manufacturers written warranty addressed to the California Department of Transportation that includes the following provisions. For the five-year period commencing from the date of completion of the contract, the manufacturer shall warranty the performance and durability of each modular joint seal assembly. Conditions constituting unsatisfactory performance and durability include broken welds or bolts (including field splices), cracks in steel members, fatigue damage, loss of precompression in springs or bearings, debonded PTFE, breakdown of corrosion protection, and leakage. The Manufacturer shall provide the components and necessary technical staff to replace or repair any modular joint seal assembly component demonstrating unsatisfactory performance or durability within the five-year period commencing from the date of completion of the contract. All materials and technical staff that are required to satisfactorily perform warranty obligations shall be provided at the manufacturer's sole cost and expense.

MATERIALS

Attention is directed to "Welding" and "Steel Audits" in these special provisions.

Structural steel shall conform to the section "Steel Structures" elsewhere in these special provisions. Structural steel shall conform to the requirements of ASTM Designation: A 572M, Grade 345. Aluminum components shall not be used. Stainless steel shall conform to ASTM Designation: A 240, Type 304.

Bolts, nuts and washers shall conform to the requirements of ASTM Designation: A 325 or A 325M and Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications. Bolted splices shall not be permitted in supporting elements and supports.

DU self-lubricating bearing materials made by Garlock Bearings Inc. shall conform to the manufacturer's recommendations and material properties.

Polytetrafluoroethylene (PTFE) sheet shall be made from unfilled PTFE resin and shall conform to the following requirements:

Test	Test Method	Requirements
Tensile strength (Minimum)	ASTM D 4894 or D 4895	19.3 MPa
Elongation (Minimum)	ASTM D 4894 or D 4895	200 %

The PTFE resin shall be virgin material (not reprocessed), woven PTFE fabric, or dimpled PTFF conforming to the requirements of ASTM Designation: D 4894 or D 4895. Specific gravity shall be from 2.13 to 2.19. Melting point shall be 327±10°C.

Box-type sealing elements or sealing elements utilizing double webs shall not be permitted. Sealing elements shall be continuous without splices. The neoprene glands, if used for sealing elements, shall conform to the requirements in Table 1 of ASTM Designation: D 2628 and the following, except that no recovery tests or compression-deflection tests will be required:

Property	Requirement	ASTM Test Method
Hardness, Type A Durometer, points	55-70	D 2240 (Modified)
Tensile Strength	14 MPa minimum	D 412
Elongation at break	250%	D 412
Compression set, 70 hours at 100°C, maximum, percent	40%	D 395 Method B (Modified)

QUALITY CONTROL

Quality Control (QC) shall be the responsibility of the Contractor. Quality Control shall be performed by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department. As a minimum, the Contractor shall perform inspection and testing prior to fabrication, during fabrication, and after fabrication as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the requirements of the

contract documents. Quality Control shall apply to each component of the modular joint seal assembly in addition to the assembly, shipping and installation of the complete modular joint seal assembly.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all fabrication.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship

The Contractor shall provide sufficient number of QC Inspectors to ensure continuous inspection.

The Contractor shall designate in writing a Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of the fabrication, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting and receiving all correspondences, required submittals, and reports to and from the Engineer.

The Contractor shall submit to the Engineer 3 copies of Quality Control Plan (QCP), in conformance with the requirements in "Working Drawings," of these special provisions. As a minimum, each QCP shall include the following:

A. A manual including equipment, testing procedures, and code of safe practices
B. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors
C. An organizational chart showing all QC personnel and their assigned QC responsibilities
D. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:

    1. All visual inspections
    2. Tests
    3. Calibration procedures and calibration frequency for all equipment
    4. Geometry tolerance control plan as specified in the section "Working Drawings" of these special provisions

E. Forms to be used for Certificates of Compliance, weekly production logs, and weekly reports
F. Mill certificates and material certificates
G. Shipping plan
H. Installation plan

Prior to submitting the QCP, a pre-fabrication meeting between the Engineer, Contractor, and Fabricator, any entity performing modular joint seal assembly component fabrication or subcontractor to the Fabricator, shall be held to discuss the requirements for the QCP. The pre-fabrication meeting shall be held in San Francisco Bay Area.

After a complete QCP is submitted, the Contractor shall allow the Engineer 10 working days to review the submittal. An amended QCP or addendum shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved QCP. The Contractor shall allow the Engineer 10 working days to complete the review of the amended QCP or addendum.

After final approval of the QCP, amended QCP, or addendum, the Contractor shall submit 7 copies to the Engineer of each of these approved documents.

It is expressly understood that the Engineer's approval of the Contractor's QCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's approval shall not constitute a waiver of any requirement of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding approval of the QCP.

A weekly production log for fabrication shall be kept by the QCM for each day that fabrication if performed. The weekly report from each QC Inspector shall be included in the log.

The Contractor shall submit the reports of all visual inspections, weekly production log, and a complete "As-Built Log of Measurements" to the Engineer within 7 working days following the completion of fabrication of any modular joint seal assembly. The Engineer will review the reports, production log, and the "As-Built Log of Measurements" to determine if the Contractor is in conformance with the QCP. The Contractor shall allow the Engineer 7 working days to review and respond in writing after a complete reports, production log, and the "As-Built Log of Measurements" have been received.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each modular joint seal assembly. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and approved working drawings and the provisions of the Standard Specifications and these special provisions. The certificate shall state that all of

the as-built measurements of essential parts and completed assemblies are within the target tolerances specified in geometry tolerance control plan.

FABRICATION

The modular joint seal assembly shall be fabricated consistent with the details, dimensions, material specifications, and procedures delineated in the approved working drawings and supplement.

All modular joint seal assemblies shall be fabricated by the same manufacturer.

PTFE shall be bonded under controlled conditions and in strict accordance with written instructions provided by the PTFE manufacturer.

PTFE surfaces shall be smooth and free of bubbles after completion of bonding operations.

Stainless steel sliding surfaces in contact with PTFE shall be polished to a Number 8 mirror finish.

Each stainless steel sheet shall be welded to the steel backing plate in accordance with AWS specifications as specified in "Steel Structures" elsewhere in these special provisions. The stainless steel sheet shall be clamped to provide full contact with the steel backing plate during welding. The welds shall not protrude above the sliding surface of the stainless steel sheet.

Steel surfaces, except those surfaces beneath stainless steel sheet, those to be bonded to PTFE, or those in direct contact with sealing elements, shall be galvanized.

At the Contractor's option, cleaning and painting of all new metal surfaces of the joint seal assembly, except stainless steel and anchorages embedded in concrete, may be substituted for galvanizing. Cleaning and painting shall be in conformance with the provisions in "Clean and Paint Structural Steel (Modular Joint Seal Assembly)" of these special provisions.

Finish coats will not be required on modular joint seal assemblies.

During the fabrication process the Contractor shall maintain "Log of As Built Measurements" of all individual essential parts and the completed assembly. The essential parts shall include center beams, swivel support bars, support boxes, stirrups, sliding bearings, sliding springs, spring holders, bearing holders, swivel plates, and sliding discs. The "Log of As Built Measurements" of the completed assembly shall include out-of-line alignment of pivoting pins, unevenness of welded stirrup heights, unevenness of height of installed sliding bearings, and sliding springs. The measurements shall be recorded with accuracy of 0.1 mm. The Contractor shall submit to the Engineer for review and approval the "Log of As Built Measurements" at least 10 working days prior to the start of the proof testing.

GENERAL DESIGN REQUIREMENTS

The Contractor shall design the modular joint seal assemblies including all components and anchorage devices with any reinforcement required in addition to that shown on the plans. The design life of the joint seal assembly shall, whenever possible, comply with the 150 year design life of the bridge.

Each modular joint seal assembly shall extend continuously across the full width of the roadway and up into the traffic barriers as shown on the plans. The modular joint seal assembly shall be designed to allow for cutting the joint seal assembly into segments. Removal of any one segment shall not affect the load carrying capacity of the remaining segments. The segments shall be arranged to accommodate removal and replacement of the joint seal assembly while maintaining a minimum of 4 traffic lanes. Each traffic lane shall be 3.6 meter wide and additional allowance for traffic barrier shall be made for separation from the construction area.

Field splices of any part of the modular joint seal assembly shall not be permitted.

The modular joint seal assembly shall be designed with adequate access to all internal components in order to assure the feasibility of inspection and maintenance activities.

The modular joint seal assembly shall be designed to minimize concrete cracking above the support boxes. Measures taken shall include assuring adequate support box top plate thickness, specifying any additional roadway deck steel reinforcement required, and providing adequate concrete cover.

The modular joint seal assembly and concrete deck steel reinforcement shall be designed to assure that adequate concrete consolidation can be achieved underneath all support boxes.

The sealing elements shall not protrude above the top of the modular joint seal assembly.

The elastomeric or urethane springs, bearings with stainless steel surfaces, and other sliding elements shall be designed to be removable and replaceable. The removal and reinstallation of each sealing element shall be easily accomplished from above the joint with a 32 millimeters minimum gap width. The replacement of such elements shall not require closing more than 3 traffic lanes at any time.

The modular joint seal assembly shall be watertight.

Metallic attachments used to secure elastomeric seals to the center beams, if welded to the center beams and edge beams, shall be welded continuously along both their top and bottom edges.

The longitudinal movement demands in the table shown on the plans consist of movements due to temperature variation (T_{rise} and T_{drop}), creep and shrinkage (CS), functional evaluation earthquake ($FEE_{opening}$), and safety evaluation earthquake ($SEE_{closing}$ and $SEE_{opening}$). The longitudinal movement demands are normal to the transverse axis as shown on the plans.

The number of cells for each modular joint seal assembly shall conform to the following table. A cell is defined as sealing elements supported by adjacent beams.

Hinge Location	No. of Cells
Hinge BW	13
Hinge BE	13
Hinge CW	12
Hinge CE	12
Hinge DW	7
Hinge DE	7

The sealing elements shall be capable of accommodating 130 mm longitudinal movement without any damage.

When the modular joint seal assembly is subject to combined movements of $SEE_{closing}$, $SEE_{opening}$, and CS, the load carrying capability of the modular joint seal assembly shall not be degraded, and cell width equalizing mechanism shall be fully operational. No unseating of supporting elements shall be permitted. The damage to the modular joint seal assembly shall be limited to the sealing elements only and there shall be no damage to any other parts of the assembly.

The modular joint seal assemblies shall be capable of providing for a transverse displacement (relative to the ends of the joint), horizontal rotation in the plane of the bridge deck (fanning angle), and rotation about transverse and longitudinal axis as shown on the plans.

DESIGN AXLE LOADS AND IMPACT FACTORS

The center beams, edge beams, support bars, bearings, connections, and other structural components shall be designed for the simultaneous application of vertical and horizontal loads from a tandem axle. The tandem axle shall consist of a pair of axles spaced 1.2 meters apart with vertical and horizontal loads as specified elsewhere in these special provisions. The transverse spacing of the wheels shall be 1.8 meters. The distribution of the wheel load among center beams shall conform to the requirements specified elsewhere in these special provisions.

The vertical load range for fatigue design shall be a 145 kN tandem. This tandem shall be taken as two 72.5 kN axles spaced 1.2 meters apart. Only one of these tandem axles shall be considered in the design, unless the joint opening exceeds 1.2 meters. The load range shall be increased by the dynamic load allowance (Impact Factor) of 75%. Load factors shall be applied in accordance with Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition.

The vertical load for strength design shall be a 220 kN tandem. This tandem shall be taken as two 110 kN axles spaced 1.2 meters apart. Only one of these tandem axles shall be considered in the design, unless the joint opening exceeds 1.2 meters. This load shall be increased by the dynamic load allowance (Impact Factor) of 75%. Load factors shall be applied in accordance with Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition.

The horizontal load range for fatigue design shall be 40 percent of the amplified vertical load range (LL+IM) for fatigue design specified in these special provisions.

The horizontal load for strength design shall be 20 percent of the amplified vertical load (LL+IM) for strength design specified in these special provisions.

DISTRIBUTION OF WHEEL LOADS

The following table specifies the center beam distribution factor as a function of center beam top flange width. This factor is the percentage of the design vertical axle load and the design horizontal axle load which shall be applied to an individual center beam for the design of that center beam and its associated support bars. Distribution factors shall be interpolated for center beam top flange widths between those explicitly denoted in the table. In no case shall the distribution factor be taken as less than 50%. The remainder of the load shall be divided equally and applied to the two adjacent center beams or edge beams.

Width of Center beam Top Flange	Distribution Factor
64 millimeters	50%
80 millimeters	60%
100 millimeters	70%
120 millimeters	80%

FATIGUE LIMIT STATE DESIGN REQUIREMENTS

Modular joint seal assembly structural members, bolted and welded splices and connections, and attachments shall be designed to resist the Fatigue Limit State load combination specified in Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition. The vertical and horizontal load ranges for fatigue design specified in these special provisions shall be applied simultaneously. These loads shall be distributed as specified in these special provisions.

The nominal stress ranges, Δf, at all fatigue critical details shall be obtained from a structural analysis of the modular joint seal assembly applying the design vertical and horizontal load ranges, and distributed specified in these special provisions. The modular joint seal assembly shall be analyzed with a minimum gap opening corresponding to the operating range configuration (at least 60 mm). The design axle load shall be applied as two wheel loads, each having a transverse width of 510 millimeters. For each detail under consideration, the wheel loads shall be positioned transversely on a center beam to achieve the maximum nominal stress range at that detail. The vertical and horizontal wheel loads shall be applied as line loads to the top of the center beams at their centerlines. The design stress range in the center beam-to-support bar connection shall be calculated according to subsections 1 and 2 below. The design nominal stress ranges, Δf, shall be used for fatigue design as specified in these special provisions.

Welded Single-Support-Bar Systems

A. The nominal stress range, Δf, in the center beam at a welded stirrup shall be the sum of the longitudinal bending stress ranges at the critical section resulting from vertical and horizontal loading. The effects of stresses in any load-bearing attachments such as the stirrup or yoke shall not be considered when calculating the longitudinal stress range in the center beam.
B. The nominal stress range, Δf, in the stirrup or yoke shall be calculated without considering the effects of stresses in the center beam. The stress range shall be calculated by assuming a load range in the stirrup equal to 30% of the total vertical reaction force between the center beam and the support bar. The effects of horizontal loads may be neglected in the design of the stirrup.

To assure an infinite fatigue life, all modular joint seal assembly structural members, connections (bolted and welded), splices, and attachments shall satisfy the following:

$$\Delta f \leq \frac{F_{TH}}{2}$$

where:

Δf = the nominal stress range
F_{TH} = constant amplitude fatigue limit (CAFL)

FATIGUE RESISTANCE OF DETAILS

The fatigue resistance of all details shall be characterized in terms of the fatigue categories specified in Table 6.6.1.2.5-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition. Many details composing modular joint seal assembly may clearly correspond to specific structural details depicted in Figure 6.6.1.2.3-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition. In these cases, the applicable fatigue categories specified in Table 6.6.1.2.3-1 may be used for design. In cases where the Engineer establishes that a detail does not clearly correspond to a structural detail depicted in Figure 6.6.1.2.3-1, fatigue testing of specimens exhibiting that detail shall be conducted, in accordance with Sections "Fatigue Testing of Metallic Structural Components and Connections" and "Durability Testing of Elastomeric Support Bearings" of these special provisions, to establish the appropriate constant amplitude fatigue limit (CAFL) for that detail.

STRENGTH I LIMIT STATE DESIGN REQUIREMENTS

Modular joint seal assembly structural steel members, connections (bolted and welded), splices, and attachments shall be designed to resist the Strength I Limit State load combination specified in Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition. The vertical and horizontal loads specified in Section "Design Axle Loads and Impact Factors" of these special provisions shall be applied simultaneously. These loads shall be distributed as specified in Section "Distribution of Wheel Loads" of these special provisions.

PROTOTYPE TESTING REQUIREMENTS

Prototype testing of modular joint seal assemblies consists of fatigue testing of metallic structural components and connections, durability testing of elastomeric support bearings, and dynamic testing in conformance with the requirements in these special provisions.

Dynamic testing shall be performed in the State of California.

Fatigue testing and durability testing of elastomeric support bearings shall be performed by an independent testing laboratory in the United States.

The following individuals have stated that they have access to facilities capable of performing the fatigue testing:

A. Prof. Charles W. Roeder
Department of Civil Engineering
233B More Hall
University of Washington
Seattle, Washington
Tel: (206) 543-6199
Fax: (206) 543-1543

B. Dr. John W. Fisher
ATLSS Research Center
Lehigh University
117 ATLSS Drive
Bethlehem, PA 18015-4793
Tel: (610) 758-3535
Fax: (610) 758-5553

C. Prof. Robert J. Dexter
Department of Civil Engineering
University of Minnesota
122 CivE
500 Pillsbury Drive S.E.
Minneapolis, MN 55455-0220
Tel: (612)-624-0063
Fax: (612)-626-7750

FATIGUE TESTING OF METALLIC STRUCTURAL COMPONENTS AND CONNECTIONS

Methodology

A. This test procedure is acceptable for, and specifically applicable to, establishing the fatigue resistance of the center beam-to-support bar connection in modular joint seal assemblies. It is applicable to single-support-bar and multiple-support-bar systems having either welded or bolted center beam-to-support bar connections. The same methodology may be applied to establish the fatigue resistance of other modular joint seal assembly metallic structural component details, including center beam splices.
B. Each fatigue test generates a discrete datum. Each datum comprises an applied constant amplitude nominal stress range, S_r, and the corresponding number of cycles, N, associated with either a predetermined extent of crack propagation, defined as failure, or with termination of the test, defined as runout. Ten data shall be acquired for each connection detail. All data shall be in the very long life range, corresponding as closely to the constant amplitude fatigue limit (CAFL) as practical. Specifically, the number of cycles, N, associated with each datum, shall be no less than one order of magnitude less than N_{min} corresponding to the detail category specific CAFL specified in these special provisions.
C. The constant amplitude nominal stress range shall be calculated at the anticipated initiation location of an incipient crack. Nominal stresses shall be calculated using conventional equations for analyzing bending and axial load. These equations are essentially the same as those used in strength design. The stress concentration effects of a weld, bolt hole, or other local features are not explicitly embodied in the conventional nominal stress equations.
D. The appropriate AASHTO detail category applicable to fatigue design shall be established by comparing acquired test data to fatigue resistance graphs representing the AASHTO detail categories. The constant amplitude fatigue limit (CAFL) applicable to fatigue design corresponds to the AASHTO detail category fatigue resistance graph representing a lower bound of the experimentally acquired data.

E. When testing is conducted exclusively in the infinite life regime and more stringent test data scatter requirements are satisfied, a unique CAFL (different from those CAFL corresponding to specific detail categories specified by AASHTO) may be established for fatigue design.

Specimens

A. Specimens selected for testing shall be full-scale center beam and support bar assemblies or subassemblies representative of those installed in field applications. A subassembly is defined as a specimen having the same physical and geometric properties as an assembly but having a reduced number of center beams.
B. Each specimen shall consist of three continuous center beam spans over four equally spaced support bars. Center beam spans between adjacent support bar centerlines shall be a minimum of 910 millimeters and a maximum of 1.35 meters. Support bar spans shall be a minimum of 910 millimeters and a maximum of 1.12 meters. The center beam-to-support bar connection being tested shall be located at the midspan of each support bar.
C. Any welded or bolted attachments used to secure equidistant springs to a support bar, center beam, or stirrup shall be fabricated as an integral part of the specimen. A rigid load path to the test fixture shall be provided to resist any horizontal forces or displacements which would normally be resisted through these attachments in a field installation. Any miscellaneous welded or bolted attachments, including welded attachments used to secure the modular joint seal assembly sealing elements to the center beams, shall also be fabricated as integral parts of the specimen.
D. Support bars of subassembly specimens that are components of single-support-bar swivel-joist type modular expansion joint systems shall be oriented perpendicular to the longitudinal axis of the center beam.
E. Prior to testing, each specimen shall be visually inspected for any defects, loose fasteners or other aberrations which could plausibly affect the tested fatigue resistance. Defects and flaws shall be defined in accordance with the appropriate governing specification (ASTM A-6, AWS D1.5, etc.). Data acquired from specimens containing such anomalies shall not be excluded from consideration except as permitted elsewhere in these special provisions. Any observed anomaly shall also be reported with its corresponding data in the tabular format stipulated in these special provisions.

Instrumentation

A. Each specimen shall be sufficiently instrumented to measure the static nominal strain range within that specimen for a specific applied load range. Best results can generally be obtained when the applied load range for the static calibration tests does not pass through zero load. Strain measurements shall be made at locations sufficiently distant from local effects, such as weld toes or bolt holes, which could significantly influence acquired test data.
B. As a minimum, eight strain gages shall be installed on the center beam top flange in the vicinity of each center beam-to-support bar connection. These gages shall be installed in pairs on each side of the connection at distances of one and two times the depth of the center beam from the centerline of the connection. Each pair of strain gages shall be located symmetrically about the centerline of the center beam. As a minimum, two strain gages shall also be installed on the support bar bottom flange in the vicinity of each center beam-to-support bar connection. One of these strain gages shall be installed on each side of the connection at a distance equal to the depth of the support bar from the centerline of the connection. These strain gages shall be installed along the centerline of the support bar.

Test Fixtures

A. Test fixtures shall have the capability to adequately support and secure the specimen throughout the duration of the test. The fixture shall be designed and fabricated to such tolerances as required to assure that additional stresses will not be generated in the specimen as a consequence of fixture misalignment. Mismatches resulting from specimen fabrication errors shall be accommodated by shimming or other such means precluding the application of force to the specimen.
B. Typical elastomeric bearings and springs used to transfer vertical loads from the support bars to the support boxes may be replaced with steel bearings in the test fixture. This modification will enable fatigue testing at higher load ranges and different frequencies than those encountered during normal service conditions.
C. Load shall be applied through two 250 millimeter long patches. Each patch shall typically comprise a steel plate and a hard rubber bearing pad placed in contact with the bottom flange of the center beam. Each patch shall be located at midspan of each outer span.

D. In order to assure adequate seating of the specimen to the test fixture, a minimum of 45 kN shall be applied at each patch location. This requirement is waived for tests of single support bar systems conducted using load reversal. Once this load has been applied, all strain measuring devices shall be rebalanced to zero strain while the preload is maintained. An additional load approximately equivalent to the calculated load range shall be applied. Strain ranges shall be measured for the load range from 45 kN to the peak load. Each static calibration test shall be repeated three times while still maintaining a minimum 45 kN load at each load patch. The measured strain ranges from each repetition should vary by no more than 25% from the mean value. If the stress ranges are not repeatable, appropriate modifications shall be made to the test fixture.

Static Calibration Test

A. Prior to any fatigue resistance testing, a static calibration test shall be performed in order to validate the structural analysis model. The static calibration test shall be performed after attainment of stress range repeatability as described elsewhere in these special provisions. The structural analysis model shall be considered validated when calculated strain ranges are within ±25% of the measured strain ranges at every strain gage location.
B. For the purpose of reporting nominal fatigue resistance stress ranges at specific details, stress ranges determined through structural analysis of the model shall be preferred over stress ranges acquired directly from test measurements.

Test Procedure

A. A minimum of ten data points shall be required to establish the fatigue resistance of each detail. The center beam-to-support bar connection shall be considered as a single detail.
B. Several data points may be obtained from a single specimen by repairing the cracked sections of that specimen and resuming testing. Such repairs shall have minimal effect on the stress ranges at unfailed details still being tested. Data points derived from tests in which a repaired detail cracks again shall be discarded.
C. All data shall be in the very long life range, corresponding as closely to the constant amplitude fatigue limit as practical, but in no case less than 200,000 cycles. Either finite life regime or infinite life regime testing may be conducted. For infinite life regime testing, the number of cycles, N, associated with each of the ten data shall be at least twice the number of cycles, N_{min}, designated in the table elsewhere in these special provisions.
D. Loads shall be applied using hydraulic actuators or other similar loading devices. The magnitude of the vertical load range, ΔP_v, shall be maintained and continuously monitored throughout the duration of the test. Vertical and horizontal load ranges shall be applied to the specimen simultaneously. The horizontal load range shall always be equal to 20% of the vertical load range, ΔP_v. This horizontal-to-vertical load ratio may be maintained by inclining the specimen 11.3 degrees with respect to the horizontal plane and applying load through vertically oriented actuators.
E. For multiple support bar systems, the loading mechanism shall be either exclusively tension or exclusively compression and shall be applied at a constant amplitude at any desired frequency. The applied load range shall be in a direction such that the reaction force between the center beam and support bar is always tensile. The load range shall not pass through zero load. Minimum preload shall be maintained throughout the duration of the test.
F. Single support bar systems may be loaded using the same procedures as those for multiple support bar systems. If premature stirrup failure occurs, an applied load range of 70% compression and 30% tension may be used.
G. The load ranges used in the test shall not be so large as to alter the observed failure mode from that which would be observed under service conditions. Under no circumstance shall imposed stress exceed the yield stress of the material in any portion of the specimen. Each specimen shall be tested using at least two different load (stress) ranges.
H. If infinite life regime testing is conducted, the first load range should be chosen so that the applied stress range is just above the postulated CAFL. The load range in the subsequent test shall be decreased if failure resulted and increased if the test resulted in a runout. A suggested increment in load is such that the stress range is increased or decreased by 14 MPa. The applicable CAFL shall be selected from those CAFL values corresponding to the AASHTO fatigue categories. The selected CAFL is the one just below the lowest stress range that resulted in cracking.
I. The following criteria shall be used to define failure of a given center beam-to-support bar connection:

Welded Center beam-to-Support Bar Connections

1. *Center beam weld toe cracking* originates at or near the center beam weld toe, propagates up into the center beam at some angle, and grows back over the connection. These cracks typically grow at an angle of about 45

degrees. A specimen shall be considered as failed due to this type of cracking when the crack has grown on any vertical face a length from the point of origin equal to half of the center beam depth.

2. *Support bar weld toe cracking* originates at or near the support bar weld toe, propagates down into the support bar, and grows back under the connection at some angle, typically about 45 degrees. A specimen shall be considered as failed due to this type of cracking when the crack has grown on any vertical support bar face a length from the point of origin equal to half of the depth of the support bar.
3. *Weld throat cracking* originates in the weld throat and typically grows in a plane parallel to the longitudinal axis of the support bar at about mid-depth of the weld throat. A specimen shall be considered as failed due to this type of cracking when a complete fracture of the weld throat has occurred. These cracks have been observed to turn down into the support bar, but only after significant growth. In such instances, the criteria for support bar weld toe cracking shall be applied.

Welded Stirrup Connections

1. A specimen shall be considered as failed when cracks result in the complete fracture of any stirrup leg or when cracks originating at or near a stirrup weld have grown into any face of the center beam a length from the stirrup weld toe equal to half of the center beam depth.

Bolted Center beam-to-Support Bar Connections

1. Fatigue cracks which have grown out of a bolt hole have resulted in the complete fracture of the tension flange of the center beam.
2. Fatigue cracks which have grown out of a bolt hole have extended into any face of the center beam web a distance equivalent to half of the center beam depth less the center beam flange thickness.
3. Any portion of a stirrup fractures completely.
4. Any single bolt fractures completely.

J. Alternate Criteria for Termination of a Finite Life Regime Test

1. A test may also be terminated when, for a given stress range, the specimen has survived the number of cycles required to plot the data above either a particular fatigue resistance curve or the maximum permitted in these special provisions.

K. Nominal Stress Range Calculation

Welded Center beam-to-Support Bar Systems

1. The nominal stress range for center beam weld toe cracking shall be calculated by taking the square root of the sum of the squares of the longitudinal bending stress range in the center beam and the vertical stress range at the top of the weld.
2. The nominal stress range for support bar weld toe cracking shall be calculated by taking the square root of the sum of the squares of the longitudinal bending stress range in the support bar and the vertical stress range at the bottom of the weld.
3. The nominal stress range for weld throat cracking shall be the calculated vertical stress range in the throat of the weld.
4. The nominal stress range in the center beam at a welded stirrup shall be calculated as the summation of the longitudinal bending stress ranges at the critical section resulting from vertical and horizontal loading. The entire load range shall be used in the calculation, even if the loading is partly in compression. The effects of stresses in any load-bearing attachments such as the stirrup or yoke shall not be considered when calculating the nominal stress range in the center beam.

   The load range in the stirrup itself shall be taken as 30% of the total vertical load range carried through the connection. The effect of horizontal forces may be neglected.

Bolted Systems

1. The nominal stress range in the center beam shall be taken as the summation of the longitudinal bending stress ranges in the center beam resulting from vertical and horizontal loading. Nominal stress ranges shall be

calculated using the net section. The effects of stresses in the stirrup shall not be considered when calculating the nominal stress range in the center beam.

2. The nominal load range in the bolt group and the stirrup assembly shall be taken as 30% of the total vertical load range carried through the connection. The effect of horizontal forces may be neglected.

Interpretation of Test Data

A. The experimentally acquired data and graphs representing the fatigue resistance of the detail categories delineated in Section 6.6 of the AASHTO LRFD Bridge Design Specifications - Second Edition shall be juxtaposed on a log-log scale. The equation representing the finite life fatigue resistance of these AASHTO detail categories is:

$$N = \frac{A}{S_{r,eff}^{3}}$$

where:

N =number of cycles to failure
$S_{r,eff}$ = nominal effective stress range representing fatigue resistance
A = constant defined in Table 6.6.1.2.5-1 of the AASHTO LRFD Bridge Design Specifications - Second Edition

The minimum number of cycles associated with infinite fatigue life, N_{min}, and the corresponding constant amplitude fatigue limit (CAFL) for each AASHTO detail category is designated in the table below.

Detail Category	N_{min} (infinite fatigue life)	CAFL(MPa)
A	1.8×10^6 cycles	165
B	3.0×10^6 cycles	110
B'	3.5×10^6 cycles	82.7
C	4.4×10^6 cycles	69.0
C'	2.5×10^6 cycles	82.7
D	6.4×10^6 cycles	48.3
E	1.2×10^7 cycles	31.0
E'	2.2×10^7 cycles	17.9

B. Finite Life Regime Testing

1. The number of cycles, N, to either failure or runout, associated with each of the ten data need not exceed N_{min}, designated in the table elsewhere in these special provisions.
2. The detail category applicable to fatigue design shall be that corresponding to the highest of the AASHTO detail category fatigue resistance graphs representing a lower bound of all ten experimentally acquired data.
3. If all but one datum falls above a selected AASHTO S-N curve, that one datum may be discarded and replaced by three new data obtained through additional testing. The additional testing shall be conducted using the same stress range as that of the discarded datum. The three additional data shall be plotted along with the remaining nine data. The applicable detail category shall be that corresponding to the highest of the AASHTO detail category fatigue resistance graphs representing a lower bound of all twelve data, except as limited in the previous table. For any detail, only one datum may be discarded and subsequently replaced with three additional data for any set of ten original data.
4. The maximum fatigue resistance of any detail shall not exceed that associated with the fatigue category prescribed in the table below.

Type of Detail	Maximum Permitted Category
Welded Multiple Center beam-to-Support Bar Connections	C
Weld Stirrup Attachments for Single Support Bar Systems	B
Bolted Stirrup Attachments for Single Support Bar Systems	D
Groove Welded Center beam Splices[a]	C
Miscellaneous Welded Connections[b]	C
Miscellaneous Bolted Connections	D

Footnotes:

a. Groove welded full penetration splices may be increased to Category B if weld integrity is verified using non-destructive testing (NDT).
b. Miscellaneous connections include attachments for equidistant devices.

5. The fatigue resistance for stirrups welded to a center beam flange shall not be taken greater than that defined using the fatigue details defined in Section 6.6 of the AASHTO LRFD Bridge Design Specifications - Second Edition. The applicable fatigue detail shall be a "Longitudinally Loaded Groove-Welded Attachment" or a "Longitudinally Loaded Fillet-Welded Attachment", depending on the type of connection used.

C. Infinite Life Regime Testing

1. The applicable constant amplitude fatigue limit (CAFL) for fatigue design may be selected as the highest CAFL of the AASHTO detail categories representing a lower bound to the experimentally acquired data. The CAFL of the AASHTO detail categories are designated in the table elsewhere in these special provisions.
2. A unique CAFL (different from the CAFL categories delineated in Section 6.6 of the AASHTO LRFD Bridge Design Specifications - Second Edition) may be established if all ten data are within 28 MPa of that unique CAFL.

Data Reporting

A. Fatigue Test Results and Observations

1. Data shall be reported in the typical S-N format (logarithm(S) vs. logarithm (N)) with the log of the stress range plotted as the ordinate (y-axis). Additionally, the data shall be reported in tabular format. The table shall contain the following information:

   a. Nominal stress range at the specific detail, $S_{r,eff}$
   b. Applied load range for each patch
   c. Number of cycles at initial observation of cracking (for reporting purposes only, not included as S-N data)
   d. Number of cycles at failure or termination of the test, N, and the reason for stopping the test (failure or termination)
   e. Type of crack as described elsewhere in these special provisions. A detailed description of the fatigue crack shall be provided if the observed crack does not resemble any of the crack types described elsewhere in these special provisions.

B. Miscellaneous Required Information

1. The following information shall also be reported:

   a. Expansion joint system type and manufacturer
   b. Drawings depicting shape, size, and dimensions of the specimen
   c. Drawings depicting fixture details, including specimen orientation
   d. Section properties and dimensions of the center beam and support bar
   e. Center beam-to-support bar connection details

i. Weld procedure specifications for welded expansion joint systems
ii. Bolt size, material specifications, location, and method of tightening for bolted expansion joint systems

DURABILITY TESTING OF ELASTOMERIC SUPPORT BEARINGS

Scope

A. This section provides requirements for durability testing of the elastomeric support bearings typically used in modular expansion joint systems. It is not applicable to compression springs, equidistant springs, or other elastomeric components.
B. Tests shall be performed dynamically on individual bearings. Fatigue life is evaluated by applying a displacement range to each specimen rather than a load or stress range.

Specimens

A. Specimens shall comprise full scale bearing components representative of those installed in field applications. PTFE sliding surfaces or materials typically bonded to the elastomeric support bearings shall be fabricated as an integral part of the specimen.
B. Prior to testing, each specimen shall be visually inspected for any flaws or defects that could plausibly affect fatigue resistance. Any flaws or details shall be defined and recorded. Data obtained from specimens containing such anomalies shall not be excluded from the data set. Observed anomalies shall also be reported with the test data.

Test Fixtures

A. Test fixtures shall have the capability to adequately support and secure the specimen throughout the duration of the test. The fixture shall be designed and fabricated to such tolerances as required to assure that additional stresses will not be generated in the specimen as a consequence of fixture misalignment.

Loading Details

A. Loads shall be applied through hydraulic actuators or other similar loading devices. Fatigue testing shall be performed using displacement control. Displacement and load ranges shall be continuously monitored throughout the duration of the fatigue test to assure that desired displacement range and minimum preload are maintained.
B. Load shall be applied to the specimen through flat steel plates that are smooth and free of surface corrosion. These plates shall be sufficiently thick to assure even load distribution to the specimen.

Dynamic Stiffness Test

A. Testing shall be conducted on each specimen to be subjected to fatigue testing in order to establish its dynamic stiffness for at least three different loading frequencies. The maximum of these loading frequencies shall be equal to the service load frequency corresponding to a vehicle traveling at 96 kph. The loading frequency, f, shall be calculated as:

$$f = \frac{V}{2(g+b)}$$

where

V = vehicle speed (96 kph at service load)
g = center beam gap (assume mid-range configuration)
b = center beam width

B. The load range applied during the dynamic stiffness test shall be that obtained from structural analysis using fatigue wheel load and wheel load distribution factors as specified in Sections, "Design Axle Loads and Impact Factors" and "Distribution of Wheel Loads" of these special provisions.

C. Each dynamic stiffness test shall be performed three times. Data from individual tests shall be compared to assure consistency of test results.

Fatigue Test

A. A minimum of three fatigue tests shall be required to establish the durability of each type of bearing.
B. The fatigue test shall be conducted using displacement control. The displacement (strain) range shall be applied using a sine or other smooth waveform at any frequency less than or equal to the service load frequency calculated elsewhere in these special provisions. The magnitude of the applied displacement amplitude, Δ, shall be calculated as:

$$\Delta = \frac{R_v}{K}$$

where

R_v = vertical reaction force at the support bearing as obtained from structural analysis
K = dynamic stiffness of the support bearing as determined elsewhere in these special provisions

C. A minimum precompression strain shall be maintained in the specimen throughout the duration of the test. This precompression strain shall be approximately equal to that present in a support bearing in a field installation. The magnitude of the applied cyclic strain shall be at least equal to the precompression strain.
D. The minimum and maximum dynamic load shall be recorded at the beginning of the test. The minimum and maximum dynamic load shall be monitored and periodically recorded throughout the duration of the test.
E. At the end of each applied displacement cycle, the displacement shall be held at the precompression level for no less than one half of the period of loading in order to facilitate heat dissipation. Artificial air flow devices (electrical fans) may be used to assist heat dissipation. Excessive heat generation will adversely affect the tested fatigue life.
F. A specimen shall be accepted as having passed the fatigue test criteria after withstanding 2 million cycles of loading without failure.
G. The following criteria shall constitute failure:

    1. The elastomeric material exhibits excessive deterioration or cracking.
    2. The measured minimum dynamic load falls to 30% of the initial dynamic load recorded at test initiation.
    3. The measured dynamic load range decreases to half of the initial dynamic load range recorded at test initiation.

Data Reporting for Fatigue Test

A. Data shall be reported in tabular format and shall contain the following information for each specimen tested:

    1. Minimum (precompression) strain, maximum strain, displacement, and load at test initiation
    2. Type of loading impulse (sine wave, ramp, etc.)
    3. Number of cycles at initial observation of distress leading to failure (for reporting purposes only, not to be included in the data)
    4. Number of cycles at failure
    5. A description of the mode of failure

B. The following data shall also be reported for each specimen tested:

    1. Bearing type and manufacturer
    2. Drawings depicting shape, size, and dimensions of the specimen including any PTFE sliding surfaces or materials bonded to the specimen
    3. Drawings depicting fixture details, including specimen orientation.

DYNAMIC TESTING

The Contractor shall perform a series of tests on one full-scale modular joint seal assembly at the laboratory designated in the approved working drawings and supplement. The tests shall verify the performance of the modular joint seal assembly during a seismic event involving high velocity longitudinal and transverse displacements. The tests shall demonstrate the

satisfactory performance of the modular joint seal assembly under the specified velocities. The test will also serve as a benchmark for establishing of relationship between friction force under slow velocity movement and size of the modular joint seal assembly.

The test specimen shall be a minimum of 6 meters in length. The test specimen shall consist of a minimum of 3-spans along the length of the joint and 4 support boxes including all tributary components except sealing elements. The test specimen shall contain 7 cells. Each cell is defined by sealing elements supported by adjacent beams. The relative angle measured in plan between the support bars of the test specimen shall be as similar as possible to the relative angle between the support bars of the production modular joint seal assemblies.

Design of the test specimen for all components used in the fabrication of the test specimen including design criteria, material specifications, fabrication procedures, and quality control program shall be the same as that used in the production of modular joint seal assembly.

The Contractor shall notify the Engineer, in writing, at least 10 working days prior to the start of both fabrication and testing of the test specimen.

During the fabrication process of the dynamic specimen the Contractor shall maintain a "Log of As Built Measurements" of all individual essential parts and the completed assembly as specified in section "Fabrication" of these special provisions. The Contractor shall submit to the Engineer for review and approval the "Log of As Built Measurements" at least 10 working days prior to the start of the dynamic testing.

Instrumentation shall be installed on the test specimen and test fixtures to continuously monitor and record transverse and longitudinal joint displacements, actuator force outputs in longitudinal and transverse directions. Total travel of each bearing throughout all the dynamic tests shall be computed based on recorded data. All tests shall be recorded on video media with a minimum of two video cameras recording the picture and sound during the test. One camera shall be positioned at level of the second support bar capturing in detail behavior of the sliding bearings and sliding springs. The second camera shall be positioned on side and above the modular joint seal assembly capturing the spacing of the center beams during the tests.

Prior to the start of each test all stainless steel sliding surfaces shall be cleaned using alcohol. No greasing or lubricating agents shall be applied to the stainless steel sliding surfaces.

The Contractor shall conduct a total of 17 dynamic tests in the sequence listed in the following table. The tests are defined by the following parameters: initial rotation about vertical, transverse and longitudinal axis as shown on the plans, displacement amplitude, speed and number of cycles.

Dynamic Test No.	Initial cell width (mm)	Initial rotation @ axis (radian)			Displacement (millimeter)		Speed (mm/sec)	No. of cycles
		vertical	transverse	longitudinal	longitudinal	transverse		
1	10	0	0	0	±450	0	∓ 25	10
2	0	0	0	0	+525	0	∓ 25	N/A
3	75	0	0	0	-420	0	∓ 25	N/A
4	10	0	0	0	0	±250	∓ 25	10
5	10	0	0	0	±450	±250	∓ 25	10
6	10	0	0	0	±450	0	1000	10
7	10	0	0	0	0	±250	1000	10
8	10	0	0	0	±450	±250	1000	10
9	10	0.012	0.05	0.01	±450	0	∓ 25	3
10	10	0.012	0.05	0.01	0	±250	∓ 25	3
11	10	0.012	0.05	0.01	±450	±250	∓ 25	3
12	10	0.012	0.05	0.01	±450	0	1000	10
13	10	0.012	0.05	0.01	0	±250	1000	10
14	10	0.012	0.05	0.01	±450	±250	1000	10
15	10	0	0	0	±450	0	∓ 25	3
16	10	0	0	0	0	±250	∓ 25	3
17	10	0	0	0	±450	±250	∓ 25	3

where
+ indicates opening movement
- indicates closing movement

The Contractor shall provide the access and assistance to the Engineer to observe the tests, monitor the process, and take the measurements as necessary. The Contractor shall also provide the space in the testing room to accommodate the Engineer's monitoring equipment.

After completion of each test for Test No. 2 and Test No. 3, the Contractor shall measure and record the size of all cells at a minimum of 4 locations spaced equally along the length of the center beams.

After completion of each test, the Contractor shall inspect the test specimen, in the presence of the Engineer, to identify any damage that may have occurred to the test specimen components.

After completion of Test No. 17, the Contractor shall completely disassemble the test specimen to allow the Engineer to inspect the test specimen for accumulated damage or deterioration to the test specimen components.

The acceptance criteria for dynamic testing of the modular joint seal assemblies shall be as follows:

A. During the Test No. 1 through Test No. 5 there shall be no vibrations or excessive noise and the movement shall be smooth. There shall be no excessive shear deformations of the sliding bearings and sliding springs. There shall be no other observations that might indicate mechanical problem.
B. The ratio of the largest to the smallest cell size measured at end of the Test No 2 and Test No. 3 shall be less then 1.15.
C. After completion of Test No. 5, the sliding areas of the test specimen shall have minimum wear and no signs of uneven wear.
D. After conducting all tests, the test specimen shall have no visible signs of any binding, dislocation or unseating of its components.
E. Minor damage to the sliding components that does not impair the ability of the test assembly to carry traffic and does not impair short term functionality of the center beam equal distance mechanism will be considered acceptable as determined by the Engineer.

ACCEPTANCE OF PROTOTYPE TESTS

Prior to fabricating or assembling modular joint seal assemblies to be installed, assemblies and components of assemblies shall have successfully met, as determined by the Engineer, the requirements specified for fatigue testing of metallic structural components and connections, durability testing of elastomeric support bearings, and dynamic testing in conformance with the requirements in these special provisions.

If the modular joint seal assembly test specimen or components of assemblies fail to meet any of the acceptance criteria as determined by the Engineer, the modular joint seal assembly will be rejected. The Contractor shall modify the design, fabrication, and assembly procedures, submit to the Engineer the revised working drawings, supplement and the "Log of As Built Measurements", allow the Engineer 20 working days to review the revised documents, and conduct additional tests. Additional testing shall not begin until the Engineer has approved the revised working drawings and supplement in writing. No extension of time or compensation will be made for modifying and resubmitting working drawings and supplement, fabricating additional test specimens or components of assemblies, conducting additional tests, and all other related work resulting from rejection of failed test specimens or components.

Within 10 working days after the completion of the tests, the Contractor shall submit to the Engineer 4 copies of the final test reports including complete test results for the modular joint test specimen tested.

After the completion of the tests, the test specimen and components of assemblies shall not be used in production and it shall become the property of the Contractor and shall be disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

PROOF TESTING

The Contractor shall perform proof testing on each fabricated modular joint seal assembly to be used in production except that the sealing elements shall not be installed for proof testing. All proof tests shall be performed in the United States.

The Contractor shall notify the Engineer, in writing, at least 10 working days prior to the start of each proof testing.

Instrumentation shall be installed on the modular joint seal assembly to be tested and the test fixtures to continuously monitor and record longitudinal joint displacements, actuator force outputs and total travel of each bearing throughout the proof test. All tests shall be recorded on video media. There shall be at least two video cameras recording the picture and sound during the test. One camera shall be positioned at level of the second support bar capturing in detail behavior of the sliding bearings and sliding springs. The second camera shall be positioned on side and above the modular joint seal assembly capturing the spacing of the center beams during the tests.

Prior to each test all stainless steel sliding surfaces shall be cleaned using alcohol. No greasing or lubricating agents shall be applied to the stainless steel sliding surfaces.

The Contract shall conduct a total of 3 proof tests for each fabricated modular joint seal assembly in the sequence listed in the following table. The tests are defined by the following parameters: initial rotation about vertical, transverse, and longitudinal axis as shown on the plans, displacement amplitude, speed and number of cycles.

Proof Test No.	Initial cell width (mm)	Initial rotation @ axis (radians)			Displacement (millimeter)		Speed (mm/sec)	No. of cycles
		Vertical	transverse	longitudinal	longitudinal	transverse		
1	0	0	0	0	±n x 75	0	25	5
2	0	0	0	0	+n x 75	0	25	N/A
3	n x 75	0	0	0	-n x 60	0	25	N/A

where
n - number of cells in the test specimen
\+ indicates opening movement
\- indicates closing movement

The Contractor shall provide access and assistance to the Engineer to observe the tests, monitor the process, and take the measurements as necessary. The Contractor shall also provide the space in the testing room to accommodate the Engineer's monitoring equipment.

After completion of each test for Test No. 2 and Test No. 3, the Contractor shall measure and record the size of all cells for at least 4 locations spaced equally along the length of the center beams.

After completion of Test No. 3, the Contractor shall inspect the modular joint seal assembly, in the presence of the Engineer, to identify any damage that may have occurred to the its components.

The acceptance criteria for proof testing of the modular joint seal assemblies shall be as follows:

A. During the tests there shall be no vibrations or excessive noise and the movement shall be smooth. There shall be no excessive shear deformations of the sliding bearings and sliding springs. There shall be no other observations that might indicate mechanical problem.
B. The ratio of the largest to the smallest cell size measured at end of the Test No. 2 and Test. No. 3 shall be less than 1.15.
C. After completion of Test No. 3, the sliding areas of the modular joint seal assembly shall have no visible wear and no signs of uneven wear.
D. The measured friction forces shall comply at least with one of the following criteria:

$$\frac{Fm1}{Fe1} \leq 1.15$$

or

$$\frac{Fm1}{Fe1} + \frac{abs(Fm1 - Fm2)}{\frac{1}{2}(Fm1 + Fm2)} \leq 1.25$$

or

$$\frac{abs(Fm1 - Fm2)}{\frac{1}{2}(Fm1 + Fm2)} \leq 0.07$$

where
Fm1 = measured friction force on the unit being proof tested
Fm2 = measured friction force on the unit with identical number of cells as the unit being proof tested
Fe1 = expected friction force on the unit being proof tested

If the proof tests fail to meet any of the acceptance criteria, as determined by the Engineer, the modular joint seal assembly will be rejected. No extension of time or compensation will be made for manufacturing, furnishing, and testing additional modular joint seal assemblies.

At the completion of successful proof testing for each modular joint seal assembly, within 10 working days, the Contractor shall submit to the Engineer 4 copies of the complete test results in conformance with the requirements for the specific test as specified in these special provisions.

Modular joint seal assembly will not be accepted and released for installation until the Engineer has reviewed and approved, in writing, the proof testing.

STORAGE, SHIPPING, AND HANDLING

Lifting mechanisms, temperature adjustment devices, and temporary anchorages shall not be welded to the center beams or edge beams.

Damage to the modular joint seal assembly during shipping or handling shall be cause for rejection of the modular joint seal assembly.

Damage to the corrosion protection system shall be repaired to the satisfaction of the Engineer prior to installation.

INSTALLATION

No modular joint seal assembly shall be installed until the Engineer has reviewed and approved, in writing, the working drawings, the results of the prototype and proof testing, and the inspection of the assemblies to be used.

A qualified installation technician shall be present at the job site to assure proper installation of each modular joint seal assembly. The qualified installation technician shall inspect the blockout prior to installation and shall be present during lowering of the modular joint seal assemblies into the blockout, leveling, adjusting of the cell width and grouting below support boxes. The qualified installation technician shall inspect anchorage reinforcement and the formwork before placing concrete and shall be present during the concrete placement operation. This technician shall be a full time employee of the manufacturer of the modular joint seal assembly. The Contractor shall comply with all recommendations made by the modular joint seal assembly manufacturer's installation technician as approved by the Engineer. Each modular joint seal assembly manufacturer's installation technician shall certify to the Engineer that the approved installation procedures were followed. All certifications to the Engineer shall be in writing and shall be signed and dated by the manufacturer's installation technician.

Each modular joint seal assembly shall be installed in accordance with the approved working drawings and supplement and the recommendations of the manufacturer's installation technician.

Each installed modular joint seal assembly shall match the finished roadway profile and grades.

The Contractor shall protect each modular joint seal assembly from damage. The Contractor shall protect concrete blockouts and support systems from damage and construction traffic prior to installation of the modular joint seal assemblies.

Each modular joint seal assembly shall be set to a gap width corresponding to the ambient temperature at the time of setting. The gap widths shall conform to the values shown on the plans and approved working drawings and supplement. The Contractor shall provide hardware for mechanically opening or closing the modular joint assembly for thermal adjustments. The manufacturer shall provide factory attached lifting devices and brackets to facilitate field handling and grade adjustments.

Each modular joint seal assembly shall be tested for watertightness after installation. The Contractor shall flood each completely installed modular joint seal assembly with water to a minimum depth of 75 millimeters for a duration of at least one hour. If leakage is observed, the modular joint seal assembly shall be repaired to the satisfaction of the Engineer at the Contractor's expense. The repair procedure shall be prepared by the modular joint seal assembly manufacturer and shall be submitted to the Engineer for approval. After repairs are completed, the modular joint seal assembly shall be retested for leakage.

The Contractor shall replace sealing elements not fully bonded to the steel extrusions with fully bonded seals at the expense of the Contractor.

The assembly shall have cast-in-place anchorage components forming a mechanical connection between the joint components and the concrete deck.

The bridge deck surface shall conform to the provisions in Section 51-1.17, "Finishing Bridge Deck," of the Standard Specifications after placing modular joint seal assemblies and anchorage.

The assembly shall be completely assembled and placed in a blocked out recess as shown on the plans.

All reinforcement other than primary reinforcement shall continue through the recess construction joint into the recess and engage the anchorage components of the assembly.

The vertical modular joint seal assembly in barrier shall be available for inspection after placement of the recess concrete around the anchorage components of the assembly.

The assembly shall make a watertight, continuous return 150 mm up into the barrier at the low side of the deck joint. Neoprene glands shall be continuous without field splices or joints, including the return up into barrier.

TIME LINE

Due to the time constraints on this contract and requirements of prototype and proof testing the contractor shall complete milestones within the duration shown in the following table.

Milestone No.	Milestone Description	Scheduled duration measured from previous milestone
0	Notice to proceed	N/A
1	Submit working drawings and supplement for the modular joint seal assembly for each hinge location and final working drawings for dynamic test specimen	60 working days
2	Approval of working drawings	N/A
3	Fabricate dynamic test specimen and ship to testing laboratory. Specimen ready to be installed in the testing rig	40 working days
4	Test specimen installed in the testing rig, dynamic test ready to proceed.	N/A
5	Conduct, successfully complete dynamic test and submit dynamic test report.	40 working days
6	Approval of dynamic test report	N/A
7	Revise and resubmit working drawings for the modular joint seal assembly for each hinge location	40 working days
8	Approval of final working drawings for each hinge location.	N/A
9	Fabricate first set of two modular joint seal assemblies. Conduct proof testing and submit proof test reports.	110 working days
10	Approval of the first set of two proof tests.	N/A
11	Fabricate second set of two modular joint seal assemblies. Conduct and successfully complete proof tests.	50 working days
12	Approval of the second set of two proof tests	N/A
13	Fabricate third set of two modular joint seal assemblies. Conduct and successfully complete proof tests.	50 working days

ALTERNATIVE MODULAR JOINT SEAL ASSEMBLY

At the Contractor's option, an alternative modular joint seal assembly may be substituted for the Maurer Sohne Swivel-Joist Expansion Joint provided:

A. The quality of the alternative and its suitability for the intended application are at least equal to the Maurer Sohne Swivel-Joist Expansion Joint specified in these special provisions.
B. The Contractor's written request for substitution of an alternative modular joint seal assembly is approved by the Engineer.
C. Acceptable working drawings and supplemental calculations are furnished as specified herein.
D. Alternative modular joint seal assembly shall conform to the following requirements:

1. Due to the time constraints on this contract, only one alternative modular joint seal assembly request for substitution will be accepted for review.
2. The acceptability, quality, and suitability of an alternative modular joint seal assembly will be made in accordance with the provisions of Section 6-1.05, "Trade Names and Alternatives," of the Standard Specifications.
3. The complete written request for substitution shall include a description of the alternative modular joint seal assembly; the name of the modular joint seal assembly manufacturer; verification that the qualifications specified herein have been met by the manufacturer for the alternative modular joint seal assembly; written evidence that alternative modular joint seal assembly conforms with all requirements specified in these special provisions, and a copy of the manufacturer's list of materials and standards used to manufacture the alternative modular joint seal assembly.
4. The Contractor shall provide written certification of the manufacturer's experience to the Engineer. This certification shall include the location of each bridge, installation date, governmental agency/owner, and the name, address, and telephone number of each owner's/agency's representative.
5. Schedule verifying that the alternative modular joint seal assembly manufacturer can meet the milestones specified in "Time Line" of these special provisions.
6. If the blockout sizes are different from that shown on the plans, the Contractor shall redesign the segment and reinforcement to comply with the design criteria. Any additional cost resulting from different blockout sizes shall be at the Contractor's expense.

7. The maximum depth and width of the blockout shall be such that the primary reinforcement to provide the necessary strength of the structural members is outside the recess.
8. The alternative modular joint seal assembly shall be a modular single support bar system. Horizontal support of the center beam on the support bar shall be sliding and resilient in torsion. The load carrying function of the joint shall be separated from the water sealing function. Multiple support bar systems or sliding bridge plate systems will not be accepted. Due to high number of sealing elements the expansion joint shall be equipped with a control system which renders the individual control of each center beam possible. The equal spacing of the center beams shall not be assured by a sequentially arranged spring based control mechanism. The center beams shall be able to be exchanged individually, leaving the functioning of the joint intact.

Standard data and catalog cut sheets from alternative modular joint seal assembly manufacturer will not be considered sufficient. The Engineer will not be responsible for seeking further data from the manufacturer, or for otherwise researching the alternative modular joint seal assembly. Failure to provide complete data will be cause for rejection of the alternative modular joint seal assembly.

Prototype and proof testing of the alternative modular joint seal assemblies shall be as specified in "Prototype Testing" and "Proof Testing" of these special provisions.

Development of the Contractor's written request for substitution of an alternative modular joint seal assembly, preparation and submittal of complete working drawings and supplemental information, and testing will be at the Contractor's expense. There will be no compensation and no extension of contract time allowed for the development and review processes to evaluate the proposed substitution of an alternative modular joint seal assembly.

The Contractor shall be responsible for any additional costs and time delays associated with selection of an alternative modular joint seal assembly incurred as a result of noncompliance with these requirements, including the failure of the manufacturer to retest revised details or material substitutions of a previously prequalified system.

No alternative modular joint seal assembly shall be installed until the Engineer has reviewed and approved, in writing, the working drawings, the results of the prototype and proof testing, and the inspection of the assemblies to be used.

MEASUREMENT AND PAYMENT

Modular joint seal assemblies will be measured by the meter from end to end along the centerline of the completed seal as shown on the plans.

The contract prices paid per meter for modular joint seal assembly, of the types and at locations listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in designing, fabricating, furnishing, prototype and proof testing including test specimens, storing, transporting, inspection by a qualified representative of the modular joint seal assembly manufacturer, and installing the modular joint seal assemblies, including protecting, repairing, cleaning, and painting, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No payment will be made for modular joint seal assemblies that fail to meet any of the acceptance or inspection criteria.

If modular joint seal assemblies are fabricated or tested more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impracticable and extremely difficult to ascertain and determine the actual increase in these expenses, it is agreed that payment to the Contractor for furnishing the modular joint seal assemblies will be reduced $5000 for each fabrication site or testing facility located more than 480 line kilometers from both Sacramento and Los Angeles and an additional $3000 ($8000 total) for each fabrication site or testing facility located more than 4800 air line kilometers from both Sacramento and Los Angeles.

Full compensation for modifications to bridge members or elements made necessary by the use of an alternative modular joint seal assembly shall be considered as included in the contract price paid per meter for modular joint seal assembly, of the types and at locations listed in the Engineer's Estimate and no additional payment will be made therefor.

Bikepath expansion joints including cover plates shall be measured and paid for separately as specified in Section "Steel Structures" elsewhere in these special provisions.

Concrete barrier including cover plates will be measured and paid for as concrete barrier (type 732 modified).

10-1.34 CIRCULAR SEGMENTED BEARING

The Contractor shall fabricate, test, and install circular segmented bearings consisting of steel plates, steel anchor bolts, studs, elastomer, woven polytetrafluoro-ethylene (PTFE) fabric, and high strength grout conforming to the details shown on the plans, to the Standard Specifications, and to these special provisions.

GENERAL

Each bearing consists of several individually fabricated bearing segments, which are assembled to form a cylindrical surface as shown on the plans.

The Contractor's attention is directed to the Section "Steel Structures," of these special provisions for hinge pipe beam requirements.

The design service load and design ultimate load shall conform to the values as shown on the plans. The design service load applied on one bearing segment shall be obtained by dividing the total design service load shown on the plans by the number of segments in an arc subtended by a 90° angle. The design ultimate load applied on one bearing segment shall be obtained by dividing the total design ultimate load shown on the plans by the number of segments in an arc subtended by a 90° angle.

Circular segmented bearings shall be of 2 types:

A. Fixed type (Type III and Type IV as shown on the plans), a curved steel laminated elastomeric unit with concentric curved steel anchor plate.
B. Expansion type (Type I and Type II as shown on the plans), a curved steel laminated elastomeric unit with concentric curved steel anchor plate and an inner woven PTFE fabric on the sliding surface.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in Section, "Working Drawings," elsewhere in these special provisions and these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the circular segmented bearing and its components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use including the placement of high strength grout.

Working drawing submittals shall include the following:

A. Bearing fabrication plans for all bearings including complete details for each component of every bearing segment. Each segment shall have a unique number. The segment number shall be identified on the working drawings and shall be permanently marked on each component of the segment. The segment number shall be visible in the final installed position of the bearin. The segment number shall contain the following information:

    1. Hinge location
    2. Diaphragm location
    3. Bearing number
    4. Segment number

B. All ASTM, AASHTO, or other material designations.
C. Description and details of the method of mechanical interlocking of the woven PTFE fabric to the metallic substrate.
D. Storage and shipping plans including details of handling and supporting of the circular segmented bearings. Each shipment of the circular segmented bearings shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-l.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
E. Installation plans including method, materials, equipment, sequence, procedures, and temporary support details that the Contractor proposes to use for installation of the circular segmented bearings. The installation plans shall also include measures that will protect the stainless steel surface of the pipe beam from damage during installation.
F. Details of lifting locations and mechanisms.

A supplement to the working drawings shall include the following:

A. The manufacturer of the woven PTFE fabric shall furnish to the Engineer fabric performance reports. Reports shall include documentation from at least 2 separate projects where the manufacturer's woven PTFE fabric successfully performed under condition and for applications similar to these shown on the plans for a performance life of at least 3 years.
B. High strength grout mix design.
C. Bearing segment test procedures, details, and substantiating calculations including test equipment to be used, test equipment calibration and traceability standards, required fixtures. The bearing segment tests shall be performed by a reputable nationally recognized independent testing laboratory. The Contractor shall submit the qualifications of independent testing laboratory and personnel who will perform the tests and prepare the test reports. The qualifications of personnel shall include position held, responsibilities, and the length of service in position. The Contractor's independent testing laboratory shall submit to the Engineer 5 copies of certified test results for each tested bearing in conformance with the requirements for testing in these special provisions.

D. Quality Control program for fabrication and installation of circular segmented bearings.
E. The manufacturer of the circular segmented bearing shall submit to the Engineer a manual for the bearing inspection, maintenance, and replacement. This manual shall include:

1. A record of bearing segment number for each component of every bearing segment including the tracing of all components during the fabrication and installation of circular segmented bearings.
2. Recommended life expectancy for each bearing segment component.
3. Recommended frequency for bearing inspection and maintenance schedule.
4. Procedures and details to perform the bearing inspection and maintenance.
5. List of indication of bearing segment defects and the associated repair methods, if applicable.
6. Procedures and sequences for bearing segment replacement including locations of temporary support and estimate of jacking load for each temporary support location.

After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal.

MATERIALS

Steel components including plates, anchor bolts, and studs shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Except studs, welding of bearing segment components shall not be permitted after molding the elastomer. Welding quality control of studs shall conform to the requirements specified in "Welding Quality Control," of these special provisions.

High strength grout shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications.

The elastomeric elements shall have shear modulus of 1.2 MPa conforming to ASTM Designation: D 4014. The elastomer shall be fully vulcanize-bonded to the carbon steel plates under factory controlled conditions

PTFE surfaces of expansion type bearings shall be unfilled PTFE fabric made from virgin PTFE oriented multifilament and other fibers. The resin in the filaments shall be virgin (not reprocessed) PTFE material in conformance with the requirements of ASTM Designation: D 1457.

FABRICATION AND INSTALLATION

At the highest point of substrate and after compression under the design ultimate load, the woven PTFE fabric shall have a minimum thickness of 1.6 mm and a maximum thickness of 3.2 mm.

Concave plate radius dimension tolerances shall be +250 µm to 0.000 µm.

The woven PTFE fabric on sliding bearing surfaces shall be epoxy bonded and mechanically interlocked to the steel substrate. All bonding shall be done under controlled factory conditions. The mechanical interlock on the cylindrical surface must be integrally machined into the steel substrate. Welded retention grids will not be allowed on the cylindrical surface. Any edges, other than the selvage shall be oversown or recessed so that no cut fabric edges are exposed.

After completion of the bonding operation the PTFE surface shall be smooth and free from bubbles and in full contact with its concentric substrate.

Metal surfaces of bearings exposed to the atmosphere in the completed work and the inner surfaces of the fixed type bearings shall be cleaned and painted in conformance with the provisions in Sections 59-2, "Painting Structural Steel," and 91, "Paint" of the Standard Specifications, and "Clean and Paint Structural Steel" of these special provisions.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for circular segmented bearings.

Finish coats will not be required on the bearings.

Bearing segment elements shall be fabricated and inspected in the factory by the Contractor. The Quality Control for fabrication and installation of circular segmented bearings shall be the responsibility of the Contractor. The Contractor shall perform quality control in accordance with approved working drawings and supplement.

Each segment shall be marked for location and orientation in conformance with the approved working drawing and supplement. Segments shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers and in addition the woven PTFE surface shall be fully covered with opaque material at all times until immediately before placement.

During fabrication, the maximum temperature of bonded PTFE surfaces shall be 150°C.

Damaged bearings shall be replaced.

A qualified representative of the manufacturer shall be present during installation of the first bearing and shall be available for advice during remaining installations.

The Contractor's attention is directed to the section "Steel Structures," of these special provisions for pipe beam requirements.

The Contractor shall protect the pipe beam stainless steel surface during the installation of the circular segmented bearings. No damage to the stainless steel surface shall be permitted.

Circular segmented bearing steel anchor plates shall be temporarily supported during grout operation. Temporary supports shall be designed to ensure a uniform concentric gap between the bearing and the pipe beam as shown on the plans. Temporary supports shall prevent the rotation or displacement of the bearing during grout operation. Temporary supports shall not inhibit the functioning of the circular segmented bearing after grout has set. Temporary supports shall not restrict the movement at bridge joints due to temperature changes and shortening from prestress forces. Materials for temporary supports within the limits for placing concrete shall conform to the requirements for form fasteners.

Circular segmented bearings under the design service load shall have a first movement static coefficient of friction not exceeding 0.08.

TESTING

Full sized bearing segment shall be tested and evaluated for compression, elastomer shear and coefficient of friction in the presence of the Engineer. The tests shall be performed on samples randomly selected by the Engineer from the production bearing segments to be used in the work. Testing shall be performed by the Contractor's independent testing laboratory as approved in the working drawings and supplement.. The Contractor shall give the Engineer at least 7 days notice before beginning testing. Testing of bearing segments shall conform to the following requirements:

A. For service load testing, one bearing segment shall be selected from each circular segmented bearing. For ultimate load testing, one bearing segment shall be selected from a set of eight circular segmented bearings at each hinge. Bearing segment that has been tested under ultimate conditions shall not be installed in the bridge and shall become the property of the State.
B. The bearing types and tests required for each type shall be as follows:

Load Level	Service	Ultimate
Compression	F, E	F, E
Elastomer shear	F, E	
Friction	E	E

F Fixed Type Bearings
E Expansion Type Bearings
C. The test fixtures shall conform to the following requirements:

1. The test fixture elements including the mating surfaces shall be fabricated to match the curved surface of the tested segments as specified elsewhere in these special provisions. The materials and tolerances of the fixture mating surfaces shall be the same as those in the pipe beam as specified in section "Steel Structures," of these special provisions.
2. The surface of the test fixture elements in contact with the bearing segment shall match that of the bearings as installed, for each of the fixed and expansion bearing segments without causing the bearing segments to flex or marring their surfaces.
3. The test fixtures shall be designed to transfer loading uniformly to the curved surfaces throughout the range of test loads with deflection equal to or less than the actual hinge pipe beams as shown on the plans.
4. The test fixture elements shall be subject to the same quality control and inspection requirements as bearing segments, and pipe beams in Section, "Steel Structures," elsewhere in these special provisions.

D. The compression tests at the design service load shall be performed to verify fabrication quality and shall conform to the following procedures and requirements:

1. Prior to the start of each test all steel sliding surfaces shall be cleaned using alcohol. No greasing or lubricating agents shall be applied to the steel sliding surfaces.
2. The bearing segment and its load transfer plates shall be centered in a press capable of loads in excess of the design service load.
3. Hold the design service load for one minute. Check for uneven bulges that suggest misplaced shims or bond failure. Release at a rate not exceeding 1000 kN per minute.

E. The compression at the design service load test acceptance criteria shall be the following:

1. Shim placement shall not be off by more than 30% of the design rubber thickness.

2. There shall be no bond failure of two adjacent shims at any location around the edge of the bearing.
3. The total length of debonding at all internal shims shall be no longer than 2% of the perimeter of the elastomeric component of the bearing.
4. There shall be no visible sign of bond failure between the outer steel plates and the elastomer.
5. There shall be no visible sign of bond failure between the woven PTFE fabric and the steel bearing plate.
6. There shall be no damage to the PTFE.
7. If the bearing segments fail to comply with the compression test acceptance criteria, then all bearing segments in that circular segmented bearing shall be individually proof tested.

F. The friction test at the design service load shall be performed to verify the coefficient of friction between the PTFE and the mating surface, and shall conform to the following procedures and requirements:

1. The slider shall be constructed from a piece of hinge pipe beam that has been surface finished using exactly the same procedures and resulting in exactly the same finish as used for the pipe beam. The direction of the PTFE sliding, relative to the direction of the surface machining on the stainless steel surface, is the same as in the prototype structure. The length of the slider shall be such that the slider always overhangs the PTFE even at maximum displacement.
2. The stainless steel surface of the slider shall be cleaned with a non lubricating, degreasing solvent.
3. Testing shall be completed after conditioning specimens for 12 hours at 21°±8°C.
4. The axis of the slider shall be aligned with the axis of the PTFE element.
5. The design service load shall be applied without any relative movement of the sliding surfaces for a minimum of 1 hour prior to friction measurement.
6. The tests shall be arranged to allow measurement of the static coefficient of friction on the first movement of the bearing.
7. The first movement static and dynamic coefficients of friction shall be measured at a sliding speed not exceeding 25 millimeter per minute.
8. The test bearing segments shall be subjected to a minimum of 100 movements of at least 50 mm of relative movement, peak to peak, at a sliding speed not exceeding 125 millimeter per minute. After cycling, the first movement static and dynamic coefficients of friction shall be measured again at a sliding speed not exceeding 25 millimeter per minute.
9. A record shall be kept of the compressive force, shear force, shear displacement and time. Readings shall be taken at sufficiently close intervals to detect the force peak that may occur at the reversal of direction but not at less than 200 readings per cycle. The zero for force shall be taken as the mid-point between the forces at zero displacement during sliding in the two different directions. Friction forces shall be measured from this zero value.
10. Testing shall be conducted at an ambient temperature of 21°±8°C.
11. A new stainless steel sliding surface shall be used for each PTFE specimen tested.
12. Testing may also be performed using two bearings back to back so that two PTFE components remain stationary but the stainless steel component moves backwards and forwards. In this case the slider consists of two segments of pipe joined back to back with the stainless steel facing outwards.

G. The coefficient of friction at the design service load test acceptance criteria shall be the following:

1. Friction value shall be computed by dividing the instantaneous shear force with the instantaneous compressive force.
2. Friction coefficient at initial breakaway shall be less than 8%.
3. Dynamic and static coefficients of friction after 100 cycles shall be less than 6%.
4. There shall be no sign of debonding damage or wear to the PTFE or the stainless steel surface. Debonding shall be particularly checked at the front and back edges of the PTFE where these are clamped to the backing substrate.
5. If a bearing segment fails to comply with the coefficient of friction test, then all bearing segments in that bearing shall be individually proof tested. Segments that do not comply with the coefficient of friction test acceptance criteria will be rejected.

H. The shear test for the elastomer at the design service load shall be performed to verify the material properties and consistency of fabrication of the elastomer compound in nominally similar bearings, and shall conform to the following procedures and requirements:

1. This test may be conducted in the same rig as the service friction test. However, in this test the longitudinal movement must take place at the elastomer whereas in the friction test all the movement must take place at the sliding surface.
2. The shear loading may be applied simultaneously with a compressive load that is no greater than the service compressive load on the bearing.
3. The test specimen shall be subjected to seven full cycles of shear displacements, with zero-to-peak amplitude equal to the smaller of 0.5 times the elastomer thickness or the service shear displacement, and a shear strain rate between 0.01 and 0.05 mm/mm/sec. On the fourth, fifth and sixth cycles record compressive and shear loads, shear displacement and time. Reading frequency shall not be less than 200 readings per cycle.

I. The shear test acceptance criteria shall be the following:

1. The bearing stiffness shall be obtained as follows: A best fit line shall be drawn between $-0.75\Delta_s$ and $+0.75\ \Delta_s$ where Δ_s is the target peak shear displacement during the test. This procedure shall be repeated seapartely for the loading and unloading halves of the cycles 4, 5 and 6. The slope of each line gives the stiffness of that half cycle. The test bearing stiffness shall be taken as the arithmetic average of these six stiffness values.
2. The stiffness of any individual test bearing shall not differ from the group average stiffness by more than 20%. The group average bearing stiffness is defined as the average of the stiffness of all bearings in a group.
3. The stiffness of any individual test bearing shall not differ from the design stiffness by more than 20%. The design stiffness, k_{shear}, shall be obtained from the equation $k_{shear}=GA/T$, where G is the specified shear modulus, A is the average plan area of the elastomer, computed along the curved surface and T is the total elastomer thickness normal to the surface.
4. Allowance may be made for the effect of compressive load on the shear stiffness, if the test is so conducted. The method of adjusting the stiffness to account for the effects of compressive load shall be submitted to the engineer for his approval prior to the start of testing.
5. If a bearing segment fails to comply with the elastomer shear test, then all bearing segments in that bearing shall be individually proof tested. Bearing segments that do not comply with the elastomer shear test shall be rejected.

J. The friction test at the design ultimate load shall be performed to verify that the coefficient of friction between the PTFE and the mating surface, at ultimate conditions lies within acceptable limits, and shall conform to the following procedures and requirements:

1. The test shall be preferably conducted on a full sized bearing. As an alternative, the test may at the Contractor's option, be conducted using a sample of PTFE no smaller than 100 mm x 100 mm.
2. The slider shall be constructed from a piece of hinge pipe beam that has been surface finished using exactly the same procedures and resulting in exactly the same finish as used for the pipe beam. The direction of the PTFE sliding, relative to the direction of the surface machining on the stainless steel surface, is the same as in the prototype structure. The length of the slider shall be such that the slider always overhangs the PTFE even at maximum displacement.
3. The stainless steel surface of the slider shall be cleaned with a non lubricating, degreasing solvent.
4. Testing shall be completed after conditioning specimens for 12 hours at 21°±8°C.
5. The axis of the slider shall be aligned with the axis of the PTFE element.
6. The compressive load shall be such as to cause the same average compressive stress on the test specimen as is experienced bearing under its ultimate load.
7. The first movement static and dynamic coefficients of friction shall be measured at a sliding speed not exceeding 25 millimeter per minute.
8. The test displacements shall be full cycles with zero-to-peak amplitude of the smaller of 100 mm or the ultimate displacement of the bearing. Three full cycles shall be applied at an average sliding speed of no more than 25 mm/min. No readings need be taken during these three cycles. Then three cycles shall be imposed at an average sliding speed that is the smaller of the maximum design sliding speed or 150 mm/sec.
9. A record shall be kept of the compressive force, shear force, shear displacement and time. Readings shall be taken at sufficiently close intervals to detect the force peak that may occur at the reversal of direction but not at less than 100 readings per cycle. The zero for force shall be taken as the mid-point between the forces at zero displacement during sliding in the two different directions. Friction forces shall be measured from this zero value.
10. Test shall be conducted at an ambient temperature of 20±8°C.

11. A new stainless steel sliding surface shall be used for each PTFE specimen tested. The sliding surface used for service friction test is also acceptable.
12. Testing may also be performed using two bearings back to back so that two PTFE components remain stationary but the stainless steel component moves backwards and forwards. In this case the slider consists of two segments of pipe joined back to back with the stainless steel facing outwards.

K. The coefficient of friction at ultimate load test acceptance criteria shall be the following:

1. Friction value shall be computed by dividing the instantaneous shear force with the instantaneous compressive force.
2. Dynamic and static coefficients of friction after 100 cycles shall be less than 15%.
3. There shall be no sign of debonding damage or wear to the PTFE or the stainless steel surface. Debonding shall be particularly checked at the front and back edges of the PTFE where these are clamped to the backing substrate.
4. If a bearing segment fails to comply with the coefficient of friction at ultimate test, then all bearing segments in that bearing will be rejected and the test shall be repeated for all expansion type bearings at that hinge; one bearing segment shall be tested from each expansion type bearing at that hinge. If three bearing segment tests fail, all bearings at that hinge will be rejected.

L. The compression test at the design ultimate load shall conform to the following procedures and requirements:

1. This test shall be preferably conducted on a full size specimen. As an alternate the test may be conducted on a reduced sized specimen.
2. If a reduced sized bearing is tested, the dimensions of the specimen and the loading imposed on it shall be selected, to the satisfaction of the engineer, so as to represent the conditions of strain experienced by the prototype bearing when acted upon by the ultimate loads. The loading shall include both compression and rotation.
3. Prior to the start of each test all steel sliding surfaces shall be cleaned using alcohol. No greasing or lubricating agents shall be applied to the steel sliding surfaces.
4. The bearing segment and its load transfer plates shall be centered in a press capable of loads in excess of the design ultimate load.
5. Hold the design ultimate load for one minute. Check the bearing for debonding. Release the load at a rate not exceeding 1000 kN per minute.

M. The compression at the design ultimate load test acceptance criteria shall be the following:

1. Debonding of any steel-elastomer interface shall not exceed 25% of the plan area of the layer.
2. The external steel plates shall not be permanently bent or distorted.
3. Debonding of the PTFE from its substrate shall not exceed 10% of the plan area of the PTFE.
4. The stainless steel element shall not come into contact with the steel components of the elastomeric component of the bearing assembly.
5. If a bearing segment fails to comply with the compression at the design ultimate load test acceptance criteria, then all bearing segments in that bearing will be rejected and the test shall be repeated for all bearings at that hinge; one bearings segment shall be tested from each bearing at that hinge. If three bearing segment tests fail, all bearings at that hinge will be rejected.

N. Test results shall be certified correct and signed by the testing laboratory personnel who conducted the test and interpreted the test results. Test results shall include the identification number of the bearing segment tested.

MEASUREMENT AND PAYMENT

Quantities of circular segmented bearing will be determined as units from actual count in the completed work.

No payment will be made for circular segmented bearings that do not pass the specified testing requirements.

The contract unit price paid for circular segmented bearings of Types I, II, III, and IV on Hinges BE, BW, CE, CW, DE, and DW shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the bearing, installing in final position, including high strength grout, temporary supports, testing including fixtures, and cleaning and painting of circular segmented bearings, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for circular segmented bearings of Types III and IV on Hinges AE, AW and Types I and II on Hinges EE and EW shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals,

and for doing all the work involved in constructing the bearing, temporary supports, testing including fixtures, and cleaning and painting and installation of the circular segmented bearings in temporary recessed position, excluding high strength grout, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for circular segmented bearings of Types I and II on Hinges AE, AW and Type III and IV on Hinges EE and EW shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the bearing, testing including fixtures, and cleaning and painting and storing of the circular segmented bearings as specified elsewhere of these Special Provisions, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for bearing testing including testing fixtures and test specimen for design ultimate load tests shall be considered as included in the contract unit price paid for circular segmented bearings and no separate payment will be made therefor.

If a portion or all of circular segmented bearings are either fabricated or tested at a site more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Payment to the Contractor for furnishing circular segmented bearings will be reduced $5,000 for any fabrication and testing site located more than 480 air line kilometers from both Sacramento and Los Angeles, or in the case where a fabrication or testing site is located more than 4800 air line kilometers from both Sacramento and Los Angeles, payment will be reduced $15,000.

10-1.35 NEOPRENE BUMPER

Neoprene bumpers at hinge locations shall conform to the details shown on the plans and to the requirements in these special provisions.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in Section "Working Drawings," elsewhere in these special provisions. Working drawings shall include complete details, information, drawings, and substantiating calculations of the methods, materials, equipment, and procedures the Contractor proposes to use in fabricating and installing the neoprene bumpers.

Working drawing submittals shall include the following:

A. Neoprene bumper layout, sizes, and dimensions at each hinge location.
B. Neoprene bumper installation procedures and sequences.
C. Neoprene bumper details including materials and connections between the components.
D. Details and descriptions of neoprene vulcanizing process.
E. Anchor embedments and setting plan.

A supplement to the working drawings shall include the following:

A. Documentation of qualifications of neoprene bumper manufacturer. The Contractor shall demonstrate to the Engineer that the manufacturer of neoprene bumpers has completed 3 installations, each having been in service for at least 3 years.
B. Certified test reports furnished by an independent testing agency, attesting that furnished products and materials conform to the requirements specified on the plans and these special provisions.
C. Neoprene bumper replacement procedures, sequences, and details.

After complete working drawings and supplement are received, the Contractor shall allow the Engineer 30 working days to review the submittal.

MATERIALS

Neoprene shall conform to the provisions for "Neoprene" in Section 51-1.14, "Waterstops," of the Standard Specifications.

The integral steel mounting flanges shall be of ASTM A36, or stronger.

Studs, bolts, nuts, and washers for attaching elements to embbeded anchor sleeves shall be of size and quantity recommended by neoprene manufacturer. Studs shall conform to the requirements in ASTM Designation: A307. Bolts shall be Type 316 stainless steel per ASTM A194, grade 8M heavy hex. Washers shall be Type 316 stainless steel.

INSTALLATION

The neoprene bumpers shall be installed after the precast concrete segment has been erected and all prestressing operations are completed. Attention is directed to the section in "Erect Precast Concrete Segment," of these special provisions.

Concrete embedments including studs shall be no closer than 150 mm to an edge the concrete member, and shall be designed to resist a pullout, assuming 45 MPa concrete and 1.25 times greater than the breaking strength of the male threads.

MEASUREMENT AND PAYMENT

Neoprene bumpers will be measured by the unit as shown on the plans and in the Engineer's Estimate.

The contract unit price paid for neoprene bumpers shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing and installing the neoprene bumpers, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.36 POLYESTER CONCRETE OVERLAY (20 mm, 13 mm)

This work shall consist of constructing a polyester concrete overlay in conformance with the details shown on the plans and these special provisions.

Before starting deck overlay work on the project, the Contractor shall submit, for approval by the Engineer, a program for public safety associated with use of methacrylate resin and polyester concrete during the construction of the project. Such program shall identify materials, equipment and methods to be used. The Contractor shall not perform any deck overlay work on the project, other than that specifically authorized in writing by the Engineer, until such program has been approved.

If the measures being taken by the Contractor are inadequate to provide for public safety associated with use of methacrylate resin and polyester concrete, the Engineer will direct the Contractor to revise his operations and his public safety program. Such directions will be in writing and will specify the items of work for which the Contractor's program for public safety associated with use of methacrylate resin and polyester concrete are inadequate. No further work shall be performed on these items until the public safety measures are adequate and, if required, a revised program for public safety associated with use of methacrylate resin and polyester concrete has been approved.

The Engineer will notify the Contractor in writing of the approval or rejection of any submitted or revised program for public safety associated with use of methacrylate resin and polyester concrete in not more than 10 working days following submittal.

The State will not be liable to the Contractor for failure to approve all or any portion of an originally submitted or revised program for public safety associated with use of methacrylate resin and polyester concrete, nor for any delays to the work due to the Contractor's failure to submit an acceptable program for public safety associated with use of methacrylate resin and polyester concrete.

A prime coat shall be applied to the surfaces to be covered with polyester concrete.

When magnesium phosphate concrete is placed prior to the deck overlay, the magnesium phosphate concrete shall be placed at least 72 hours prior to placing the prime coat.

When modified high alumina based concrete is placed prior to the deck overlay, the prime coat shall not be placed on said concrete until at least 30 minutes after final set.

Polyester concrete shall consist of polyester resin binder and dry aggregate. The resin shall be an unsaturated isophthalic polyester-styrene co-polymer conforming to the following:

POLYESTER RESIN BINDER		
PROPERTY	REQUIREMENT	TEST METHOD
* Viscosity	0.075 to 0.20 Pa·s (RVT, No. 1 Spindle, 20 RPM at 25°C)	ASTM D 2196
* Specific Gravity	1.05 to 1.10 at 25°C	ASTM D 1475
Elongation	35 percent, minimum Type I at 11.5 mm/min. Thickness= 6.5±1 mm	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
Tensile Strength	17.5 MPa, minimum Type I at11.5 mm/min. Thickness= 6.5±1 mm	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
* Styrene Content	40 percent to 50 percent (by weight)	ASTM D 2369
Silane Coupler	1.0 percent, minimum (by weight of polyester styrene resin)	
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum at 24 hours and 21±1°C	California Test 551
* Static Volatile Emission	60 gram per square meter, loss, maximum	South Coast Air Quality Management District, Standard Method
* Test shall be performed prior to adding initiator.		

The silane coupler shall be an organosilane ester, gammamethacryloxypropyltrimethoxysilane. The promoter shall be compatible with suitable methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators.

Aggregate for polyester concrete shall conform to the provisions in Section 90-2.02, "Aggregates," of the Standard Specifications and either of the following combined aggregate gradings:

COMBINED AGGREGATE		
Sieve Size	9.5-mm Max. Percent Passing	4.75-mm Sieve Max. Percent Passing
12.5-mm	100	100
9.5-mm	83 - 100	100
4.75-mm	65 - 82	62 - 85
2.36-mm	45 - 64	45 - 67
1.18-mm	27 - 48	29 - 50
600-µm	12 - 30	16 - 36
300-µm	6 - 17	5 - 20
150-µm	0 - 7	0 - 7
75-µm	0 - 3	0 - 3

Aggregate retained on the 2.36-mm sieve shall have a maximum of 45 percent crushed particles when tested in conformance with California Test 205. Fine aggregate shall consist of natural sand only.

Aggregate absorption shall not exceed one percent as determined by California Test 206 and 207.

At the time of mixing with the resin, the moisture content of the aggregate, as determined by California Test 226, shall not exceed one half of the aggregate absorption.

The prepared surface shall receive a wax-free, high molecular weight methacrylate prime coat conforming to the following:

High Molecular Weight Methacrylate (HMWM) Resin		
PROPERTY	REQUIREMENT	TEST METHOD
* Viscosity	0.025 Pa·s, maximum, (Brookfield RVT with UL adaptor, 50 RPM at 25°C)	ASTM D 2196
* Specific Gravity	0.90, minimum, at 25°C	ASTM D 1475
* Flash Point	82°C, minimum	ASTM D 3278
* Vapor Pressure	1.0 mm Hg, maximum, at 25°C	ASTM D 323
Tack-free time	400 minutes, maximum at 25°C	California Test 551
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum at 24 hours and 21±1°C	California Test 551
* Test shall be performed prior to adding initiator.		

The promoter/initiator system for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, at no time shall the metal drier be mixed with the peroxide directly. The containers shall not be stored in a manner that will allow leakage or spillage from one material to contact the containers or material of the other.

A Material Safety Data Sheet shall be furnished prior to use for each shipment of polyester resin binder and high molecular weight methacrylate resin.

The Contractor shall allow 14 days for sampling and testing of the polyester resin binder and high molecular weight methacrylate resin prior to proposed use.

If bulk resin is to be used, the Contractor shall notify the Engineer in writing 10 days prior to the delivery of the bulk resin to the jobsite. Bulk resin is any resin that is stored in containers in excess of 209 liters.

Expansion joints shall be adequately isolated prior to overlaying or may be sawed within 4 hours after overlay placement, as approved by the Engineer. The exact time of sawing will be determined by the Engineer.Prior to applying the prime coat, the area to receive the prime coat shall be dry and blown clean by compressed air to remove accumulated dust and any other loose material. The surface temperature shall be at least 10°C when the prime coat is applied.

The prime coat shall be uniformly applied to completely cover the surface to receive the polyester concrete. The rate of spread shall be approximately _____ square meter per liter.

The prime coat shall be allowed to cure a minimum of 15 minutes before placing polyester concrete. If the primed surface becomes contaminated, the contaminated area shall be cleaned by abrasive blasting and reprimed at the Contractor's expense.

Polyester concrete shall be placed within 120 minutes after the prime coat has been applied.

The prime coat shall be allowed to cure a minimum of 30 minutes before placing polyester concrete. If the primed surface becomes contaminated, the contaminated area shall be cleaned by abrasive blasting and reprimed at the Contractor's expense.

Polyester concrete shall be mixed in mechanically operated mixers. Mixer size shall be limited to a 1/4 cubic meter capacity, unless approved by the Engineer. The polyester resin binder in the concrete shall be approximately 12 percent by weight of the dry aggregate; the exact percentage will be determined by the Engineer.

A continuous mixer, employing an auger screw/chute device, may be approved for use by the Engineer upon demonstrating its ability to produce a satisfactory product. The continuous mixer shall 1) be equipped with a metering device that automatically measures and records the aggregate volumes and the corresponding resin volumes and 2) have a readout gage, visible to the Engineer at all times, that displays the volumes being recorded. The volumes shall be recorded at no greater than 5-minute intervals along with the time and date of each recording. A printout of the recordings shall be furnished to the Engineer at the end of each workshift.

The amount of initiator used in polyester concrete shall be sufficient to produce initial set time between 30 and 120 minutes during placement. The initial set time will be determined by using an initial-setting time Gillmore needle in conformance with the requirements of ASTM Designation: C 266. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the resin supplier.

The resin binder shall be initiated and thoroughly blended just prior to mixing with aggregate. The polyester concrete shall be mixed a minimum of 2 minutes prior to placing.

Polyester concrete shall be placed prior to gelling and within 15 minutes following addition of initiator, whichever occurs first. Polyester concrete that is not placed within this time shall be discarded.

The surface temperature of the area to receive polyester concrete shall be the same as specified above for the prime coat.The finishing equipment used shall strike off the polyester concrete to the established grade and cross section. Finishing equipment shall be fitted with vibrators or other means of consolidating the polyester concrete to the required compaction.

The polyester concrete shall be consolidated to a relative compaction of not less than 97 percent in conformance with tentative California Test 552.

The finished surface of the polyester concrete overlay shall conform to the provisions in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications and these special provisions.

The finished surface of the polyester concrete overlay shall include longitudinal grooves that are parallel to the center line of the bridge. The grooves shall be made with spring steel tines. Spring steel tines of the final texturing device shall be rectangular in cross section, 2.4 to 3.2 mm wide, on 19 mm centers, and of sufficient length, thickness and resilience to form grooves approximately 5 mm deep in the fresh polyester concrete surface. Final texture shall be uniform in appearance and longitudinal grooves shall have a depth between 1.5 and 8 mm.

Polyester concrete surfaces shall receive an abrasive sand finish. The sand shall be commercial quality blast sand conforming to the quality and dryness requirements for polyester concrete aggregate as specified in these special provisions. Ninety-five percent of the sand shall pass the 2.36-mm sieve, and 95 percent shall be retained on the 850-µm sieve.

The sand finish shall be uniformly applied immediately after overlay strike-off and before gelling occurs to provide a minimum uniform coverage of 0.4 kilogram per square meter.

The surface texture of polyester concrete surfaces shall be uniform and shall have a coefficient of friction of not less than 0.35 as measured by California Test 342. Any portions of surfaces that do not meet the above provision shall be ground or grooved parallel to the centerline in conformance with the provisions of Section 42, "Groove and Grind Pavement," of the Standard Specifications until the above tolerance is met.

Traffic and equipment shall not be permitted on the overlay for a minimum of 4 hours following final finishing. Overlays shall be protected from moisture for not less than 4 hours after finishing.

Prior to constructing the overlay, one or more trial overlays shall be placed on a previously constructed concrete base to determine the initial set time and to demonstrate the effectiveness of the mixing, placing, and finishing equipment proposed. Each trial overlay shall be 3.6 m wide, at least 1.8 m long, and the same thickness as the overlay to be constructed. Conditions during the construction of the overlay and equipment used shall be similar to those expected and to be used for the construction of the polyester concrete overlay.

All materials used in the trial overlays, including the concrete base shall become the property of the Contractor and shall be removed and disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Right of Way," of the Standard Specifications.

Multilayer polymer concrete overlay conforming to the following provisions may be substituted for polyester concrete overlay:

A. The Contractor shall submit, in conformance with provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, evidence for 1500 square meters of the polymer concrete that demonstrates 3 years of good performance without any failure of the material. Applications demonstrating good performance shall be at locations with traffic and environmental conditions similar to those that will exist during this project.
B. Multilayer polymer concrete overlay shall be applied by distributing a polymer binder on the bridge deck surface followed by broadcasting gap-graded aggregate. The overlay thickness shall be between 6 and 9 mm. Surface preparation, placement method and number of layers of resin and aggregate shall be in conformance with the manufacturer's recommendations. Surface preparation shown on the plans and as specified in "Prepare Concrete Bridge Deck Surface" of these special provisions shall not apply.
C. A technical representative from the material manufacturer shall be present during the overlay application.
D. Surface texture requirements for multilayer polymer concrete overlays shall be the same as those specified for polyester concrete overlays.
E. Trial overlays for multilayer polymer concrete overlays shall be placed, removed and disposed of in the same manner as specified for polyester concrete overlays.
F. The minimum time following final finishing before traffic and equipment is permitted on the overlay shall be as recommended by the manufacturer.
G. Furnishing and placing multilayer polymer concrete overlay will be measured and paid for as place polyester concrete overlay. No separate payment will be made for furnishing materials for the multilayer polymer concrete.

Furnish polyester concrete overlay of the thickness listed in the Engineer's Estimate will be measured by the cubic meter. The volume to be paid for will be determined from calculations based on the quantity of resin binder used and the yield of the specified mix design. The Contractor shall furnish suitable measuring devices to assure correct proportioning of materials and accurate measurements for calculating pay quantities. The pay quantity shall be the calculated quantity of polyester concrete overlay used in the work, exclusive of material used in trial overlays, and any wasted or unused material.

Place polyester concrete overlay of the thickness listed in the Engineer's Estimate will be measured by the square meter. The area to be paid for will be based on the dimensions as shown on the plans.

The contract price paid per cubic meter for furnish polyester concrete overlay of the thickness listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing polyester concrete, including polyester resin binder, promoter/initiator and aggregate, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per square meter for place polyester concrete overlay of the thickness listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing the polyester concrete overlay, complete in place, including application of prime coat and furnishing, constructing and disposing of trial overlays and base, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for compliance with the requirements for a program for public safety associated with use of methacrylate resin and polyester concrete shall be considered as included in the contract prices paid for the items of work involving polyester concrete overlay and no additional compensation will be allowed therefor.

Full compensation for the surface preparation involved in the use of multilayer polymer concrete shall be considered as included in the contract price paid per square meter for place polyester concrete overlay of the thickness listed in the Engineer's Estimate and no separate payment will be made therefor. No payment will be made for prepare concrete bridge deck surface.

10-1.37 REINFORCEMENT

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

Where ASTM Designations: A 706/A 706M reinforcing bars are specified on the plans or in these special provisions, the minimum percentage of elongation in 200 mm for Bar Nos. 45 and 55 on Table 2b of ASTM A 706/A706M Specifications shall be 12%.

The third paragraph in Section 52-1.04, "Inspection," of the Standard Specifications is amended to read:

· A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall also be furnished for each shipment of epoxy-coated bar reinforcement or wire reinforcement certifying that the coated reinforcement conforms to the requirements in ASTM Designation: A 775/A 775M or A 884/A 884M, respectively, and the provisions in Section 52-1.02B, "Epoxy-coated Reinforcement." The Certificate of Compliance shall include all of the certifications specified in ASTM Designation: A 775/A 775M or A 884/A 884M respectively, and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

The third paragraph in Section 52-1.08C, "Mechanical Butt Splices," of the Standard Specifications is amended to read:

· The total slip of the reinforcing bars within the splice sleeve after loading in tension to 200 MPa and relaxing to 20 MPa shall not exceed the values listed in the following table. The slip shall be measured between gage points that are clear of the splice sleeve.

Reinforcing Bar Number	Total Slip (µm)
13	250
16	250
19	250
22	350
25	350
29	350
32	450
36	450
43	600
57	750

The first paragraph in Section 52-1.08C(5), "Sleeve-Lockshear Bolt Mechanical Butt Splices," of the Standard Specifications is amended to read:

· The sleeve-lockshear bolt type of mechanical butt splices shall consist of a seamless steel sleeve, center hole with centering pin, and bolts that are tightened until the bolt heads shear off with the bolt ends left embedded in the reinforcing bars. The seamless steel sleeve shall be either formed into a V configuration or shall have 2 serrated steel strips welded to the inside of the sleeve.

Section 52-1.08F, "Nondestructive Splice Tests," of the Standard Specifications is amended by deleting the seventh paragraph.

Individual hoops, made continuous with butt welded splices, which are substituted for spiral reinforcement, shall conform to the requirements for "Ultimate Butt Splices" of these special provisions.

ULTIMATE BUTT SPLICES

Ultimate butt splices shall be either welded or mechanical splices, shall be used at the locations shown on the plans, and shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

General Requirements

The Contractor shall designate in writing an ultimate butt splicing Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for 1) the quality of all ultimate butt splicing including the inspection of materials and workmanship performed by the Contractor and all subcontractors; and 2) submitting, receiving, and approving all correspondence, required submittals, and reports regarding ultimate butt splicing to and from the Engineer.

The QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

The length of any type of ultimate mechanical butt splice shall not exceed 10 times the bar diameter of the larger bar to be spliced.

All ultimate prejob, production, and job control sample splices shall be 1) a minimum length of 1.5 meters for reinforcing bars No. 25 or smaller and 2 meters for reinforcing bars No. 29 or larger, with the splice located at mid-point, and 2) suitably identified prior to shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. Any splice that shows signs of tampering will be rejected.

A minimum of one control bar shall be removed from the same bar as, and adjacent to, all ultimate prejob, production, and job control sample splices. Control bars shall be 1) a minimum length of one meter for reinforcing bars No. 25 or smaller and 1.5 meters for reinforcing bars No. 29 or larger, and 2) suitably identified prior to shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. The portion of adjacent bar remaining in the work shall also be identified with weatherproof markings that correspond to its adjacent control bar.

Shorter length sample splice and control bars may be furnished if approved in writing by the Engineer.

Each sample splice and its associated control bar shall be identified and marked as a set. Each set shall be identified as representing a prejob, production, or job control sample splice.

The portion of hoop reinforcing bar, removed to obtain a sample splice and control bar, shall be replaced using a prequalified ultimate mechanical butt splice, or the hoop shall be replaced in kind.

Reinforcing bars, other than hoops, from which sample splices are removed, shall be repaired using ultimate mechanical butt splices conforming to the provisions in "Prejob Test Requirements for Ultimate Butt Splices" specified herein, or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in the "No Splice Zone" shown on the plans.

Section 52-1.08E, "Job Control Tests," of the Standard Specifications shall not apply.

The provisions for total slip shall not apply to any ultimate splices that are welded or that are used on hoops.

The independent qualified testing laboratory used to perform the testing of all ultimate butt sample splices and control bars shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide other services or materials for the project, and shall have the following:

A. Proper facilities, including a tensile testing machine capable of breaking the largest size of reinforcing bar to be tested.
B. A device for measuring the total slip of the reinforcing bars across the splice to the nearest 25 µm, that, when placed parallel to the longitudinal axis of the bar is able to simultaneously measure movement across the splice, at 2 locations, 180 degrees apart.
C. Operators who have received formal training for performing the testing requirements of ASTM Designation: A 370/A 370M and California Test 670.
D. A record of annual calibration of testing equipment performed by an independent third party that has 1) standards that are traceable to the National Institute of Standards and Technology, and 2) a formal reporting procedure, including published test forms.

Ultimate Butt Splice Test Criteria

Ultimate prejob, production, and job control sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370/A 370M and California Test 670.

Ultimate prejob and production sample splices shall rupture in the reinforcing bar either: 1) outside of the affected zone or 2) within the affected zone, provided that the sample has achieved at least 95 percent of the ultimate tensile strength of the control bar associated with the sample. In addition, necking of the bar shall be visibly evident at rupture regardless of whether the bar breaks inside or outside the affected zone.

The affected zone is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered by fabrication or installation of the splice.

The ultimate tensile strength of each control bar shall be determined by tensile testing the bar to rupture and shall be determined for all control bars, regardless of where each sample splice ruptures. If 2 control bars are tested for one sample splice, the bar with the lower ultimate tensile strength shall be considered the control bar.

Testing to determine the minimum tensile strength, in conformance with the provisions in the ninth paragraph of Section 52-1.08, "Splicing," of the Standard Specifications, will not be required.

Prejob Test Requirements for Ultimate Butt Splices

Prior to use in the work, all ultimate butt splices shall conform to the following prejob test requirements:

A. Eight prejob sample splices for each bar size of each splice type including ultimate mechanical butt splices, ultimate complete joint penetration butt welded splices, and ultimate resistance butt welded splices, that will be used in the work, shall be fabricated by the Contractor. For deformation-dependent types of couplers, 8 sample prejob splices shall also be fabricated for each reinforcing bar size and deformation pattern that will be used in the work.
B. The sample splices shall be fabricated using the same splice materials, position, operators, location, and equipment, and following the same procedures as will be used to make the splices in the work. In addition, for resistance butt welded splices, the sample splices shall have the weld flash removed and be epoxy-coated as specified elsewhere in these special provisions.
C. At the option of the Contractor, operator qualification tests may be performed simultaneously with the preparation of prejob sample splices.
D. If different diameters of hoops are shown on the plans, prejob sample splices, as described above, will only be required for the smallest hoop diameter. In addition, these splices shall be fabricated using the same radius as shown on the plans for these hoops.

E. Unless otherwise directed in writing by the Engineer, 4 prejob sample splices and control bar sets shall be shipped to the Transportation Laboratory and the remaining 4 sets shall be tested by the Contractor's independent qualified testing laboratory.
F. Each group of 4 sets from a prejob test shall be securely bundled together and identified by location and contract number with weatherproof markings prior to shipment. Bundles containing fewer than 4 sets will not be tested by the Transportation Laboratory, nor shall they be tested by the independent laboratory.
G. All 8 sample splices from each prejob test shall conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein.
H. Prior to performing any tensile tests on prejob test sample splices, one of the 4 samples shall be tested for, and shall conform to, the provisions for total slip. Should this sample not meet these requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. All 3 of these remaining samples tested shall conform to the aforementioned slip requirements.
I. For each bundle of 4 sets, a Prejob Test Report shall be prepared by the independent testing laboratory performing the testing. The report shall 1) be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California; 2) include, as a minimum, the following information for each set: contract number, bridge number, bar size, type of splice, length of mechanical splice, physical condition of test sample splice and control bar, any notable defects, limits of affected zone, total measured slip, location of visible necking area, ultimate strength of each splice, ultimate strength and 95 percent of this ultimate strength for each control bar, and a comparison between 95 percent of the ultimate strength of each control bar and the ultimate strength of its associated splice; and 3) be submitted to the QCM for review and approval, and then to the Engineer.
J. Test results for each bundle of 4 sets will be reported in writing to the Contractor within 10 working days after receipt of the bundle by the Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received.
K. Should the Engineer fail to provide the test results within this time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in providing the test results, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Production Test Requirements for Ultimate Butt Splices

Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of 4 sets of sample splices and control bars removed from each lot of completed splices, except when quality assurance tests are performed.

A lot of ultimate butt splices is defined as 1) 150, or fraction thereof, of the same type of ultimate mechanical butt splices used for each bar size and each bar deformation pattern that is used in the work or 2) 150, or fraction thereof, of ultimate complete joint penetration butt welded splices, or ultimate resistance butt welded splices for each bar size used in the work. If different diameters of hoop reinforcement are shown on the plans, separate lots shall be used for each different hoop diameter.

After all splices in a lot have been completed and the bars have been epoxy-coated, the QCM shall notify the Engineer in writing that all couplers in this lot conform to the specifications and are ready for testing. The sample splices will either be selected by the Engineer at the job site or a fabrication facility, provided the facility is located within an 80-km radius of the jobsite.

At the option of the Contractor, sample splices for spiral reinforcementmay be either 1) removed from the completed lot, or 2) prepared in the same manner as specified herein for ultimate prejob sample splices and control bars.

After notification has been received, the Engineer will randomly select the 4 sample splices to be removed from the lot and place tamper-proof markings or seals on them. The Contractor or QCM shall select the adjacent control bar for each sample splice bar, and the Engineer will place tamper-proof markings or seals on them. These ultimate production sample splices and control bars shall be removed by the Contractor, and tested by an independent qualified testing laboratory, in the presence of either the Engineer or the Engineer's authorized representative.

The Engineer or the Engineer's authorized representative will be at the independent qualified testing laboratory within a maximum of 5 working days after receiving written notification that the samples are at the laboratory and ready for testing. Should the Engineer or the Engineer's authorized representative fail to be at the laboratory within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of this action, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

A sample splice or control bar from any set will be rejected if any tamper-proof marking or seal is disturbed prior to testing.

The 4 sets from each production test shall be securely bundled together and identified with a completed sample identification card prior to shipment to the independent laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sets of splices shall not be tested.

A Production Test Report for all testing performed on each lot shall be prepared by the independent testing laboratory performing the testing and submitted to the QCM for review and approval. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include, as a minimum, the following information for each set: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, physical condition of test sample splice and control bar, any notable defects, limits of affected zone, total measured slip, location of visible necking area, ultimate strength of each splice, ultimate strength and 95 percent of this ultimate strength for each control bar, and a comparison between 95 percent of the ultimate strength of each control bar and the ultimate strength of its associated splice.

The QCM must review, approve, and forward each Production Test Report to the Engineer for review before any splices represented by the report are encased in concrete. The Engineer shall have 3 working days to review each Production Test Report and respond in writing after a complete report has been received. Should the Contractor elect to encase any splices prior to receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the Contractor's responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Any material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase any splices pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in notification, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Prior to performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the provisions for total slip. Should this sample not meet these requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. Should any of the 3 remaining samples not conform to these requirements, all splices in the lot represented by this production test will be rejected.

If 3 or more sample splices from any production test conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, all splices in the lot represented by this production test will be considered acceptable.

Should only 2 sample splices from any production test conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, one additional production test shall be performed on the same lot of splices. Should any of the 4 sample splices from this additional test fail to conform to these provisions, all splices in the lot represented by these production tests will be rejected.

If only one sample splice from any production test conforms to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, all splices in the lot represented by this production test will be rejected.

If a production test for any lot fails, the Contractor will be required to repair or replace all reinforcing bars from which sample splices were removed, complete in place, before the Engineer selects any additional splices from this lot for further testing.

Whenever any lot of ultimate butt splices is rejected, additional ultimate butt splices shall not be used in the work until 1) the QCM performs a complete review of the Contractor's quality control process for these splices, 2) a written report is submitted to the Engineer describing the cause of failure for the splices in this lot and provisions for correcting these failures in future lots, and 3) the Engineer has provided the Contractor with written notification that the report is acceptable. The Engineer shall have 3 working days after receipt of the report to provide notification to the Contractor. Should the Engineer not provide notification within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of this action, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Production tests will not be required on any repaired splice from a lot, regardless of the type of prequalified ultimate mechanical butt splice used to make the repair.

Should an additional production test be required, the Engineer may select any repaired splice for use in the additional production test.

Quality Assurance Test Requirements for Ultimate Butt Splices

For the first production test performed, and for at least one, randomly selected by the Engineer, of every 5 additional production tests, or portion thereof, performed thereafter, the Contractor shall concurrently prepare 4 additional ultimate job control sample splices along with associated control bars. These ultimate job control samples shall be prepared in the same manner as specified herein for ultimate prejob sample splices and control bars.

Each time 4 additional ultimate job control sample splices are prepared, 2 of these job control sample splice and associated control bar sets and 2 of the production sample splice and associated control bar sets, together, shall conform to the requirements for ultimate production sample splices in "Production Test Requirements for Ultimate Butt Splices" specified herein.

The 2 remaining job control sample splice and associated control bar sets, along with the 2 remaining production sample splice and associated control bar sets shall be shipped, unless otherwise directed in writing by the Engineer, to the Transportation Laboratory for quality assurance testing. The 4 sets shall be securely bundled together and identified by location and contract number with weatherproof markings prior to shipment. Bundles containing fewer than 4 sets will not be tested.

Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in "Production Test Requirements for Ultimate Butt Splices" specified herein.

Test results for each bundle of 4 sets will be reported in writing to the Contractor within 3 working days after receipt of the bundle by Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received. Should the Contractor elect to encase any splices prior to receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the Contractor's responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Any material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase any splices pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in notification, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

EPOXY-COATED PREFABRICATED REINFORCEMENT

Bar reinforcement to be epoxy-coated shall conform to the ASTM Designation and grade required or permitted by Section 52-1.02A, "Bar Reinforcement," of the Standard Specifications, for the location or type of structure involved. The coated bar reinforcement shall conform to the requirements in ASTM Designation: A 934/A 934M except as provided herein.

Wire reinforcement to be epoxy-coated shall conform to the ASTM Designation and grade required or permitted by Section 52-1.02D, "Reinforcing Wire and Plain Bars," of the Standard Specifications, for the location or type of structure involved. The coated wire reinforcement shall conform to the requirements for Class A, Type 2 coating of ASTM Designation: A 884/A 884M except as provided herein.

Appendices X1 and X2, "Guidelines For Job-Site Practices," of ASTM Designation: A 884/A 884M and A 934/A 934M, respectively, shall apply except as provided herein. The term "shall" shall replace the term "should" in these appendices. Section X1.2 of Appendix X1 and Section X2.2 of Appendix X2 shall not apply.

All coatings shall be purple or gray in color.

Except for field welding of butt splices, all welding of reinforcement shall be complete prior to epoxy coating the reinforcement.

Prior to epoxy coating, all resistance butt welds shall have the weld flash removed to produce a smooth profile free of any sharp edges that would prevent proper coating of the bar. The flash shall be removed such that the ultimate tensile strength and elongation properties of the bar are not reduced, and the outside radius of the flash, at any point along the circumference of the bar, is 1) not less than the nominal radius of the bar, nor 2) greater than 5 mm beyond the nominal radius of the bar.

A proposed weld flash removal process shall be submitted to and approved by the Engineer in writing, prior to performing any removal work. The submittal shall demonstrate that the proposed flash removal process produces a smooth profile that can be successfully epoxy-coated in conformance with the requirements specified herein.

Bending of epoxy-coated reinforcement after the coating has been applied will not be allowed.

When any portion of a reinforcing bar or wire requires epoxy coating, the entire bar or wire shall be coated, except, when the bar or wire is spliced outside of the limits of epoxy coating shown on the plans, epoxy coating will not be required on the portion of bar or wire beyond the splice.

Within areas where epoxy-coated reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be plastic-coated or epoxy-coated to prevent corrosion of the devices or damage to the coated reinforcement.

Prior to coating, the Contractor shall furnish to the Transportation Laboratory a representative 110 g sample from each batch of epoxy coating material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

Two 700-mm long samples of coated bar or wire reinforcement from each size and from each load shipped to the jobsite shall be furnished to the Engineer for testing. These samples shall be representative of the material furnished. These samples, as well as any additional random samples taken by the Engineer, may be tested for specification compliance. Additional sampling, and all tests performed by the Engineer, may be performed at any location deemed appropriate by the Engineer. Failure of any sample to meet the requirements of the specifications will be cause for rejection.

If any bar tested for coating thickness or for adhesion of coating fails to meet the requirements for coated bars in Section 9 of ASTM Designation: A 934/A 934M, 2 retests on random samples taken from bars represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated bars represented by the samples may be certified as meeting the test requirements.

If any wire reinforcement tested for coating thickness or for flexibility fails to meet the requirements for coated wire in Section 8 of ASTM Designation: A 884/A 884M, 2 retests on random samples taken from wire represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated wire represented by the samples may be certified as meeting the test requirements.

Epoxy-coated reinforcement shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray, and weather. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation around the reinforcement to prevent condensation under the covering. Epoxy-coated reinforcement shall not be stored within 300 m of ocean or tidal water for more than 2 months.

All visible damage to coatings caused by shipping, handling, or installation shall be repaired as required for repairing coating damaged prior to shipment conforming to the requirements in ASTM Designation: A 934/A 934M for bar reinforcement or ASTM Designation: A 884/A 884M for wire reinforcement. When the extent of coating damage prior to repair exceeds 2 percent of the bar or wire surface area in any 300-mm length, repair of the bar or wire will not be allowed, and the coated bar or wire will be rejected.

The patching material and process shall be suitable for field application. The patching material shall be prequalified as required for the coating material and shall be either identified on the container as a material compatible with the reinforcement coating, or shall be accompanied by a Certificate of Compliance certifying that the material is compatible with the reinforcement coating. Damaged areas shall be patched in conformance with the patching material manufacturer's recommendations.

Except for lap splices, all splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is on the Department's list of approved products. The covering shall be installed in conformance with the manufacturer's recommendations and as directed by the Engineer. The list is available from the Transportation Laboratory.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications, shall be furnished for each shipment of epoxy-coated bar or wire reinforcement certifying that the coated bars or wire conform to the requirements in ASTM Designation: A 934/A 934M for bars or A 884/A 884M for wire and Section 52-1.02B, "Epoxy-coated Reinforcement," of the Standard Specifications. This Certificate of Compliance shall include all the certifications specified in ASTM Designation: A 934/A 934M for bars or ASTM Designation: A 884/A 884M for wire and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

Any portion of bar or wire reinforcement extending beyond the limits for epoxy-coated reinforcement shown on the plans will be measured and paid for as bar reinforcing steel (bridge).

10-1.38 WELDED HEADED BAR REINFORCEMENT

Welded headed bar reinforcement, consisting of furnishing and friction welding heads onto one or both ends of bar reinforcement, shall conform to the details shown on the plans, the provisions of Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

GENERAL

Prior to performing any manufacturing, the Contractor shall submit to the Engineer the manufacturer's Quality Control Manual (QCM) for the fabrication of welded headed bar reinforcement. As a minimum, the manual shall include the following:

A. The pre-production procedures for the qualification of materials and equipment;
B. The methods and frequencies for performing all quality control procedures during production;
C. The calibration procedures and calibration frequency for all equipment;
D. A system for the identification and tracking of all welds. The system shall have provisions for permanently identifying each weld and the parameters used to perform it;
E. The welding procedure specification (WPS); and
F. A system for marking welded headed bar reinforcement.

A daily production log for the manufacture of welded headed bar reinforcement shall be kept by the manufacturer for each day of production. The log shall clearly indicate the production lot numbers, the heats of bar material and head material used in the manufacture of each production lot, the number of bars in each production lot, welding records, including tracking and production parameters for all welds, and results of all tests performed. A test report shall be furnished by the

manufacturer containing, on a per heat basis, the chemical analysis of the bar and of the head material, including all elements represented in the carbon equivalent formula in ASTM Designation: A 706/A 706M, in addition to phosphorus and sulfur.

A production lot of welded headed bar reinforcement is defined as 150 reinforcing bars, or fraction thereof, of the same bar size, with welded heads of the same size and type, produced from bar material of a single heat number and head material of a single heat number. A new production lot shall be started if the heat number of either the bar material or the head material changes before the maximum production lot size of 150 is reached.

The daily production log shall be submitted in writing to the Engineer within 7 calendar days following the manufacture of any welded headed bar reinforcement.

The manufacturer shall furnish certificates of compliance to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," for all material used in the manufacture of welded headed bar reinforcement.

MATERIALS AND MANUFACTURE

All bar reinforcement to be used in the fabrication of welded headed bar reinforcement shall conform to the provisions of "Reinforcement" of these special provisions.

Heads to be used in the fabrication of welded headed bar reinforcement shall be forge formed or cut from properly identified heats of mold cast or strand cast steel using the open-hearth, basic oxygen or electric-furnace process. The chemical composition of the heads shall conform to the requirements in ASTM Designation: A 29/A 29M, A 36/A 36M, A 108 Grade 1018, A 304, A 572/A 572M, or A 706/A 706M. Forging of heads shall conform to the requirements in ASTM Designation: A 788. Heads cut from plate shall conform to the provisions of Section 55, "Steel Structures," of the Standard Specifications.

Welding, welder qualifications, and inspection of welding shall conform to the requirements for friction welding in ANSI/AWS C6.1.

All welding shall be performed at an established and permanent fabrication facility.

All equipment used to perform friction welding shall be fitted with an effective in-process monitoring system to record essential production parameters that describe the process of welding the head onto the bar reinforcement. As a minimum, the parameters to be recorded shall include friction welding force, forge force, rotational speed, friction upset distance and time, forge upset distance and time, and other elements of the production process. The data from this in-process monitoring shall be recorded and preserved by the manufacturer and shall be provided to the Engineer upon request.

Heads shall be forge formed or cut from plate into a round, elliptical, or rectangular shape. Nominal head dimensions to be used for standard bar sizes shall conform to the following:

Nominal Head Dimensions			
Standard Bar Designation No.	Min. thickness mm	Min. cross-sectional area mm^2	Min. width mm
10	10	710	19
13	11	1 290	22
16	12	2 000	25
19	14	2 840	35
22	16	3 870	37
25	16	5 100	40
29	18	6 450	43
32	20	8 200	51
36	22	9 700	55
43	32	14 500	65
57	40	25 800	80
Notes: (1) These head dimensions are based on concrete compressive strength of 30 MPa. (2) The head thickness shall be measured parallel to the reinforcing bar longitudinal axis, and the head width shall be measured perpendicular to the reinforcing bar axis. (3) The cross-sectional area of the head shall be the projected area measured perpendicular to the axis of the bar.			

The Contractor may request, in writing, to use alternative head dimensions to those specified herein. The alternative head dimensions shall be designed using the concrete compressive strength shown on the plans. Alternative head dimensions will not be considered for approval unless it can be proven by the Contractor that the alternative heads have been successfully produced and have had at least 2 years of satisfactory service in conditions similar to this application. The Contractor shall furnish, at the Contractor's expense, documentation satisfactory to the Engineer that the alternative head dimensions are suitable for the intended application. The documentation shall include, but not be limited to, calculations and test reports showing the following:

A. The alternative head is capable of resisting the nominal tensile strength of the reinforcing bar when the bar reinforcement with welded head is embedded in concrete; and
B. Shear or bending forces do not cause premature failure of the alternative head or crushing failure of the concrete under the alternative head.

Quality Control (QC) is the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing prior to welding, during welding and after welding and as necessary to ensure that materials and workmanship conform to the requirements of the specifications.

All equipment and materials for performing all pre-production and production testing shall be furnished by the Contractor at the Contractor's expense. All testing shall be performed 1) at the manufacturer's plant or at an approved laboratory, 2) in the presence of the Engineer, unless otherwise directed in writing, and 3) at the Contractor's expense.

TENSILE TEST CRITERIA

Tensile testing of the welded headed bar reinforcement shall be performed in conformance with the requirements described in ASTM Designation: A 370.

Tensile test specimens shall be the full cross-section of the bar as rolled with a head attached to one end of the reinforcing bar. A specimen with a head welded to one end shall be placed in the testing machine with the head supported by a steel plate or other fixture to prevent movement and bending of the head. The fixture shall be placed concentrically with the longitudinal axis of the reinforcing bar directly against the flat inner surface of the head. The fixture shall provide clearance between the head support and the head-to-bar connection. Provisions shall be made for clearance between the support and any weld or forming material on the reinforcing bar-to-head connection. The free end of the bar, without a head attached, shall be gripped by the test machine.

All tensile test specimens for welded headed bar reinforcement shall conform to the following requirements:

A. The tensile strength, yield strength and elongation shall conform to the requirements in Table 2, "Tensile Requirements," in ASTM Designation: A 706/A 706M;
B. At rupture, there shall be no observed partial or total fracture of the head, the head-to-bar connection or the reinforcing bar within one bar diameter of the head-to-bar connection; and
C. At rupture, there shall be visible signs of necking in the reinforcing bar, at a minimum distance of one bar diameter away from the head-to-bar connection.

PRE-PRODUCTION TESTING

Prior to production, successful test results from 3 tensile tests and 3 bend tests shall be furnished by the Contractor for each combination of 1) reinforcing bar size, 2) head size, 3) head type and, 4) head material specification to be used in the work. Bend tests will not be required for reinforcing bars Nos. 43 and 57.

Tensile tests shall conform to the requirements of "Tensile Test Criteria" of this section.

The bend tests shall be performed in conformance with the requirements described in ASTM Designation: A 706/A 706M, except that the test specimen shall be bent around a test mandrel to an angle of at least 90-degrees.

The mandrel shall be placed so as to directly bend the welded region. The mandrel dimensions for bend testing shall conform to the requirements for mandrel (pin) diameters in ASTM Designation: A 706/A 706M. The centerline of the bend test mandrel shall be placed at the intersection of the reinforcing bar and the weld.

Bend test specimens shall be the full cross-section of the bar as rolled with a head attached to one end of the reinforcing bar. For welded heads directly attached to the end of the reinforcing bar where the head interferes with placement of the bend test mandrel, sufficient head material and any excess material associated with the welding process shall be removed along one edge of the reinforcing bar to provide a flat surface on the specimen for the bend mandrel. For welded headed bar reinforcement where the head does not interfere with the positioning of the bend test mandrel, no specimen preparation shall be performed.

All welded headed bar reinforcement bend test specimens shall conform to the following requirements:

A. There shall be no observed partial or total fracture of the head, the head-to-bar connection or the bar within one bar diameter of the head-to-bar connection; and
B. There shall be no cracking on the outside of the bent portion.

PRODUCTION TESTING

Production testing shall be performed using samples that have been randomly selected by the Engineer from each production lot of welded headed bar reinforcement which is ready for shipment to the job site. The Engineer shall be notified in writing at least 7 days prior to conducting any tests.

A minimum of 3 samples of welded headed bar reinforcement from each production lot shall be tested. One tensile test shall be conducted on each sample.

All tensile test specimens shall conform to the requirements of "Tensile Test Criteria" of this section, except that if one of the test specimens fails to meet said requirements, one retest may be performed on one additional sample, selected by the Engineer, from the same production lot. Should this additional test specimen, or should more than one of the original test specimens, fail to meet said requirements, all welded headed bar reinforcement represented by the tests will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials," of the Standard Specifications.

All welded headed bar reinforcement of each bar size from each production lot to be shipped to the site shall be tagged in such a manner that each such production lot can be accurately identified at the job site. All unidentified welded headed bar reinforcement received at the job site will be rejected.

Marking

All welded headed bar reinforcement shall be identified by a distinguishing set of marks legibly stamped onto the flat outer side of the head, away from the bar, to denote the following:

A. Point of Origin--Letter or symbol established as the manufacturer's designation.
B. Type of Welded Headed Reinforcing Bar--Letter T indicating that the welded headed bar reinforcement was produced to this specification.

MEASUREMENT AND PAYMENT

Quantities of welded headed bar reinforcement will be measured as units determined from the number of welded heads shown on the plans or as directed by the Engineer.

The contract unit price paid for welded headed bar reinforcement shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing heads and friction welding heads to bar reinforcement, including conforming to all testing requirements, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Bar reinforcement to be used in the manufacture of welded headed bar reinforcement will be measured and paid for as specified in Section 52, "Reinforcement," of the Standard Specifications, except that the lengths to be used in the computation of calculated weights of the bar reinforcement shall be the entire length of the welded headed bar, including heads.

Full compensation for placing the completed welded headed bar reinforcement into the work shall be considered as included in the contract price paid per kilogram for the bar reinforcement involved and no additional compensation will be allowed therefor.

10-1.39 SEALANTS AND CAULKING (SUBSTATIONS)

Sealants and caulking (substations) shall consist of furnishing and applying sealants and caulking as shown on the plans and specified in these special provisions.

Certificates of Compliance.--Certificates of Compliance shall be furnished for the sealants and caulking in accordance with the requirements in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

SUBMITTALS

60 days prior to furnishing sealants and caulking, the Contractor shall submit the following:

Product data.--Manufacturer's descriptive data and installation instructions for all sealants shall be only submitted to the Engineer for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

Samples.--Color samples of all sealants shall be submitted for approval. Unless otherwise shown on the plans, colors will be selected by the Engineer from the manufacturer's standard colors.

General.--All sealants, primers and accessories shall be non-staining to adjacent exposed surfaces. Products having similar applications and usage shall be of the same type and same manufacturer. Gun consistency compound shall be used unless otherwise required by the job conditions.

Acrylic sealant.--
Acrylic sealant shall be one compound, and shall be solvent release acrylic sealant type.
Butyl sealant.--
Butyl sealant shall be one component, and shall be skinning type.
Silicone sealant.--
Silicone sealant shall be one component, and shall be low modulus building sealant type. Sealant shall be tack-free in one hour, shall not sag or flow, and shall be ozone resistant and capable of 100 percent extension without failure.
Joint sealant.--
Joint sealant shall be a two-part, shall be non-sag polysulfide base type, and shall be synthetic rubber sealant formulated from liquid polysulfide polymer.
Backer rod.--
Backer rod shall be round, open or closed cell polyurethane. Backer rod shall be sized such that it can be compressed between 25 and 75 percent of its uncompressed diameter during installation in the joint.

Neoprene.--
Neoprene shall conform to the requirements of ASTM Designation: C 542.

Application.--Unless otherwise shown on the plans, sealants shall be applied in accordance with the manufacturer's instructions.

Silicone sealants shall not be used in locations where painting is required.

Butyl sealants shall not be used in exterior applications, and acrylic sealants shall not be used in interior applications.

Sealants shall be applied in a continuous operation for the full length of the joint. Immediately following the application of the sealant, the sealant shall be tooled smooth using a tool similar to that used to produce concave masonry joints. Following tooling, the sealant shall remain undisturbed for not less than 48 hours.

Full compensation for sealant and caulking (substations) shall be considered as included in the contract lump sum prices paid for substation architectural eastbound and substation architectural westbound and no separate payment/additional compensation will be made/allowed therefor.

10-1.40 FOOTING CONSTRUCTION

Footing construction shall conform to the details shown on the plans, the provisions in "Concrete Structures," "Steel Structures," "Reinforced, Recycled Plastic or Composite Plastic Lumber," "Ultra High Molecular Weight Polyethylene Panel," "Reinforcement," "Construction Surveying," "Prestressing Concrete," and "Miscellaneous Metal" elsewhere in these special provisions, and these special provisions.

GENERAL

Footing construction shall consist of performing all operations necessary to construct the footings as shown on the plans. Operations necessary to complete the construction of the footings include the following:

A. Steel frame fabrication and erection
B. Precast concrete wall fabrication and erection
C. Design and construction of temporary support system
D. Dewatering
E. Installing watertight seals
F. Field measurements
G. Field welding
H. Concrete and reinforcement placement
I. Installation of fender system components

The steel footing frame shall not be used as a pile-driving template.

At the option of the Contractor, high strength epoxy coated prestressing bars as shown on the plans may be used to provide temporary support during footing construction. The maximum force to be applied to the high strength epoxy coated prestressing bars shall conform to the requirements shown on the plans.

The temporary support system shall not be removed until all pile head connection plates have been installed and accepted by the Engineer.

The Contractor's attention is directed to "Piling" of these special provisions for pile installation requirements.

ORDER OF WORK

Following the installation of all driven piles at a specific footing location, the sequence of work to construct each footing shall be as follows:

A. Survey final pile locations.
B. Complete fabrication of pile head connection plates, pile collar assemblies, and footing units.
C. Install watertight seals to facilitate dewatering operations.
D. Dewater.
E. Install polyurethane seals at pile/pile collar and footing/pile collar locations.
F. Place welded reinforcement hoops at pile sleeve locations.
G. Install pile head connection plates.
H. Install welded headed studs.
I. Install reinforcement in pile sleeve chambers.
J. Place concrete in dewatered chambers.
K. Install fender system.

WORKING DRAWINGS

The Contractor shall submit working drawings in conformance with the provisions in Section "Working Drawings," elsewhere in these special provisions. Working drawings shall include complete details, information, drawings, and substantiating calculations of the methods, materials, equipment, and procedures the Contractor proposes to use in constructing the footings.

Working drawing submittals shall include the following:

A. Proposed footing construction methods, procedures, and sequences.
B. Falsework and temporary support system details.
C. Proposed details for watertight seals between pile collar assemblies and piles, and steel footing unit and pile collar assemblies to facilitate dewatering operations.

Any other plans, details, or information associated with the proposed construction methods and procedures.

The working drawings shall be supplemented by the following:

A. The Contractor's proposed methods of geometry control for the footing steel frame erection.
B. Calculations of footing stresses and stability at each stage of construction.
C. Concrete placement plan.
D. Substantiating documents to qualify supervisory personnel assigned to supervise the footing construction work. Supervisors shall have at least three years experience in similar types of construction.
E. Substantiating calculations for the design of the falsework, temporary support system, steel frame erection equipment and systems, working platforms, formwork, and to support any other proposed methods and procedures.
F. Any other information required to facilitate review and approval of proposed methods, materials, and procedures including reports, manufacturer information, and specifications.
G. List of equipment required for each stage of the Contractor's proposed methods to successfully construct the footings as shown on the plans.
H. Material and fabrication specifications for the proposed watertight seals.

After complete working drawings and supplemental information have been received, the Contractor shall allow the Engineer 60 working days to review the complete submittal.

MEASUREMENT AND PAYMENT

Full compensation for construction and removal of temporary support systems, furnishing and placing watertight seals, and dewatering operations shall be considered as included in the contract prices paid for the various items of work involved and no separate payments will be made therefore.

10-1.41 SERVICE PLATFORMS

Construction of service platforms shall conform to the details shown on the plans and to these special provisions.

Service platforms shall consist of the following major items:

1. Steel structures
2. Steel decking
3. Concrete structure
4. Reinforcement
5. Painting
6. Railing
7. Checkered plates
8. Guardrails
9. Handrails
10. All anchors, fastenings, hardware, accessories and other supplementary parts necessary to complete the work.

Steel structures shall conform to the provisions in "Steel Structures (Substations and Service Platforms)" of these special provisions.

Steel decking shall conform to the provisions in "Steel Decking (Service Platforms)" of these special provisions.

Concrete structures shall conform to the provisions in "Concrete Structures (Service Platforms)" of these special provisions.

Reinforcement shall conform to the provisions in "Reinforcement" of these special provisions.

Painting shall conform to the provisions in "Clean and Paint Structural Steel" of these special provisions.

Railing, checkered plates, guardrails, handrails, anchors, fastenings, hardware, accessories and other supplementary parts shall conform to the provisions in "Miscellaneous Metal (Substations, Service Platforms and Walkways)" of these special provisions.

The contract unit price paid for service platforms regardless of size, shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in service platforms, complete in place, including steel structures, steel decking, concrete structure, reinforcement, painting, railing, checkered plates, guardrails, handrails, anchors, fastenings, hardware, accessories and other supplementary parts, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.42 WALKWAYS

Construction of walkways shall conform to the details shown on the plans and to these special provisions.

Walkways shall consist of following major items:

1. Miscellaneous metal
2. Ladders
3. Steel rope railing and posts
4. Hardware
5. Framing at pier table
6. Checkered plates
7. Gratings
8. Hinged covers
9. All anchors, fastenings, hardware, accessories and other supplementary parts necessary to complete the work.

All major items for walkways shall conform to the provisions in "Miscellaneous Metal (Substations, Service Platforms and Walkways)" of these special provisions.

The contract lump sum price paid for walkways shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in walkways, complete in place, including miscellaneous metal, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.43 SUBSTATION ARCHITECTURAL EASTBOUND, AND SUBSTATION ARCHITECTURAL WESTBOUND

Construction of substation architectural eastbound and substation architectural westbound shall conform to the details shown on the plans and to these special provisions.

Substation Architectural Eastbound, and Substation Archtitectural Westbound shall consist following major items:

1. Steel structures
2. Miscellaneous metal
3. Hinged Doors
4. Access Doors
5. Finish hardware
6. Metal panels
7. Painting
8. Fire extinguishers and cabinets
9. Toilet accessories
10 Monorail
11. Hatch covers
12. Metal framing
13. All anchors, fastenings, hardware, accessories and other supplementary parts necessary to complete the work.

Steel structures and monorail shall conform to the provisions in "Steel Structures (Substations and Service Platforms)" of these special provisions.

Hinged doors shall conform to the provisions in "Hinged Doors (Substations)" of these special provisions.

Access doors shall conform to the provisions in "Access Doors (Substations)" of these special provisions.

Finish hardware shall conform to the provisions in "Finish Hardware (Substations)" of these special provisions.

Metal panels shall conform to the provisions in "Metal Panels (Substations)" of these special provisions.

Painting shall conform to the provisions in "Clean and Paint Structural Steel" of these special provisions.

Fire extinguishers and cabinets shall conform to the provisions in "Fire Extinguishers and Cabinets (Substations)" of these special provisions.

Toilet accessories shall conform to the provisions in "Toilet Accessories (Substations)" of these special provisions.

Metal framing shall conform to the provisions in "Metal Framing (Substations)" of these special provisions.

Miscellaneous metal, hatch covers, anchors, fastenings, hardware, accessories and other supplementary parts shall conform to the provisions in "Miscellaneous Metal (Substations, Service Platforms and Walkways)" of these special provisions.

The contract lump sum prices paid for substation architectural eastbound, and for substation architectural westbound shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in substations, complete in place, including steel structures, miscellaneous metal, hinged doors, access doors, finish hardware, metal panels, painting, fire extinguishers and cabinets, toilet accessories, monorail, hatch covers, metal framing, anchors, fastenings, hardware, accessories and other supplementary parts as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.44 STEEL STRUCTURES

Construction of steel structures shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

The Contractor shall furnish, fabricate, and erect the structural steel or metalwork, construct and remove the temporary construction, and do all work required to complete the bridge or bridges.

Fabricators and suppliers shall be certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges, with endorsement F, Fracture Critical members.

Erectors shall be certified under the AISC Quality Certifications Program, Category CASE, Certified Advanced Steel Erector, with Endorsement F, Fracture Critical members.

Details of orthotropic box girder connections shall conform to the AASHTO Standard Specifications for Highway Bridges, unless otherwise shown on the plans.

The bikepath shall be considered part of the bridge and not an ancillary structure.

GENERAL

Attention is directed to "Welding " of these special provisions.

Attention is directed to "Construction Surveying," of these special provisions.

Attention is directed to "Footing Construction," of these special provisions for the footing construction sequence.

Attention is directed to "Erect Precast Concrete Segment," of these special provisions for the hinge erection sequence.

Attention is directed to "Prestressing," of these special provisions for post-tensioning provisions within the orthotropic box girder.

The following substitutions of high-strength steel fasteners shall be made:

METRIC SIZE SHOWN ON THE PLANS	IMPERIAL SIZE TO BE SUBSTITUTED
ASTM Designation: A 325M (Nominal bolt diameter and thread pitch (mm))	ASTM Designation: A 325 (Nominal bolt diameter (inch))
M16 x 2	5/8
M20 x 2.5	3/4
M22 x 2.5	7/8
M24 x 3	1
M27 x 3	1 1/8
M30 x 3.5	1 1/4
M36 x 4	1 1/2

Steel for members, shown on the plans as fracture critical members, shall conform to the requirements in ANSI/AASHTO/AWS D1.5, Section 12, "AASHTO/AWS Fracture Control Plan (FCP) for Non-Redundant Members." Charpy V-notch (CVN) impact values for fracture critical members shall conform to the requirements for Zone 2, except as modified by these special provisions.

All corner and T-joint groove welds shall be reinforced with fillet welds with a size of 1/4 times the thickness' of the abutting member, or 10 mm, which ever is less.

DRAWINGS

Working drawings shall contain all information required for the construction of structural steel, including, at a minimum, the following:

A. Design geometry lines and fabrication geometry working lines, including vertical, longitudinal and transverse;
B. Panel designations, erection sequence and locations of field splicing;
C. Details of temporary fabrication in plan, elevation and section, material specification and grades, weld details and all tolerances;
D. Details of permanent fabrication in plan, elevation and section, material cuts and camber deformations, and tolerances of the fabricated panel structure. The scale of each panel plan and section shall not be less than 1: 50. Full detail scales shall be larger;
E. Material and weld designations including the ASTM material specification, processes of shop fabrication including cutting, grinding and welding, weld symbols as required by AWS D1.5, and for each weld, the "Joint Designation" as listed in figures 2.4 or 2.5 of AWS D1.5;
F. Distortion control plan in accordance with AWS D1.5, Section 3.4;

Supplemental calculations shall include, but not be limited to, the following:

A. Calculations for each panel showing how the camber for extension, angular change and profile affects the cutting, and assembly of the plate material.

For orthotropic box girder and pipe beam fabrication, shop practices shall be described in the shop drawings and shall include:

A. Method of rib or pipe beam fabrication including bending equipment and procedures;
B. Details of fabrication jigs (orthotropic box girder only);
C. Lifting points;
D. Details of temporary lugs or brackets and methods of handling large elements;
E. Details of tack welds and the sequence of all welding;
F. Details of removal of temporary connections and repair of material where these connections were installed;
G. Methods of repair of elements that exceed specified tolerances; and
H. Fabrication schedule.

FALSEWORK

Falsework and attachments used for the erection of structural steel shall be fabricated in accordance with the requirements of this section and the requirements for Falsework in "Concrete Structures," of these special provisions, except that dead loads shall consist of the mass of the structural steel and any other portions of the structure which are supported by the falsework.

Section 55-1.05, "Falsework," of the Standard Specifications shall not apply.

ERECTION PLAN

The Contractor shall submit working drawings and supplemental calculations for the erection of structural steel in accordance with the requirements in "Working Drawings," of these special provisions.

Erection of the orthotropic box girder transition span shall be completed with a maximum of 4 sections.

At the option of the Contractor, lifting attachments may be welded or bolted to structural steel to assist in hoisting the load. Lifting attachments shall not be attached to the deck plate or ribs attached to the deck plate. Welds attaching these devices shall conform to the requirements of field welding specified herein. Such attachments shall not be placed in areas of stainless steel cladding and shall not interfere with the holes shown on the plans. Holes shall not be made in the permanent structure, unless otherwise shown on the plans.

Working drawings shall contain all information required for the erection of structural steel, including, at a minimum, the following:

A. Details and limits of each section to be erected;
B. Details of attachments to each section for transportation and lifting including location, welding and removal procedures;
C. Methods for transportation and lifting of each erected section;
D. Method of aligning adjacent sections during erection;
E. Details of temporary work platforms and other aids required for field welding;
F. Locations and methods for tack and final welds;
G. Timing and methods for dimensional checks; and
H. Timing and methods for visual and nondestructive examination.

Supplemental calculations shall include, but not be limited to, the following:

A. Calculations indicating the stress on the permanent structure due to attachments and erection.
B. Estimates of final dimensions, including camber, based on dimensional measurements during the trial fit under support conditions that differ from those of the in-place condition.

Equipment and temporary structures such as lifting lugs, brackets or other devices, needed to handle fabrications, and which are attached to the permanent structure, or which are detached but serve to lift construction loads, shall be designed by a engineer who is registered as a Civil Engineer in the State of California, and shall be submitted to the Engineer for approval before they are placed in operation.

After erection, all lifting attachments shall be removed. All remaining welds shall be ground flush and any damaged areas shall be repaired in accordance with the requirements of ANSI/AASHTO/AWS D1.5. Any areas of damaged paint shall be painted as directed in "Clean and Paint Structural Steel," of these special provisions.

MATERIALS

Structural steel shall conform to ASTM Designation: A709 with Supplementary Requirement S84 "Fracture-Critical, *F*, Material; Toughness Testing and Marking" for fracture critical members and Supplementary Requirement S83 "Non-Fracture-Critical, *T*, Material; Toughness Test and Marking" for others, as modified below. Charpy V-notch (CVN) impact values for steel procurement shall be reported on the mill test report and shall conform to ASTM Designation: A 709 for Zone 1 except as stated below:

Component	Thickness (mm)	Impact Value (Joules at Temp.)
Grade 50 orthotropic box structure internal structure base metal	Up to 38 39 to 50 51 to 100	34 @ 10°C 34 @ 10°C 42 @ 10°C
Grade 50 orthotropic box section shell plating base metal	Up to 38 39 to 50 51 to 100	34 @ 4°C 34 @ - 7°C 42 @ - 7°C
As-deposited weld metal at Grade 50 orthotropic box section		34 @ - 30°C
Structural steel rolled shapes and plates used in footing frames		Per non-fracture critical steel in Zone 1 (T1) per ASTM Designation: A 709, S83

High-strength fastener assemblies, and other bolts attached to structural steel with nuts and washers shall be zinc-coated.

Material conforming to ASTM Designation: A 709M, Grade 50W or 100W shall not be substituted for ASTM Designation: A 709, non-weathering steel grades.

Orthotropic box girders, including internal floor beams, shall be made from fully killed material, conforming to the provisions for fine grain practice of ASTM Designation: A 709.

All steel used in the fabrication of the orthotropic box girder transition span shall not contain sulfur in excess of 0.01% by weight:

Steel designated as Pipe Beam Grade 70 on the plans shall conform to the requirements in ASTM Designation: A709, Grade HPS70W with Supplementary Requirement S5, "Ultrasonic Examination"; Supplementary Requirement S84 "Fracture-Critical, *F*, Material; Toughness Testing and Marking" tested for Zone 3; and Supplementary Requirement S93, "Limitations on Weld Repair (Fracture Critical Material Only)." Charpy V-Notch tests for the as-fabricated pipe beam and heat affected zone (HAZ) shall meet 48 joules (J) minimum average at –7˚ C. Weld metal shall meet the requirements of AWS D1.5, Table 12.1.

Steel designated as Pipe Beam Grade 50 on the plans shall conform to the following:

A. The steel shall conform to ASTM Designation: A 709 requirements for Fracture Critical Grade 50 with Supplementary Requirement S93, "Limitations on Weld Repair (Fracture Critical Material Only)," as modified herein.
B. The carbon content shall not exceed 0.12%, and the sulfur content shall not exceed 0.01% by weight.
C. The steel shall be fully killed and made to fine grain practice in conformance with the requirements in ASTM Designation: A709.
D. The steel shall be made using a low nitrogen and hydrogen practice such as vacuum degassing. The nitrogen content shall not exceed 0.015%.
E. The Yield Point or Yield Strength shall be within the range of 345 through 380 MPa.
F. The ratio of Yield Strength to Ultimate Strength shall be within the range of 0.75 to 0.85.
G. The tensile elongation shall be not less than 19% for a 200 mm gauge length specimen or 22% for a 50 mm gauge length specimen.
H. The reduction of area in the tensile test shall be not less than 35%.
I. Charpy V-Notch (CVN) tests for the base plate shall meet 41 J minimum average at - 40˚ C. CVN tests for the as-fabricated pipe beam, heat affected zone and the weld metal shall meet the requirements of AWS D1.5, Table 12.1.
J. Tensile and toughness tests shall be performed on a per-plate basis.

Pourable seals used with structural steel shall conform to the provisions in Section 51-1.12F(3), "Materials and Installation," of the Standard Specifications.

Grout for base plates shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications.

CHECK TESTING

Structural steel shall conform to the designated ASTM Standard and the check testing requirements of this section.

Check samples shall be furnished for each heat of maximum thickness of fracture critical members as shown on the plans.

Steel plates, shapes or bars containing check samples shall be furnished from the mill with extra length in order to provide for removal of material for check samples at the point of fabrication. Check samples may be cut from either end of the designated plate, shape or bar.

At the option of the Contractor, check samples may be removed at the rolling mill rather than at the point of fabrication. The sample will be removed from the mill plate that will be stripped by the fabricator to produce the designated plate and may be taken from any location within that plate. The mill plate from which samples are removed shall be marked with the same identifying numbers as are used on the samples.

Unless otherwise directed, material for check samples shall be removed by the Contractor in the presence of the Engineer. Check samples for plates wider than 610 mm shall be 355 mm wide and 460 mm long with the long dimension transverse to the direction of rolling. Check samples for all other products shall be 460 mm long, taken in the direction of rolling, and the width shall be the product width. Check samples shall be removed and delivered to the Engineer before the material is fabricated into components and preferably when it is still being prepared for fabrication. The direction of rolling, heat numbers, and plate numbers shall be marked on the samples with paint or other indelible marking material or may be steel stamped in one corner of the plate. Certified Material Test Reports complying with the requirements in these special provisions shall accompany the check sample.

Unless otherwise directed, check samples shall be delivered to the Transportation Laboratory at the Contractor's expense. The check samples will be tested by the Transportation Laboratory for compliance with the requirements specified in ASTM and these special provisions. Check sample test results will be reported to the Contractor within 15 working days of delivery to the Transportation Laboratory. In the event several samples are submitted on the same day, an additional day will be added for each 2 samples submitted. The test report will be made for the group of samples.

The results of the tensile and impact tests shall not vary more than 5 percent below the specified minimum or 5 percent above the specified maximum requirements except that if the initial check test results vary more than 5 percent but not more than 10 percent from the specified requirements, a retest may be performed on another sample from the same heat and thickness. The results of the retest shall not vary more than 5 percent from the original specified requirements. If the results of check tests exceed these permissible variations, material planned for use from the heat represented by said check samples shall be subject to rejection.

THROUGH-THICKNESS QUALITY

Where through-thickness quality steel is shown on the plans, the steel shall meet the low sulfur and reduction of area requirements of AWS D1.5, Section 12.4.4.1. Additionally, each plate shall be ultrasonically examined and accepted in conformance with the requirements in ASTM Designation: A578, Level I.

FABRICATION

Quality of Workmanship

The Engineer will inspect fabrications for dimensional accuracy, fabrication practices, welding, and for compliance with the specifications. The Contractor shall make all documentation available to the Engineer on request.

Shop Size

The shop or yard shall be of sufficient size and shall have adequate facilities to permit checking and controlling of the alignment of the orthotropic box sections to be erected before they are shipped to the site. Shop or yard size shall be sufficient to join any three contiguous sections.

Fabrication Procedure

The Contractor shall submit to the Engineer for approval in accordance with Section 55-1.02 "Drawings," of the Standard Specifications, written, detailed procedures for the fabrication of the following items:

A. Orthotropic box shell plating
B. Orthotropic box section (fabrication and splice)
C. Footings frames for Piers E3-E6, E7-E14 and E15-E16
D. Pipe beams

Procedures shall be of sufficient detail to demonstrate the proposed fabrication procedure and verify the inspectability of welds and shall include, at a minimum, the following:

1. Stages of fabrication;
2. The extent of each subassembly;
3. The use of jigs;
4. The sequence and methods for tack and final welding;
5. The timing and methods for dimensional checks;
6. The timing and methods for visual and nondestructive examination; and
7. The support conditions, fixturing, measurement methods, match marking and location for the trial fit of erection joints.

Pipe Beams

The Contractor shall fabricate pipe beams in accordance with the approved fabrication procedure conforming to the requirements of these special provisions. Welding of the pipe beam longitudinal and circumferential groove welds and stainless steel cladding shall be made using the SAW process unless otherwise approved by the Engineer.

Pipe beams shall be formed in sections that are welded with a single longitudinal seam. Forming shall be performed at ambient temperature unless approved and qualified at elevated temperature, which shall not exceed 590˚C. Prior to stress relieving and machining the formed pipe beam shall have a smooth surface with local roundness variations less than 5 mm, as measured against a template with the theoretical curvature and length of 20 degrees, and out-of-roundness (maximum diameter minus minimum diameter) less than 8 mm.

The Pipe Beam Grade 50 (Fuse) section shall be welded to the Pipe Beam Grade 70 sections using a welding procedure qualified for circumferential welds in the Pipe Beam Grade 70.

The finished pipe beam shall be stress relieved, after all section and ring welding is completed and before the stainless steel cladding is placed, at a temperature of 538˚C, but not above 10˚C below the final tempering temperature.

Welding procedures for the longitudinal and circumferential welds shall be qualified by welding in the as-formed condition representing the maximum strain and testing after stress relief. Charpy V-Notch tests shall be removed from the weld metal and heat affected zone for longitudinal and circumferential welds. Heat affected zone toughness tests shall be removed from the inner and outer surfaces of the formed member after the stress relief heat treatment. Test results for both weld metal and heat affected zone shall meet the requirements specified under "Materials" above.

The AISI 316L stainless steel overlay shall be welded using a procedure qualified for the Pipe Beam Grade 70 in accordance with AWS D1.6. Chemical analysis shall be performed on the overlay 5 mm above the substrate and shall meet the chemical limits for grade 316L. After overlay welding, the bearing surfaces shall be machined to a root mean square surface finish of 3 µm, with an out-of-roundness on the machined surface not exceeding 1 mm. The cylinder defined by the machined surface shall be straight within 1 mm and shall be concentric with any part of the pipe beam within 1 mm.

Complete joint penetration welds shall be examined 100% by UT and MT. Fillet and partial joint penetration welds shall be examined 100% by MT. Final visual and nondestructive examination of weld shall be after stress relief and before cladding. Finish machined stainless steel surfaces shall be examined 100% by liquid penetrant testing (PT).

Spare Fuses

In addition to pipe beams, the Contractor shall fabricate spare pipe beam fuses in accordance with the details shown on the plans and the requirements of this section. Spare pipe beam fuses shall conform to the requirements for Pipe Beam Grade 50 of this section, including the requirements for cleaning and painting.

The Contractor shall deliver the spare pipe beam fuses to the Engineer at a location to be determined by the Engineer. Said location will be within 25 km of the San Francisco-Oakland Bay Bridge Toll Plaza. Spare pipe beam fuses shall be delivered to the Engineer within six months prior to completion of the work. The Contractor shall notify the Engineer at least two months prior to delivery of spare pipe beam fuses.

Spare pipe beam fuses shall be packaged for the protection of the steel against physical damage and corrosion during shipping and storage. The shipping package shall be clearly marked with a statement that the package contains spare pipe beam fuses for the San Francisco-Oakland Bay Bridge and show the hinge location, the grade of steel, and the date packaged.

Mechanical Cutting

Mechanical shearing of material of thickness greater than 8 mm is prohibited. Mechanically sheared edges shall be ground smooth. All cracks emanating from these edges shall be removed.

Flame, Plasma And Arc Cutting

All cut edges shall be ground to remove dross, slag and hardened material.

Rib Plates

Cold-bent rolled steel rib plates shall conform to the following:

A. The plates shall be taken from the stock plates that the direction of bending will be at right angles to the direction of rolling. The entire length of rib shall be formed simultaneously. Progressive forming methods such as roll forming will not be permitted.
B. The radius of bend of closed rib plates, measured to the concave face of the metal shall be as shown on the plans.
C. Before bending, the corners of the plate perpendicular to the axis of the bend shall be rounded to a radius of 2 mm.

The Contractor's proposed method shall be capable of bending the plates without introducing cracks at the edges or along the bent section. The Contractor shall demonstrate to the Engineer that the proposed method results in satisfactory bends. The Engineer will determine if the proposed method is acceptable. Acceptance of the Contractor's proposed bending method will be based on nondestructive tests on ten ribs and destructive tests on three of the ribs previously tested nondestructively. Ribs shall be a minimum of 10 m long. The Contractor shall perform the following tests:

A. Visual observation of the bends using magnifying lens.
B. Magnetic Particle testing of 15% of the bent parts of the ribs at locations selected by the Engineer.
C. Destructive testing of up to three ribs, with 5 samples per rib, at locations selected by the Engineer.

Minor end cracks that are less than 6 mm in any dimension may be acceptable if repaired by welding or if they are trimmed off, as determined by the Engineer. Finished surfaces shall be smooth.

The Contractor shall bend and trim ribs and shell plating to ensure that the geometric tolerances shown on the plans will be met.

Match-Marking

Match markings shall be made with low stress die stamps or other method that will not notch the steel. Bulkheads within the closed ribs shall match the diaphragm plate within 1 mm tolerance. Markings shall be sufficiently narrow to meet this requirement.

Bolted Connections

The first paragraph of Section 55-3.14 "Bolted Connections," of the Standard Specifications shall not apply.

Bolted connections in structural steel joints, unless otherwise shown on the plans or specified in the special provisions, shall be made with high-strength steel fastener assemblies. Fastener assemblies shall consist of a high-strength steel bolt, nut and hardened washer.

The method of bolt tightening shall be the "Turn-of-the-nut" method as specified in RCSC Specification.

Except where sub-punching is permitted, bolt holes shall be drilled or reamed, unless otherwise shown on the plans.

Punching

The first paragraph of Section 55-3.14A(1), "Punching," of the Standard Specifications shall not apply.

Sub-punching of structural steel conforming to the requirements in ASTM Designation: A 36 where the material is thicker than 16 mm will not be permitted. Sub-punching of high-strength structural steel where the material is thicker than 12 mm will not be permitted.

ROTATIONAL CAPACITY TESTING PRIOR TO SHIPMENT TO JOB SITE

Rotational capacity tests shall be performed on all lots of high-strength fastener assemblies prior to shipment of these lots to the project site. Zinc-coated assemblies shall be tested after all fabrication, coating, and lubrication of components has been completed. One hardened washer shall be used under each nut for the tests.

Each combination of bolt production lot, nut lot and washer lot shall be tested as an assembly.

A rotational capacity lot number shall be assigned to each combination of lots tested. Each shipping unit of fastener assemblies shall be plainly marked with the rotational capacity lot number.

Two fastener assemblies from each rotational capacity lot shall be tested.

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on, and determine acceptance of long bolts. Fasteners are considered to be long bolts when full nut thread engagement can be achieved when installed in a bolt tension measuring device:

A. Long Bolt Test Equipment:

1. Calibrated bolt tension measuring device with adequate tension capacity for the bolts being tested.

2. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Long Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F436.
4. Steel beam or member, such as a girder flange or cross frame, to which the bolt tension measuring device will be attached. The device shall be accessible from the ground.

B Long Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Insert the bolt into the bolt tension measuring device and install the required number of washers, and additional spacers as needed, directly beneath the nut to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug tension shall not be less than the Table A value but may exceed the Table A value by a maximum of 2 kips.

Table A

High-Strength Fastener Assembly Tension Values to Approximate Snug-Tight Condition	
Bolt Diameter (inches)	Snug Tension (kips)
1/2	1
5/8	2
3/4	3
7/8	4
1	5
1 1/8	6
1 1/4	7
1 3/8	9
1 1/2	10

5. Match-mark the assembly by placing a heavy reference start line on the face plate of the bolt tension measuring device which aligns with 1) a mark placed on one corner of the nut, and 2) a radial line placed across the flat on the end of the bolt. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make an additional mark on the face plate, either 2/3 of a turn, one turn, or 1 1/3 turn clockwise from the heavy reference start line, depending on the bolt length being tested as shown in Table B.

Table B

Required Nut Rotation for Rotational Capacity Tests[a,b]	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3
Greater than 4 bolt diameters but no more than 8 bolt diameters	1
Greater than 8 bolt diameters, but no more than 12 bolt diameters[c]	1 1/3
(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance shall be plus or minus 45 degrees. (b) Applicable only to connections in which all material within grip of the bolt is steel. (c) When bolt length exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.	

6. Turn the nut to achieve the applicable minimum bolt tension value listed in Table C. After reaching this tension, record the moving torque, in foot-pounds, required to turn the nut, and also record the corresponding bolt tension value in pounds. Torque shall be measured with the nut in motion. Calculate the value, T (in ft-lbs), where T=[(the measured tension in pounds) x (the bolt diameter in inches) / 48 in/ft].

Table C

Minimum Tension Values for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Minimum Tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1 1/8	56
1 1/4	71
1 3/8	85
1 1/2	103

7. Turn the nut further to increase bolt tension until the rotation listed in Table B is reached. The rotation is measured from the heavy reference line made on the face plate after the bolt was snug-tight. Record this bolt tension.
8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Long Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: 1) the measured moving torque (Step 6) shall be less than or equal to the calculated value, T (Step 6), 2) the bolt tension measured in Step 7 shall be greater than or equal to the applicable turn test tension value listed in Table D, 3) the nut shall be able to be

removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, 4) the bolt does not shear from torsion or fail during the test and 5) the assembly does not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head is expected and will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

Table D

Turn Test Tension Values	
Bolt Diameter (inches)	Turn Test Tension (kips)
1/2	14
5/8	22
3/4	32
7/8	45
1	59
1 1/8	64
1 1/4	82
1 3/8	98
1 1/2	118

The following equipment, procedure and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of short bolts. Fasteners are considered to be short bolts when full nut thread engagement cannot be achieved when installed in a bolt tension measuring device:

A. Short Bolt Test Equipment:

1. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Short Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
2. Spud wrench or equivalent.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F436.
4. Steel plate or girder with a hole to install bolt. The hole size shall be 1.6 mm greater than the nominal diameter of the bolt to be tested. The grip length, including any plates, washers, and additional spacers as needed, shall provide the proper number of threads within the grip, as required in Step 2 of the Short Bolt Test Procedure.

B. Short Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Install the bolt into a hole on the plate or girder and install the required number of washers, and additional spacers as needed, between the bearing face of the nut and the underside of the bolt head to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug condition shall be the full manual effort applied to the end of a 305 mm long wrench. This applied torque shall not exceed 20 percent of the maximum allowable torque in Table E.

Table E

Maximum Allowable Torque for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Torque (ft-lbs)
1/2	145
5/8	285
3/4	500
7/8	820
1	1220
1 1/8	1500
1 1/4	2130
1 3/8	2800
1 1/2	3700

5. Match-mark the assembly by placing a heavy reference start line on the steel plate or girder which aligns with 1) a mark placed on one corner of the nut, and 2) a radial line placed across the flat on the end of the bolt. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make 2 additional small marks on the steel plate or girder, one 1/3 of a turn and one 2/3 of a turn clockwise from the heavy reference start line on the steel plate or girder.
6. Using the torque wrench, tighten the nut to the rotation value listed in Table F. The rotation is measured from the heavy reference line described in Step 5 made after the bolt was snug-tight. A second wrench shall be used to prevent rotation of the bolt head during tightening. Measure and record the moving torque after this rotation has been reached. The torque shall be measured with the nut in motion.

Table F

Nut Rotation Required for Turn-of-Nut Installation[a,b]	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	1/3
(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees. (b) Applicable only to connections in which all material within grip of the bolt is steel.	

7. Tighten the nut further to the 2/3-turn mark as indicated in Table G. The rotation is measured from the heavy reference start line made on the plate or girder when the bolt was snug-tight. Verify that the radial line on the bolt end is still in alignment with the start line.

Table G

Required Nut Rotation for Rotational Capacity Test	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3

8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Short Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: 1) the measured moving torque from Step 6 shall be less than or equal to the maximum allowable torque from Table E, 2) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, 3) the bolt does not shear from torsion or fail during the test and 4) the assembly shall not seize before

the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

INSTALLATION TENSION TESTING AND ROTATIONAL CAPACITY TESTING AFTER ARRIVAL ON THE JOB SITE

Installation tension tests and rotational capacity tests on high-strength fastener assemblies shall be performed by the Contractor prior to acceptance or installation, and after arrival of the fastener assemblies on the project site. Installation tension tests and rotational capacity tests shall be performed at the job-site, in the presence of the Engineer, on each rotational capacity lot of fastener assemblies.

Installation tension tests shall be performed on 3 representative fastener assemblies in conformance with the provisions in Section 8, "Installation and Tightening," of the RCSC Specification. For short bolts, Section 8(d), "Joint Assembly and Tightening of Slip-Critical and Direct Tension Connections," of the RCSC Specification shall be replaced by the "Pre-Installation Testing Procedures," of the "Structural Bolting Handbook," published by the Steel Structures Technology Center, Incorporated.

The rotational capacity tests shall be performed in conformance with the requirements for rotational capacity tests in "Rotational Capacity Testing Prior to Shipment to Job Site" of these special provisions.

At the Contractor's expense, additional installation tension tests, tests required to determine job inspecting torque and rotational capacity tests shall be performed by the Contractor on each rotational capacity lot, in the presence of the Engineer, if 1) any fastener is not used within 3 months after arrival on the jobsite, 2) fasteners are improperly handled, stored, or subjected to inclement weather prior to final tightening, 3) significant changes are noted in original surface condition of threads, washers or nut lubricant or 4) the Contractor's required inspection is not performed within 48 hours after all fasteners in a joint have been tensioned.

Failure of a job-site installation tension test or a rotational capacity test will be cause for rejection of unused fasteners that are part of the rotational capacity lot.

ASSEMBLY

Orthotropic box sections shall be fabricated in subassemblies as shown on the plans. Splices within subassemblies shall be welded. At the option of the Contractor, subassemblies may become part of larger preassembled sections before they are shipped to the site. Preassembled sections shall be dimensionally checked for matching, alignment, and camber, and shall not be shipped to the job site without approval of the Engineer.

Before shipping, preassembled sections shall be straight and square in accordance with the dimensions and tolerances shown on plans and these special provisions, except as required by camber. Subassemblies and preassembled sections shall be measured in the shop for compliance with geometry requirements. As a minimum, the preassembly procedure shall consist of assembling three contiguous sections accurately adjusted for line and camber. Successive assemblies shall consist of at least one section of the previous assembly plus two or more sections added at the advancing end. In case of structures longer than 45 m, each assembly shall be not less than 45 m regardless of the length of individual continuous sections. The support conditions shall be the same as those in the final installed condition; alternative support conditions may be proposed with details submitted under the Erection Plan and supported by calculations showing the effect of the support conditions on dimensional tolerances and section-to-section fit-up tolerances.

SURFACE PREPARATION

For all bolted connections, the 1) contact surfaces and 2) inside surfaces of bolt holes shall be cleaned and coated before assembly in conformance with the provisions for cleaning and painting structural steel of these special provisions.

WELDING

Table 2.2 of ANSI/ AASHTO/AWS D1.5 is superseded by the following table:

Base Metal Thickness of the Thicker Part Joined, mm	Minimum Effective Partial Joint Penetration Groove Weld Size, * mm
Over 6 to 13 inclusive	5
Over 13 to 19 inclusive	6
Over 19 to 38 inclusive	8
Over 38 to 57 inclusive	10
Over 57 to 150 inclusive	13
Over 150	16

* Except the weld size need not exceed the thickness of the thinner part

Backing for welds that are subject to computed stress which are left in place in the completed structure as shown on the plans or approved by the Engineer shall be a single length. Backing shall be of the same material as the structural steel being welded. Single lengths of backing shall be obtained by using a continuous strip, or may consist of lengths of backing joined by complete joint penetration butt welds. Butt welds in the backing material shall be tested in conformance with the requirements in AWS D1.5, Section 3.13.1. Butt welds in backing material shall be ground flush as necessary to obtain proper inspection and for proper fit-up in the weld joint with which the backing is to be used.

WELDING OF HPS70W STEELS FOR PIPE BEAMS

Welds in Pipe Beam Grade 70 steels shall conform to the requirements for HPS 70W in this section. All welding procedures shall be qualified by testing in accordance with the requirements in AWS D1.5 and shall be used within the qualified limits of heat input. Previously qualified welding procedures may be submitted for review based on these specification requirements. Regardless of qualification range, the heat input, preheat temperature and maximum interpass temperature shall conform to the requirements of this section.

Consumables for welding HPS70W shall be low hydrogen with H2, H4 or H8 designators as shown below. The Contractor shall test the actual level of hydrogen for each consumable using the proposed welding procedure and maximum exposure conditions anticipated during production. The level of hydrogen shall not exceed the limits specified below.

The following additional provisions shall be used for welding to HPS70W:

A. Only submerged arc and shielded metal arc welding are pre-approved for welding HPS70W steel. Consumable handling requirements shall be in accordance with the requirements of AWS D1.5-96, Sections 12.6.5 and 12.6.6.
B. Filler Metal Requirements:

1. Filler metals for single pass fillet welds need not meet the requirements for exposed bare applications.
2. Filler Metals for complete joint penetration groove welds connecting Grade HPS70W to Pipe Beam Grade 50 steels shall conform to the requirements listed in paragraph 3 below.
3. Filler Metals for matching fillet welds when required by design, and all groove welds connecting Grade HPS70W plates shall conform to the following requirements:

(a) Submerged Arc Welding (SAW) Consumables;
SAW consumables shall meet AWS Electrode/Flux Classification F9P4 EXXX-X for welds that will be stress relieved, and F9A4 EXXX-X for welds that will not be stress relieved, with supplementary moisture resistance designators-H4 or -H2, in conformance with AWS A5.23, with 1% Nickel minimum in the weld deposit.

(b) Shielded Metal Arc Welding (SMAW) Consumables; E9018-CxRHZ*
(* the Designator 'R', for moisture resistant coating, is required for all SMAW electrodes used for welding HPS70W steels. HZ shall be either H4 or H8, depending upon the level of preheat used.)

(c) Other Processes
The use of other processes will be subject to approval by the Engineer based on proposed consumables and welding parameters. Filler metals for other processes shall provide, in the as-welded or stress relieved condition as appropriate, a minimum ultimate strength of 620 MPa, minimum yield strength of 485 MPa, and the toughness specified below. Consumables shall have a low hydrogen designation of H4 or H8 (depending on the level of preheat) and shall be moisture resistance.

4. Except for single pass fillet welds, or welds that will be fully consumed in a finished weld with satisfactory weathering characteristics, welding consumables and electrodes shall produce weld deposits that meet the requirements of AWS D1.5, Table 4.3.

5. Qualification Testing: Weld procedure qualification Test Requirements for HPS70W groove welds shall be evaluated using Welding Procedure Specification (WPS) Test Plates from the as-formed base metal and shall be stress relieved the same as the final members. The test results shall meet the following properties:

   Transverse tensile ultimate strength: ≥ 620 MPa
   All-Weld-Metal: yield strength: ≥ 485 MPa
   All-Weld-Metal: ultimate tensile strength: ≥ 620 MPa
   All-Weld-Metal: percent elongation: ≥ 19% in 50 mm
   Charpy V-Notch: as specified under Materials above.

6. In addition to the requirements for WPS qualification in accordance with AWS D1.5, diffusible hydrogen (Hd) tests shall be performed on the weld metal. The deposited weld metal shall have a diffusible hydrogen level equivalent to 4 mL/100 g or less for SAW and 8 mL/100 g or less for other processes. Hd test specimens shall be prepared at the fabrication plant. Specimens shall be tested in accordance with AWS A4.3. Test results in excess of the specified limit are unacceptable, and a retest is required, with a revised welding or consumable control procedure. AWS D1.5, Section 5.7.6, "Exemption from Further Testing," is applicable, but WPS or Hd results are not transferable from fabricator to fabricator. Fabricators with multiple plants under a common umbrella of welding equipment, welding training, and supervision will be required to perform the Hd testing only once per combination of consumables for each location. Plants audited as a single facility by the American Institute of steel Construction (AISC) as a part of their Quality Certification Program, or other owner approved equal Quality Assurance program, shall be considered one location. Multiple plants not falling under the AISC, or other 'single facility' audit definition, are considered separate facilities and additional WPS and Hd tests are required.

C. Preheat and Interpass Temperature:

1. The minimum preheat and interpass temperatures shall be in accordance with AWS D1.5, Table 12.4.

   If satisfactory results are not achieved with the above minimum preheat and interpass temperatures during development of the Welding Procedure Specification (WPS), and an increased preheat temperature is used to provide a satisfactory Procedure Qualification Record (PQR), the higher preheat temperature shall be used during pipe beam fabrication as the required minimum.

   The minimum preheat or interpass temperature required for a joint composed of different base metals and/or different thickness shall be based on the highest of the minimum preheats required by AWS D1.5, Table 12.4.

2. The maximum interpass temperature for welding HPS70W steel is 230˚C.

D. Heat Input (HI);
   1.5 kilojoules per mm (kJ/mm), minimum
   3.5 kJ/mm, maximum
   as determined using AWS D1.5, Section 5.12.

E. Backing; AWS D1.5, Section 5.4.5 is modified to allow steel backing material for WPS test plates to be of grade 50W (Sulfur = 0.025 max.) or HPS70W material.

F. Transition at butt joints; AWS D1.5, Section 9.16.3, is modified to allow a straight (width) transition for butt joints with HPS70W steel consistent with the fatigue rules of AASHTO.

Except as specified herein, welding, welder qualifications, and inspection of welding work shall conform to the requirements of AWS D1.5.

SHOP WELDING

General Provisions

A. Steel fabrication shall conform to the requirements of AWS D1.5, except FCMs shall be fabricated to Chapter 12 of the AWS D1.5, "AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members", except as modified in these special provisions.

B. The welding shop shall be temperature and ventilation controlled. At no time shall the temperature fall below 10˚C. Fumes from welding shall be removed by methods satisfying ANSI Z49.1, "Safety in Welding cutting and Allied Processes, and Safety Plans" consistent with legislation. To the extent that air movement may be harmful to welding procedures, ventilation in the welding areas shall be controlled to levels consistent with qualification procedures.
C. Welding of ancillary products – connections of ancillary products, such as bikepath railings, to the main bridge elements shall be done by bolting. No structure which is welded to the orthotropic box section or main elements of the bridge shall be considered ancillary. The provisions of AWS D1.5, Section 1.3.6, "Welding of Ancillary Products," shall not apply. The bikepath deck, and all its members shall be fabricated as a main element of the bridge and not as an ancillary product.
D. Welding of temporary fixtures such as lifting lugs or temporary shear enhancement devices shall be shown on the shop drawings and shall conform to AWS D1.5. After removal, the structure shall be repaired to meet the requirements of these special provisions and AWS D1.5.
E. Welding of orthotropic deck ribs – Ribs shall be welded to the deck plate in accordance with a welding procedure that is qualified to meet penetration requirements as specified in these special provisions. The procedure shall be approved by the Engineer before it is adopted for production and shall be monitored during production using extension test pieces described below. Closed ribs shall be clamped in place and both stems welded to the deck plate simultaneously.

Design Details

A. Unless otherwise shown on the plans or specifically approved in writing by the Engineer, all complete joint penetration (CJP) welds shall be back-gouged. Where backing bars are used, the backing bars shall be removed and the weld back-gouged and re-welded. The back gouged areas shall be ground to bright metal.
B. Weld backing shall conform to the requirements in AWS D1.5 and these special provisions.
C. Weld matching: weld electrodes shall match the lower strength of the materials joined, except where otherwise noted.
D. Tightly adhering weld spatter shall be removed by power brush or grinding.
E. Gouging for back gouging or for repair shall be done by an approved arc method and /or by grinding. Oxygen cutting will not be permitted for any form of gouging. Procedures to avoid retention of carbon deposits, slag or dross shall be used. Air-carbon-arc gouged surfaces shall be ground or filed to bright metal.
F. Weld repairs – In addition to the provisions in AWS D1.5, Section 3.7.4, re-repairs of welds or base metal shall require prior approval of the Engineer. Repairs to Fracture Critical Members shall be as specified in AWS D1.5, "AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Member," Section 12.17.

    1. The dimensional tolerances in AWS D1.5 shall be limited such that the actual location of the pile sleeve surface at any point shall be within 20 mm of its theoretical location with respect to the other piles and other geometric references in each footing.

G. Dimensional Tolerances

    1. Dimensional tolerances shall conform to AWS D1.5 as modified on the plans and in these special provisions.
    2. The dimensional tolerances in AWS D1.5 shall be limited such that the actual location of the pile sleeve surface at any point shall be within 20 mm of its theoretical location with respect to the other piles and other geometric references in each footing.
    3. Dimensional tolerances for the orthotropic box shall conform to the tolerances in AWS D1.5, AASHTO Sixteenth Edition 1996, Division II – Construction, Section 11.4.13 – Orthotropic Deck Superstructures, and the following:

        a. Members comprising the orthotropic box, including all internal structure, shall be within 5 mm of the theoretical location shown on the plans at any point along the member in the as-installed condition.
        b. The vertical web plates, transverse diaphragms and floor beam webs shall be within 0.25% of plumb at any point along the member in the as-installed condition.

Welding of Closed Ribs to Deck Plate

A. Welding of closed ribs to deck plates shall be accomplished with a welding process and procedure capable of achieving a minimum of 80% penetration of the rib thickness. The Contractor's proposed process and rib groove detail shall undergo trials to obtain the optimum joint detail, without internal notches. In addition to these tests, the

qualification procedure required by AWS D1.5 shall be followed. Production welding, with any of the processes tried, will not be permitted without the approval of the Engineer.

B. Weld Procedure Trials– For closed rib welds to the deck plate and other plate, the Contractor shall perform weld trials with a minimum of two details using the SAW automated welding process. One of the trials shall be made with a backing bar and another trial shall have no backing bar or a ceramic backing.

The trials shall be conducted with welding machines, parameters, root openings and bevels as shown in the approved WQCP. Each weld detail shall be performed on a rib prototype, which is a minimum of ten (10) meters long. During these trials, the welding shall be stopped at every 1.0 meters, and then restarted. Each rib shall have a total of 18 re-starts, 9 for each rib stem.

At completion of welding, welds shall be 100% ultrasonically tested. The rib shall then be split in two and one stem shall be selected for examination, after cutting and macroetching at anomalies as determined by UT and selected by the Engineer, but at least the ends of the rib, all the re-starts, and intermediate points between re-starts.

The Engineer will evaluate all the rib to deck plate weld details and make a selection based on the as-welded configuration of the joint. The macroetched sections of the selected welding procedure will be evaluated and given a quality status based on visual inspection (VT) and UT. The evaluation criteria for the macroetched sections shall be a minimum weld size of 80% of the rib thickness; no gross notches or burn-through at the rib inside surface, although uniform melt-through or reinforcement shall be acceptable; a reinforcement fillet between zero and 3 mm; and a surface profile meeting AWS D1.5, Section 9.21.1 for a weld in a primary member with tension parallel to the weld axis. The worst of these macrosections that is still acceptable to the Engineer will be considered qualified welds and will be used as standards for acceptance of production welds as monitored during deck fabrication.

C. Monitoring of Production Welds – During fabrication, weld monitoring tests shall be conducted on each welding machine at least every four hours. Test specimens shall consist of run-off extensions of production deck panels. They shall be produced with a separate, unattached, piece of deck plate and an extra long bent rib plate. The rib shall be sawn off at the termination of the deck panel, thus producing a production panel and a specimen for monitoring tests. The specimen shall be 500 mm long, and shall be macroetched 25 mm from each end and at two intermediate locations as determined by the Engineer.

In the event that the monitoring test specimens do not provide quality similar to those originally developed and accepted, fabrication shall cease. The welding parameters shall then be adjusted and production of qualified welds verified through two consecutive successful additional specimen trials approved by the Engineer before fabrication of deck panels is allowed to continue with the welding machine being monitored.

Welding Procedure Qualification

A. Qualification of Welding Procedure – Qualification testing shall be conducted for all welds and weld details as specified hereunder. Procedure qualification records (PQR) pertaining to tests conducted within the last 30 months, witnessed by Caltrans, and certified to be accurate will be accepted if the test material thickness was equal or greater than the material to be used on the project, and the properties meet the requirements of these special provisions. Otherwise, new tests shall be conducted. Qualification tests shall be performed to qualify the range of material thicknesses using Table 5.2 of AWS D1.5 except that the thickness of the thicker test plate shall not be less than the maximum thickness to be welded using the qualified procedure. Groove weld macroetch tests per AWS D1.5 are required for qualification of all non-standard complete joint penetration and partial joint penetration welds.

The ductility requirements shall be 22% elongation for a gage length of 50 mm in the reduced section of the reduced section tension specimens. Charpy V-Notch impact tests shall be taken from the weld and heat affected zone. The toughness requirements are stipulated above under "Materials."

Inspection and Testing

The Contractor shall provide the Engineer with work schedules, and expected readiness of work for quality assurance (QA) inspection by the Engineer.

Full access for the State's QA personnel shall be provided to conduct VT for not less than 60 hours from the time the weld is completed.

All CJP welds shall be 100% UT inspected by the Contractor. Closed rib to plate welds shall be 15% UT inspected by the Contractor.

In addition, butt welds shall be inspected by radiographic methods as follows:

LOCATION	FREQUENCY OF TESTING
Orthotropic box section butt joints - deck and soffit plates and ribs	Transverse Plate Seams: 100% per FCM requirements Longitudinal Plate Seams: Minimum of 15% at locations selected by the Engineer Transverse Rib Seams: Minimum of 50% at locations selected by the Engineer
Orthotropic box section - One-sixth of web and wing plate depth starting from the deck and soffit plates	Minimum of 10%, at locations selected by the Engineer
Orthotropic box section – Central 2/3 of web and wing plate depth transverse seam	Minimum of 5%, at locations selected by the Engineer
For FCMs, butt joint, except as noted above, and repairs to butt joints	100%

The Contractor shall MT 15% of each fillet and PJP weld (including weld restarts), at locations selected by the Engineer.

Acceptance

For purposes of acceptance, all welds shall be considered to sustain tension.

If unacceptable discontinuities (as defined by AWS D1.5) are found in any weld not 100% nondestructively examined, the entire weld shall be examined by the same method.

FIELD WELDING

Field fabricators shall be certified under the AISC Quality Certifications Program, Category CASE, Certified Advanced Steel Erector, with Endorsement F, Fracture Critical members.

Field welding shall comply with all provisions under "Shop Welding" of these special provisions.

The Contractor shall provide suitable enclosures to permit field welding during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures with limits suitable for field welding in accordance with the requirements of AWS D1.5 and "Welding" of these special provisions. Full compensation for providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring field welding and no additional compensation will be allowed therefor.

No extension of contract time will be granted and no additional compensation will be allowed as a result of weather conditions which exceed the limits for field welding designated herein, except as approved by the Engineer.

Field welding of pile head connection plates shall conform to the following requirements:

A. Stray current corrosion of the structure shall be avoided during installation at the site. Welding machines shall be placed on the structure being welded. Where this is not practical, the insulated welded power source output "ground" lead shall be connected directly to the work at a location close to the weld being made and shall not be permitted to touch the water. The minimum total cross sectional area of the return ground cable(s) shall be 645 circular mm per 1000 amperes per 30.5 m of cable. Grounding sufficiency shall be periodically monitored by simultaneously measuring the potential of the structure being welded and that holding the welding machines using a standard calomel electrode (SCE), Ag-AgCl or other reference electrode approved by the Engineer. A change in potential reading of 10% or more shall indicate insufficient grounding.
B. Weld filler metal for the welding of ASTM A709, Grade 50 shall conform to AWS D1.5, Table 4.1 or 4.2 and shall be designated H4 or H8 by the manufacturer. All welding consumables shall be heat or lot tested by the manufacturer, and certified test reports shall be submitted to the Engineer prior to being used.
C. Prequalified welding procedures are not permitted. All field welding procedures shall be qualified by testing as required by AWS D1.5 and these special provisions. Qualification tests shall include Charpy V-Notch tests of the weld metal and heat affected zone. The tests shall meet the requirements of these special provisions.
D. Welding filler materials shall be considered an essential variable for welding procedure qualification. Any change in the filler material brand name, size or type shall require requalification of the welding procedure.

E. GMAW shall not be used for field welding.
F. The preheat and interpass temperature shall be in conformance with AWS D1.5, Table 12.3; and the minimum preheat and interpass temperature shall be 60°C. In the event welding is interrupted, preheating to 60°C must occur before welding is resumed. For welds with required preheat temperatures greater than 60°C, preheat temperatures shall be achieved and maintained using electric resistance heating bands for the entire length of the weld. The heaters shall be controlled by attached thermocouples at spacing not exceeding 2 m. For these welds, the minimum preheat temperature shall be maintained continuously from beginning to completion of the entire weld, even if welding is interrupted.
G. Welds shall not be water quenched. Welds shall be allowed to cool unassisted.
H. Slots in the piles shall be precision cut using mechanically-guided cutting equipment on tracks that span the entire length of the cut. A hole, with diameter equal to the intended slot opening, shall be drilled at the bottom of each slot before cutting commences. Cut surfaces shall be protected as necessary to prevent gouging when cutting bevels in the slots.
I. The pile sleeve wall shall be ground to bright metal at each connection plate weld to at least 50 mm beyond the full connection footprint.

FIELD WELDING QUALIFICATIONS FOR PILE HEAD CONNECTION PLATES

Difficult access and working conditions are anticipated for field welding pile head connection plates. The Contractor shall construct full-scale wood and then, after approval by the Engineer, steel mock-ups and perform qualification testing for pile head connection plates in accordance with these special provisions.

The wood mock-up shall show the pile head connection plate connections to the footing, including installation of pile head connection plates.

The steel mock-up shall include the following details:

A. De-watering cofferdam; method of attaching, sealing, drying, and protecting from welding and cutting sparks;
B. Pile head connection plate connections to footing, including installation of connection plate.

The Contractor shall submit to the Engineer for approval, a written installation and welding sequence procedure for each mock-up. The Contractor shall allow the Engineer 15 working days for review of the proposed procedures and each mock-up.

The Engineer shall be given sufficient notice to witness all fit-up of the wood mock-up and fit-up and welding for the steel mock-up.

For the steel mock-up, the procedure shall describe the equipment and details for installing the collar, field cutting slots in the piles, installing the connection plates and reinforcing steel, and performing all welding.

Welders and welding operator shall be qualified with similar access to that anticipated in the field and used in the preliminary mock-up.

Testing

Completed steel mock-up assemblies shall be examined visually and by MT, and by UT or RT for complete and partial penetration welds, using the nondestructive examination procedures proposed for production. Each mock-up pile head connection plate shall be sectioned and tested. Three macroetch specimens shall be removed from each weld between the pile head connection plate and the pile sleeve and between the pile head connection plate the pile at locations indicated by the Engineer. The size of the macroetch specimens shall be agreed with the Engineer. Each specimen shall demonstrate the required weld size and weld profile. Qualification tests shall be adequate to:

A. Demonstrate the proposed installation procedure for each orientation of connection plate considering the least favorable combination of tolerances;
B. Demonstrate the welding sequence and verify the inspectability of each weld; and
C. Confirm that satisfactory welds can be made with the heat sink on the opposite side of the through plate. This confirmation weld shall be an additional qualification test and PQR required to qualify welding procedures for this weld. The qualification weld shall be performed in accordance with the low heat input, low preheat temperature test piece per AWS D1.5, Section 5.12.2.2, except that the weld plate shall be artificially cooled. Sufficient water at the San Francisco Bay water temperature, or equivalent cooling as approved by the Engineer, shall be used as a heat sink to simulate the actual conditions. The procedure test piece shall be examined and tested per Test Plate A (Fig. 5.1) of AWS D1.5 and these special provisions, including Charpy V-Notch tests of the weld and heat affected zone.

The results of the mock-up procedure evaluation and weld procedure qualification tests shall be used to finalize the written installation and welding sequence procedure. The procedure shall describe all equipment and temporary attachments

to be used in installing the collar, footing, connection plates and other work to complete the installation of the footing. Approval of the installation and welding sequence procedure shall be contingent on satisfactory results from the mock-up examination and destructive tests, as determined by the Engineer.

At completion of testing, all mock-ups shall become the property of the Contractor and disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

FIELD WELDING NONDESTRUCTIVE TESTING FOR PILE HEAD CONNECTION PLATES

Field welded pile shear plates shall receive NDT as follows:

A. The root pass shall be visually inspected before placing subsequent passes.
B. UT shall be used for each complete joint penetration (CJP) field weld. UT shall be performed over the full length of weld. UT shall also be performed over the full length of welds between the pile head connection plate and the pile sleeve and the pile head connection plate and the pile. In addition, MT shall be used for 100% of all partial joint penetration (PJP) and fillet welds. The acceptance criteria shall conform to the requirements of AWS D1.5 for connections subject to tensile stress. UT and MT shall be performed, after the weld has cooled to ambient temperature, in accordance with a written procedure that shall be approved by the Engineer before use.

BEARINGS AND ANCHORAGES

Elastomeric bearing pads shall be bonded to steel with adhesive conforming to Federal Specification MMM-A-121, where shown on the plans.

MEASUREMENT AND PAYMENT

Payment for structural steel shall conform to the provisions in Section 55-4.02, "Payment," of the Standard Specifications and these special provisions.

Structural steel for use in bridge structures will be paid for at the contract price per kilogram for furnish structural steel and the contract price per kilogram for erect structural steel of the types listed in the Engineer's Estimate, except as noted.

The contract price paid per kilogram for furnish structural steel of the types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating and delivering structural steel to the job site, ready for erection, including furnishing all bolts, nuts and washers, stud connectors, welding materials, asbestos sheet packing, preformed fabric pads and elastomeric bearing pads, or other materials required for the erection and connection or splicing of the structural steel; galvanizing the structural steel when galvanizing is required by the specifications or plans; and conforming to the qualification and testing requirements associated with member fabrication; as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per kilogram for erect structural steel of the types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in erecting the structural steel, complete in place, including connecting and splicing the structural steel; installing stud connectors; placing asbestos sheet packing, preformed fabric pads and elastomeric bearing pads; furnishing and applying caulk; furnishing and placing mortar for masonry or bearing plates and anchor bolts; checking bolt tension; and conforming to qualification and testing requirements associated with member erection, connection or splicing; as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Furnishing and installing pile head connection plates will be measured and paid for as furnish structural steel (bridge footing) and erect structural steel (bridge footing), respectively.

Spare pipe beam fuses will be measured by the unit as furnish structural steel (pipe beam fuse).

The contract unit price paid for furnish structural steel (pipe beam fuse) shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating and delivering spare structural steel pipe beam fuses to the location specified by the Engineer, including conforming to the qualification and testing requirements associated with member fabrication, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for mock-ups and welding qualification procedures and testing shall be considered as included in the contract prices paid per kilogram for furnish structural steel, of the types listed in the Engineer's Estimate, and no additional compensation will be allowed therefor.

Full compensation for cutting slots in steel shells for pile head connection plates shall be considered as included in the contract prices paid per kilogram for erect structural steel, of the types listed in the Engineer's Estimate, and no additional compensation will be allowed therefor.

Full compensation for repairing damaged paint surfaces shall be considered as included in the contract prices paid per kilogram for erect structural steel, of the types listed in the Engineer's Estimate, and no additional compensation will be allowed therefor.

The sixth paragraph of Section 55-4.02, "Payment," of the Standard Specifications shall not apply.

If a portion or all of the structural steel is fabricated more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impracticable and extremely difficult to ascertain and determine the actual increase in these expenses, it is agreed that payment to the Contractor for furnishing the structural steel from each fabrication site located more than 480 air line kilometers from both Sacramento and Los Angeles will be reduced $5000 or by an amount computed at $0.044 per kilogram of structural steel fabricated, whichever is greater, or in the case of each fabrication site located more than 4800 air line kilometers from both Sacramento and Los Angeles, payment will be reduced $8000 or by $0.079 per kilogram of structural steel fabricated, whichever is greater.

If a portion of or all check samples are removed at a mill more than 480 air line kilometers from both Sacramento and Los Angeles, shop inspection expenses will be sustained by the State which are in addition to expenses incurred for fabrication site inspection. Payment to the Contractor for furnishing structural steel will be reduced $2,000 for each mill located more than 480 air line kilometers from both Sacramento and Los Angeles.

10-1.45 STEEL STRUCTURES (SUBSTATIONS AND SERVICE PLATFORMS)

Construction of steel structures for substations and service platforms, shall conform to the provisions in "Steel Structures" elsewhere in these special provisions and these special provisions.

Steel structures (substations and service platforms) shall include furnishing, fabricating, and erecting the structural steel, construction and removal of the temporary construction, and all work required to complete the steel structures (substations and service platforms).

Steel structures (substations and service platforms) shall consist of the following: major items:

1. Stairway at substations
2. Monorail
3. Service platform structure

PAYMENT

Steel Structures (service platforms) are paid as specified in "Service Platforms," of these special provisions.

Steel Structures (substations) are paid as specified in "Substation Architectural Eastbound, and Substation Architectural Westbound," of these special provisions.

10-1.46 STEEL DECKING (SERVICE PLATFORMS)

Forms for the deck slabs between girders shall be constructed and left in place at those locations shown on the plans in conformance with these special provisions.

Steel decking and accessories shall be formed from steel conforming to the requirements in ASTM Designation: A653/A653M (Designation SS, Grades 33 through 80) having a coating designation G165. The forms shall be mortar-tight, true to line and grade, and of sufficient strength to support the loads applied.

Steel deck units, shall be 0.91 mm thick (20-gage), 38 mm rib height, Type B as manufactured by United Steel Deck, Inc., H.H. Robertson, Inc., Curoco or equal.

Detailed working drawings for decking shall be submitted to the Engineer for approval in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Three sets of drawings shall be submitted. These drawings shall show the grade of steel, the physical and section properties for all deck members, the method of support and grade adjustment, accommodation for skew, and methods of sealing against grout leaks.

Working drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work. Such time shall be proportional to the complexity of the work but in no case shall such time be less than 3 weeks after complete drawings and all support data are submitted.

Physical design properties shall be computed in conformance with the requirements of the AISI specification for the "Design of Cold Formed Steel Structural Members."

The maximum allowable stresses and deflections used in the design of steel forms shall be as follows:

A. Tensile stress shall not exceed 0.725 of the specified yield strength of the material furnished or 250 MPa.

B. Deflection due to dead load shall not exceed 0.0056 of form span or 13 mm whichever is less. In no case shall the dead load for deflection calculations be less than 5750 Pa total.
C. Form camber, used at the option of the Contractor, shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the allowable limits.
D. Design span of the form sheets shall be the clear span of the form plus 50 mm measured parallel to the form flutes.

Permanent steel deck forms shall not be welded to the flanges of girders.

Permanent steel deck forms shall not interfere with the movement at deck expansion joints.

The clearance between the surface of permanent forms and any bar reinforcement shall be not less than 25 mm. The configuration of the forms shall be such that the mass of deck slab is not more than 110 percent of the mass of the total deck slab as dimensioned on the plans.

Steel decking shall be installed in conformance with the approved working drawings.

Welding shall conform to AWS D1.3-80 and "Welding Quality Control" elsewhere in these special provisions.

Unless otherwise noted on the plans, steel deck units shall be fastened to steel framework at the ends of units and at all intermediate supports by 13 mm effective diameter puddle welds spaced not more than 305 mm across the width of the unit. Boundary puddle welds at perimeter supports shall be 13 mm effective diameter spaced not more than 305 mm on center.

Seam attachment or sidelaps of adjacent unit shall be done with 38 mm side seam welds at maximum spacing of 305 mm on center.

Welds shall be cleaned immediately by wire brushing, and shall be coated with galvanizing repair material before being covered by the succeeding sheet.

Form sheets shall not rest directly on the top of the girder flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 25 mm at each end. Form supports shall be placed in direct contact with the flange of the girder. Attachment of supports shall be made by bolts, clips or other approved means.

Transverse deck construction joints will not be allowed.

Permanently exposed galvanized surfaces that are abraded or damaged prior to installation shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 applications of unthinned zinc-rich primer (organic vehicle type) conforming to the provisions in Section 91, "Paint," of the Standard Specifications. Aerosol cans shall not be used. Minor heat discoloration in area of welds need not be repaired.

Full compensation for steel decking (service platforms) shall be considered as included in the contract unit price paid for service platforms and no separate payment/additional compensation will be made/allowed therefor.

10-1.47 METAL FRAMING (SUBSTATIONS)

Metal framing for substations shall consist of furnishing and installing metal framing, including load-bearing and non-bearing steel studs, in accordance with the details shown on the plans and these special provisions.

GENERAL

References

Structural properties of studs and joists shall be computed in accordance with American Iron and Steel Institute (AISI), "Specification for Designing of Cold-Formed Steel Structural Members."

Welding shall be in accordance with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."

Welders shall be qualified in accordance with "Welder Qualification," procedures of AWS D1.1, "Structural Welding Code-Steel."

Loadings

Components shall be sized to withstand the design loads shown on the plans.

Wall system shall be designed to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclical day/night temperature range.

Wall system design shall accommodate construction tolerance, deflection of building structural members, and clearances of intended openings.

SUBMITTALS

Product data

Manufacturer's descriptive data and installation instructions for each item of cold-formed metal framing and accessories shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

Installation instructions shall include instructions for securing studs to tracks and other framing connections.

Where metal framing units are components of assemblies indicated to be fire-rated, provide units which have been approved for the rating indicated on the plans.

Working drawings

Working drawings and calculations for metal framing components not fully dimensioned in manufacturer's descriptive data shall be submitted for approval.

Working drawings shall include framing members showing size and gage designations, number, type, location and spacing. Working drawings shall include supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

The metal framing supplier shall submit drawings and calculations stamped by an engineer who is registered as a Civil or Structural Engineer in the State of California showing that the metal framing and fasteners comply with seismic and wind uplift requirements of the Uniform Building Code as amended by Title 24, Part 2, California Code of Regulations.

The Engineer will require 3 weeks to review the working drawings after a complete set has been received, as determined by the Engineer. Should the Engineer fail to complete his review within the time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in the working drawings review, the delay will be considered a right of way delay as specified in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

PRODUCTS

Load-bearing studs shall be formed to channel shape, punched web, and knurled faces, conforming to ASTM Designation: C 955. Studs shall be 1.21 mm (18-gage) minimum thickness and size as shown on the drawings.

Framing components, 1.21 mm (18-gage) or lighter, shall be fabricated of commercial quality galvanized steel sheets with a minimum yield strength of 228 MPa; conforming to ASTM Designation: A 653M, Grade A.

Track shall be formed steel, channel shape, and same width as studs; solid web; not less than 1.21 mm (18-gage) thickness.

Fasteners shall be hot-dipped galvanized, self-drilling, self-tapping screws, or bolts, nuts and washers.

Anchorages shall be ICBO approved for the purpose intended, integral stud type, powder driven or drilled expansion bolts.

Studs, tracks and headers shall be hot-dipped galvanized to conform to ASTM Designation: A 653M, G60

Miscellaneous parts, including, bracing, furring, plates, gussets, and bridging, shall be hot dipped galvanized to not less than 381 kilograms per square meter.

DELIVERY, STORAGE AND HANDLING

Metal framing components shall be protected from rusting and damage. Components shall be delivered to the jobsite in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Components shall be stored off ground in a dry ventilated space.

FABRICATION

Framing components shall be fabricated in place or prefabricated into panels to the maximum extent possible prior to erection. Panels shall be fabricated plumb, square, true to line and braced against racking with joints welded. Lifting of prefabricated panels shall be performed in a manner to prevent damage or distortion.

Panels shall be fabricated in jig or templates to hold members in proper alignment and position to assure accurate placement.

Components shall be fastened by shop welding, bolting or screw fasteners as shown on the approved drawings.

INSTALLATION

Studs shall be erected plumb, except as needed for diagonal bracing or similar requirements. Channel tracks shall be aligned accurately to the wall layout at both floor and ceiling. Tracks shall be secured to floor and ceiling with fasteners spaced at not more than 406 mm intervals. Fasteners shall be provided at corners and ends of track.

Studs shall extend from floor to underside of ceiling except at wall openings. Each stud shall be secured to tracks at both top and bottom by bolting or screw fastening at both inside and outside flanges. Field welding shall not be permitted. A 12 mm clearance shall be provided at the top shoes. Door openings shall have double studs continuous across head and from floor to ceiling on each jamb.

Studs at openings shall be fastened solidly and securely to floor clips. Floor clips shall be fastened to the floor with 2 anchors unless otherwise shown on the plans.

Supplemental framing, blocking and bracing shall be installed in steel stud system wherever walls or partitions are to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition.

One continuous, horizontal 19 mm channel reinforcement shall be placed approximately 152 mm above all wall openings. The reinforcement shall pass through the web openings in the studs and shall extend through the first stud located beyond the double studs at either side of the opening and shall be saddle tied to each stud it passes through.

PAYMENT

Full compensation for metal framing (substations) shall be considered as included in the contract lump sum prices paid for Substation Architectural Eastbound and Substation Architectural Westbound and no separate payment/additional compensation will be made/allowed therefor.

10-1.48 TRAVELER SUPPORT RAILS

This work shall consist of furnishing and erecting new traveler rails in accordance with the details shown on the plans, the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

The fourth paragraph in Section 55-2.02, "Structural Steel," and the fourth paragraph in Section 55-2.07, "Unidentified Stock Material," of the Standard Specifications shall not apply.

All bolts, nuts and washers, except where these are stainless steel, shall be galvanized in accordance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

Traveler rails shall be galvanized in accordance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

Traveler support rails will be measured and paid for by the kilogram.

The contract price paid per kilogram for traveler support rails shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing the traveler support rails, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.49 TRAVELER SCAFFOLDS

This work shall consist of furnishing, fabricating and installing one under-deck traveler scaffold in accordance with the details shown on the plans and provisions in Section 55, "Steel Structures," Section 57, "Timber Structures," of the Standard Specifications, and these special provisions.

The fourth paragraph in Section 55-2.02, "Structural Steel," and the fourth paragraph in Section 55-2.07, "Unidentified Stock Material," of the Standard Specifications shall not apply.

All bolts, nuts and washers, except where these are stainless steel, shall be galvanized in accordance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

Traveler scaffolds shall be cleaned and painted in accordance with the requirements for of "Clean and Paint Structural Steel," of these special provisions.

Tubular or pipe connections

Dimensional details and workmanship for welded joints in tubular and pipe connections shall conform to the provisions in Part C, Structural Details; Part D, Special Provisions for Welding Tubular Joints; and Part E, Workmanship, in Section 10 of AWS D1.1.

Decking

Plywood panels for decking shall conform to or exceed the requirements of U.S. Product Standard PS-1-9S for APA Structural 1 BB Marine Grade. Plywood shall be pressure treated. Plywood decking shall be painted on all sides.

Toeboards

Toeboards shall be pressure treated S4S Douglas Fir. Toeboards shall be painted on all sides.

Pressure treatment of wood

Pressure treatment shall conform to AWPA Standard C1 to a retention of at least 1.95 kg/m^3.

Hardware

Hardware shall consist of all fasteners, shackles, rope thimble, carriage bolts with attached washer used to attach decking to the steel structure, lag screws or bolts through the toeboards, blind rivets, oil impregnated bronze bars, stainless steel socket set screws, or any other hardware shown on the plans to attach the decking or toeboards to the traveler structure and shall conform to Section 75-1.02, "Miscellaneous Iron and Steel," of the Standard Specifications.

Measurement and Payment

Traveler scaffold will be measured and paid on a lump sum basis.

The contract lump sum price paid for traveler scaffold shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing the traveler scaffold, complete in place, including plywood decking, toeboards, cleaning and painting steel, and hardware, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.50 TRAVELER SCAFFOLD MECHANICAL

GENERAL.--

Traveler scaffold mechanical consists of furnishing, fabricating, and installing the traveler scaffold mechanical equipment, including the on board air lines, in accordance with the details shown on the plans, the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

The fourth paragraph in Section 55-2.07, "Unidentified Stock Material," of the Standard Specifications shall not apply.

Mechanical work shall include furnishing all labor, materials, equipment and services required to provide an operating traveler.

EQUIPMENT

All equipment shall be manufactured from material that is resistant to deterioration or corrosion in a marine environment or shall have a protective coating to provide such resistance. Seals and gasket material shall be suitable for air or non-corrosive gases and shall be resistant to deterioration in a marine environment and to hydrocarbons (air-entrained petroleum or vehicle exhaust).

Miscellaneous bolts, nuts, washers, fasteners, and springs shall be 18-8 stainless steel.

All equipment shall be capable of operating in a temperature range of –6º C to 95º C and shall be rated for operation in a pressure range 170 kPa gauge to 1,000 kPa gauge.

CODES

All work, including equipment, material and installation, shall conform to California Administrative Code, Title 8, Division of Industrial Safety.

SUBMITTALS

In addition to the requirements of "Drawings" of these special provisions, five bound identified copies of complete description, information and performance data covering material and equipment furnished shall be submitted to the Engineer for approval. Installation shall not commence until the Engineer approves the submitted equipment.

Before completion of the project, the Contractor shall submit two sets of operation and maintenance instruction and parts lists for all the equipment furnished.

WARRANTY

Warranties and guarantees.--Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

PRODUCTS

A. **Piston motor driven trolley (motor trolley) -** Piston motor driven trolley shall be Ingersoll Rand series ATE –MR3/6-0, 6 metric tonne capacity with flat tread wheels, 4 wheel drive and shall be installed in accordance with the

details shown on the plans. The drive wheels shall be connected to the air motor by means of a geared speed reducing power train.
Piston motor driven trolleys shall be rated by the manufacturer to have a manned platform rating as follows:

1. Outer trolleys 5.2 metric tonnes (service load) (2.8 metric tonnes Dead load + 2.4 metric tonnes Live load)
2. Inner trolleys 3.0 metric tonnes (service load) (1.5 metric tonnes Dead load + 1.5 metric tonnes Live load)

The manufacturer shall certify that the trolleys are structurally capable of carrying the stated service loads with a factor of safety of at least 5.0 and with any further factor of safety that the manufacturer requires in order to certify the trolleys for this application, recognizing that the platform has a secondary means of support via the brake trolleys which will support ten times total load.

The drive wheels shall be flat tread and be suitable for operation on the lower flange of the 127 mm wide traveler rail and shall provide adequate clearance from the splice plates and jumper assemblies.
The units shall have the "marine grade epoxy finish" option.
The air motor shall be 4 cylinder reversible, radial piston-type having a remote control valve chest. Crank pin and connecting rods shall be drop forged construction. Bearings and shafting shall have dust shields.
Starting, reversing and stopping of the traveler scaffold shall be accomplished by means of a remotely controlled throttle installed as shown on the plans.
The equipment specified is a standard Ingersoll Rand item.

Manufacturer	Distributor
Ingersoll Rand Company	Global Fabricators 8929 Rosedale Hwy. Bakersfield, CA 93312 Telephone: (661) 589-2774 Fax: (661) 589-7504 Contact: Russ Wilson

The price quoted by the manufacturer for the piston motor-driven trolley, FOB Cerritos, California and without load certification, is $12,500. Bidders are to verify the price.
The above price is understood to be firm for all orders placed on or before June 1, 2001, provided delivery is accepted within 90 days after the order is placed.

B. **Brake trolley -** Brake trolley shall be as shown on the plans. Brake trolleys shall have ductile iron or surface hardened steel wheels with flat treads and shall be equipped with thrust ball or roller bearings in hardened races and with dust seals. Trolley wheels shall be suitable for operation on the lower flange of the traveler rails. Trolley wheels shall be rated for a working load of 1360 kg each.
Brake trolley shall have a marine grade epoxy finish.

C. **Safety parking brake -** The brakes shall be spring-actuated to set the brake full stop. Brake release shall be by air pressure.
The brakes chamber shall conform to the details shown on the plans.
The position of the fabric-lined brake shoe shall be controlled by means of an operating cylinder having a bore of approximately 152 mm diameter and a single acting spring loaded piston. Stroke shall be 50 mm minimum.
The brake shall be rated at 360 kg clamping force at 50 mm and 900 kg at 0 mm stroke. The brake shall set at 25 mm stroke. Brakes shall release to 0 mm stroke under 480 kPa air pressure.
Brake shoe shall provide a minimum holding capacity of 2.7 kN.
Under a condition of zero gauge air pressure, the safety parking brake shall be in the "on" position preventing movement of the travelers.
The manufacturer of the safety parking brake shall furnish quick release valves.

D. **Foot-operated poppet valve. -** The foot-operated poppet valve shall be a 3-way foot-operated, spring return, normally closed poppet valve. The valve shall have a bronze body and NPT National Pipe Thread ports and shall be suitable for 235 L/s at 860 kPa gauge minimum working pressure. Downstream side shall be at atmosphere when "off."

E. **Throttle control valve -** The throttle remote control valve shall be a lever operated disc or rotor type. Valve shall have mechanite body and National Pipe Thread ports and, when supplied with 690 kPa gauge inlet air, the valve shall be rated for a flow capacity of 120 L/s. Valve shall be suitable for 860 kPa minimum working pressure.

F. **Compressed air piping -** Piping for air lines on the traveler shall be rigid pipe of the nominal size shown on the plans with flexible hose for no more than 750 mm connecting to the brakes and motors.

G. **Ball valve -** Ball valves shall be Class 400 bronze body with bronze trim and threaded ends.

H. **Whistle -** Whistles shall be 38 mm bell diameter and produce 100 dB tone minimum at 690 kPa supplied air pressure.

I. **Whistle valve -** Whistle valve shall be a poppet valve, 2-way lever operated, normally closed type. The valve shall have brass steel body and NPT National Pipe Thread ports and, when supplied with 690 kPa gauge inlet air, the valve shall be rated for a flow capacity of 42 L/s, and shall be suitable for 1,000 kPa gauge minimum working pressure.

J. **Hose -** Hose shall have a rubber core, 2 synthetic body plies and a weather and abrasion resistant cove. Hose shall have a minimum working pressure of 2,000 kPa. All clamps, couplings, and other hardware used in conjunction with the hose shall be mode of stainless steel and shall be rated for 2,000 kPa.

K. **Quick coupling -** Quick coupling shall be claw type, bronze body, with neoprene gasket. NPS threaded ends for pipe, and barb end for hose.

L **Pressure regulator assembly -** Pressure regulator assembly shall be combination type, with 50 micron filter element rating, automatic drain and plastic bowl, 0 kPa to 1,000 kPa pressure regulator with pressure gauge, and 500 ml lubricator. The filter and lubricator elements shall be similar in size and appearance and shall be supplied by the same manufacturer. A manual drain shall be supplied at the low point of the oil storage bowl. Port sizes for both elements shall be the line size.

M. **Pressure gages -** Pressure gages shall be included and shall be 50 mm dial type, Grade A, and National Pipe Thread back ported. Pressure gages shall have a range of 0 kPa to 1,350 kPa.

E. **Double check valve -** Double check valve shall be bronze body, NPT 3/8 inlets and NPT 1/2 outlet with a stainless steel ball. The valve shall be rated for 860 kPa minimum and shall be of the type used for truck braking systems.

F.

G. **Compressed air piping –** Piping for on board air lines shall be Schedule 40 galvanized steel pipe conforming to ASTM Designation: A 53, Type S, Grade B. Fittings shall be extra heavy type, galvanized steel or malleable iron.

GENERAL

A. **Operation –** When the distribution piping is connected to the bridge air system (620 kPa gauge) a single operator shall be able to operate the traveler by depressing the foot valve and moving the two hand throttles from the neutral position. The following shall be the sequence of operation:

1. The foot-operated poppet valve is depressed.
2. Air is transmitted to release the brake and provide air to the throttle valves.
3. The hand controls of the throttle valves are moved to the desired port alignment to allow air flow to the motors.
4. When the throttle and control handle is returned to the neutral position air supply to the motors is cut off and the motors stop.
5. When the foot valve is released, air to the brake and throttle valve is cut off, causing the spring-loaded brake to set and the throttle valve to become inoperative. The foot valve is a dead man safety control which causes the brake to set whenever the pedal is released.

TESTING AND ADJUSTING SYSTEMS

Pre-test requirements - Before starting or operating systems, the Contractor shall flush and clean equipment and check for proper installation, lubrication and servicing.

General requirements - The Contractor shall test and start up mechanical systems upon project completion as hereinafter specified.

The Contractor shall follow the equipment manufacturer's break-in procedure before full load testing for all equipment.

Final adjustments and balancing of the systems shall be performed so they will operate as specified.

The Contractor shall replace or revise any equipment, systems or work found deficient during tests.

Particular care shall be used in lubricating bearings to avoid damage by overfilling with lubricant and blowing out seals.

The Contractor shall repair, or replace with new equipment, any equipment damaged during shipment, after delivery, during installation and during testing.

The Contractor shall perform tests after installing the hoses to insure the lines are airtight. The test shall be conducted for a period of one hour at the design pressure. Defective work shall be repaired at the Contractor's expense.

Project completion tests - The Engineer shall be notified at least 3 calendar days in advance of starting these tests.

Upon completion of mechanical work and pre-test requirements, or at such time prior to completion as determined by the Engineer, the Contractor shall operate and test the installed mechanical systems for at least one 8 hour day to demonstrate satisfactory overall operation. Traveler shall cross at least one expansion joint in each direction during this test.

The Contractor shall furnish, install and remove all apparatus necessary for performing the tests.

MARINE GRADE EPOXY FINISH

Marine grade epoxy finish shall conform to the requirements of these special provisions.

Surfaces to be coated with marine grade epoxy shall be blast cleaned in accordance with the requirements in Section 59-2.03 "Blast Cleaning," of the Standard Specifications.

Marine grade epoxy shall be applied to two coats. The dry film thickness of the each coat shall not be less than 100 microns minimum nor more than 150 microns maximum.

The final coat color shall match Federal Standard No. 595B, No. 13432.

The target minimum total dry film thickness shall be 200 microns for smooth surfaces without major surface discontinuities. The target minimum total dry film thickness shall be 300 microns for mating surfaces.

WEIGHING OF SCAFFOLDS

Each traveler scaffold shall be weighed prior to installation on the bridge, with the method of weighing subject to approval by the Engineer. The weights for each traveler shall be taken and recorded at each trolley support; the total weight will be the sum of those individual weights.

MEASUREMENT AND PAYMENT

Traveler scaffold mechanical will be measured and paid on a lump sum basis.

The contract lump sum price paid for traveler scaffold mechanical shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing the traveler scaffold mechanical system, complete in place, including testing and weighing the traveler scaffolds, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.51 SIGN STRUCTURES

Sign structures and foundations for overhead signs shall conform to the provisions in Section 56-1, "Overhead Sign Structures," of the Standard Specifications and these special provisions.

Before commencing fabrication of sign structures, the Contractor shall submit 2 sets of working drawings to the Engineer in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings." The working drawings shall include sign panel dimensions, span lengths, post heights, anchorage layouts, proposed splice locations, a snugging and tensioning pattern for anchor bolts and high strength bolted connections, and details for permanent steel anchor bolt templates. The working drawings shall be supplemented with a written quality control program that includes methods, equipment, and personnel necessary to satisfy the requirements specified herein and in the special provisions.

Working drawings shall be 559 mm x 864 mm or 279 mm x 432 mm in size and each drawing and calculation sheet shall include the State assigned designations for the contract number, sign structure type and reference as shown on the contract plans, District-County-Route-Kilometer Post, and contract number.

The Engineer shall have 30 working days to review the sign structure working drawings after a complete submittal has been received. No fabrication or installation of sign structures shall be performed until the working drawings are approved in writing by the Engineer.

Should the Engineer fail to complete the review within the time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the sign structure working drawings, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays."

The third paragraph of Section 56-1.01, "Description," of the Standard Specifications shall not apply.

Section 56-1.02, "Bars, Plates and Shapes," of the Standard Specifications is amended by the addition of the following:

Pentagon pole sign structures structural materials shall be in conformance with the following:

Tapered steel post and base plate	ASTM Designation A 709, Grade 50
Hollow structural section	ASTM Designation A 500, Grade B
Materials not otherwise indicated	ASTM Designation A 709, Grade 36

A permanent steel template shall be used to maintain the proper anchor bolt spacing.

One top nut, one leveling nut, and 2 washers shall be provided for the upper threaded portion of each anchor bolt.

Surfaces of base plates which are to come in contact with concrete, grout, or washers and leveling nuts shall be flat to within 3 mm tolerance in 305 mm, and to within 5 mm tolerance overall. Faying surfaces of plates in high-strength bolted connections including flange surfaces of field splices, chord joints, and frame junctures, and contact surfaces of plates used for breakaway slip base assemblies shall be flat to within 2 mm tolerance in 305 mm, and within 3 mm tolerance overall.

Thermally cut holes made in tubular members of sign supports, other than holes in base and flange plates, shall initially be made a minimum of 2 mm undersized, and then be mechanically enlarged by reaming or grinding to the final required size and shape. All edges shall have a surface roughness of not greater than 6.35 μm. Round holes may be drilled to the exact final diameter. No holes shall be made in members unless the holes are shown on the plans or are approved in writing by the Engineer.

The sixth through the thirteenth paragraphs in Section 56-1.03, "Fabrication," of the Standard Specifications are amended to read:

- High-strength bolted connections, where shown on the plans, shall conform to the provisions in Section 55-3.14, "Bolted Connections," except that only fastener assemblies consisting of a high-strength bolt, nut, hardened washer and direct tension indicator shall be used.
- High-strength fastener assemblies, and any other bolts, nuts, and washers attached to sign structures shall be zinc-coated by the mechanical deposition process.
- An alternating snugging and tensioning pattern for anchor bolts and high-strength bolted splices shall be used. Once tensioned, high-strength fastener components and direct tension indicators shall not be reused.
- For bolt diameters less than 10 mm, the diameter of the bolt hole shall be not more than 0.80-mm larger than the nominal bolt diameter. For bolt diameters greater than or equal to 10 mm, the diameter of the bolt hole shall be not more than 1.6 mm larger than the nominal bolt diameter.
- Sign structures shall be fabricated into the largest practical sections prior to galvanizing.
- Sheet metal for enclosing the pentagon pole sign mounting structure shall be flat, hot-rolled sheets, that are in conformance with ASTM Designation: A 570, Grade 33, galvanized after fabrication.
- Ribbed sheet metal panels for box beam closed truss sign structures shall be fastened to the truss members by cap screws or bolts as shown on the plans, or by 4.76 mm stainless steel blind rivets conforming to Industrial Fasteners Institute, Standard IFI-114, Grade 51. The outside diameter of the large flange rivet head shall be not less than 15.88 mm in diameter. Web splices in ribbed sheet metal panels may be made with similar type blind rivets of a size suitable for the thickness of material being connected.
- Spalling or chipping of concrete structures shall be repaired by the Contractor at the Contractor's expense.
- Overhead sign supports shall have an aluminum identification plate permanently attached near the base, adjacent to the traffic side on one of the vertical posts, using either stainless steel rivets or stainless steel screws. As a minimum, the information on the plate shall include the name of the manufacturer, the date of manufacture and the contract number.

Steel members used for overhead sign structures shall receive nondestructive testing (NDT) in conformance with AWS D1.1 and the following:

A.

Weld Location	Weld Type	Minimum Required NDT
Welds for butt joint welds in tubular sections, nontubular sections, and posts	CJP groove weld with backing ring	100% UT or RT
Longitudinal seam welds*	PJP groove weld	25% MT
	CJP groove weld	100% UT or RT
Welds for base plate, flange plate, or end cap to post or mast arm	CJP groove weld	25% UT or RT
	Fillet weld	25% MT
* Longitudinal seam welds shall have 60% minimum penetration, except that within 150 mm of any circumferential weld, longitudinal seam welds shall be CJP groove welds.		

B. A written procedure approved by the engineer shall be used when performing UT on material less than 8 mm thick. Contoured shoes shall be used when performing UT on round tubular sections under 1270 mm in diameter.

C. When less than 100 percent of a weld is specified for NDT, and if defects are found during this inspection, additional NDT shall be performed. This additional NDT shall be performed on 25 percent of the total weld for all similar welds, as determined by the Engineer, produced for sign structures in the project. If any portion of the additional weld inspected is found defective, 100 percent of all similar welds produced for sign structures in the project, as determined by the Engineer, shall be tested.

Circumferential welds and base plate to post welds may be repaired only one time without written permission from the Engineer.

Structure mounted signs shall not be installed until the supporting concrete structure has attained the specified compressive strength in conformance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications, except that corbels for mounting signs will not be accepted if any test result is less than the specified compressive strength.

After each structure mounted sign post is in place and accepted, mortar shall be placed under the base plate as shown on the plans. The exposed portion of the mortar shall be formed to present a neat appearance. Mortar shall consist of one part by volume of portland cement and 3 parts of clean sand, shall contain only sufficient moisture to permit packing and shall be cured by keeping it damp for not less than three days.

Full compensation for furnishing anchor bolt templates and for testing of welds shall be considered as included in the contract price paid per kilogram for furnish sign structure and no additional compensation will be allowed therefor.

10-1.52 ROADSIDE SIGNS

Roadside signs shall be installed at the locations shown on the plans or where designated by the Engineer and in conformance with the provisions in Section 56-2, "Roadside Signs," of the Standard Specifications.

10-1.53 CLEAN AND PAINT STRUCTURAL STEEL

Exposed new metal surfaces, except where galvanized, shall be cleaned and painted in conformance with the provisions in Section 59-2, "Painting Structural Steel," and Section 91, "Paint," of the Standard Specifications and these special provisions.

Whenever the Standard Specifications refer to "Steel Structures Painting Council," the reference shall be replaced with "SSPC: The Society for Protective Coatings."

The Contractor shall provide suitable enclosures to permit cleaning and painting during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures with limits suitable for cleaning throughout the cleaning operation, painting throughout the painting operation, and for the drying period in accordance with ASTM Designation: D 1640. Full compensation for providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring paint and no additional compensation will be allowed therefor.

No extension of contract time will be granted and no additional compensation will be allowed as a result of temperature or humidity which exceeds the limits for cleaning or painting designated herein, except as approved by the Engineer.

APPLICATION

Fresh water shall be used for water rinsing operations. Water from water rinsing operations shall not be permitted to fall into the bay, or on public traffic, to flow across shoulders or lanes occupied by public traffic, or to flow into gutter or other drainage facilities.

Section 59-2.01, "General," of the Standard Specifications is amended by adding the following paragraphs after the first paragraph:

- Unless otherwise specified, no painting Contractors or subcontractors will be permitted to commence work without having the following current "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council) certifications in good standing:

A. For cleaning and painting structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (SSPC-QP 1).
B. For removing paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure For Evaluating Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)" (SSPC-QP 2).
C. For cleaning and painting structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3). The AISC's Sophisticated Paint Endorsement (SPE) quality program will be considered equivalent to SSPC-QP 3.

Prior to performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in "Working Drawings," of these special provisions, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

A. The name of each Contractor or subcontractor to be used.
B. One copy each of all current "SSPC: The Society for Protective Coatings" specifications or qualification procedures which are applicable to the painting or paint removal to be performed. These documents shall become the permanent property of the Department.
C. Proposed methods and equipment to be used for any paint application.
D. Proof of each of any required certifications, SSPC-QP 1, SSPC-QP 2, SSPC-QP 3.

The Engineer shall have 10 working days to review the PQWP submittal after a complete plan has been received. No painting or paint removal shall be performed until the PQWP for that work is reviewed by the Engineer.

It is expressly understood that the Engineer's review of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's review shall not constitute a waiver of any of the requirements of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding review of the PQWP.

CLEANING

Exposed new metal surfaces shall be dry blast cleaned in conformance with the requirements in Surface Preparation Specification No. 10, "Near White Blast Cleaning," of the "SSPC: The Society for Protective Coatings." Blast cleaning shall leave surfaces with a dense, uniform, angular anchor pattern of not less than 40 µm nor more than 86 µm as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel shall conform to the requirements in Abrasive Specification No. 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings" and shall not contain hazardous material. Mineral and slag abrasives shall comply with the requirements for Class A, Grade 2 to 3 as defined therein.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications and a Material Safety Data Sheet shall be furnished prior to use for each shipment of blast cleaning material for steel.

The inside surfaces of bolt holes shall be cleaned in conformance with the requirements in Surface Preparation Specification No. 1, "Solvent Cleaning," of the "SSPC: The Society for Protective Coatings," and visible rust shall be removed.

PAINTING

Blast cleaned surfaces shall receive a single undercoat and, unless otherwise specified, a minimum of 2 finish coats of an exterior grade latex paint supplied by the manufacturer of the inorganic zinc coating.

The single undercoat shall consist of a waterborne inorganic zinc coating conforming to the requirements in AASHTO Designation: M 300, Type II, except that: 1) the first 3 sentences of Section 4.7, "Primer Field Performance Requirements," and the entire Section 4.7.1 shall not apply, and 2) zinc dust shall be Type II in conformance with the requirements in ASTM Designation: D 520. The inorganic zinc coating shall be listed on the qualified products list which may be obtained from the Transportation Laboratory.

The inside surfaces of bolt holes shall be painted with one application of a zinc-rich primer (organic vehicle type) after the application of the undercoat of inorganic zinc on adjacent steel. Finish coats are not required for the inside surfaces of bolt holes.

Inorganic zinc coating shall be used within 12 hours of initial mixing.

Application of inorganic zinc coating shall conform to the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications.

Inorganic zinc coating shall not be applied when the atmospheric or surface temperature is less than 7°C nor more than 29°C, nor when the relative humidity exceeds 85 percent.

The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 4 hours after blast cleaning.

The total dry film thickness of all applications of the inorganic zinc undercoat, including the surfaces of outside existing members within the grip under bolt heads, nuts and washers, shall be not less than 100 µm nor more than 200 µm, except that the total dry film thickness on each faying (contact) surface of high strength bolted connections shall be between 25 µm and the maximum allowable dry film thickness for Class B coatings as determined by certified testing in conformance with Appendix A of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" of the Research Council on Structural Connections (RCSC Specification). Unless otherwise stated, all inorganic zinc coatings used on faying surfaces shall meet the slip coefficient requirements for a Class B coating on blast-cleaned steel, as specified in the RCSC Specification. The Contractor shall provide results of certified testing showing the maximum allowable dry film thickness for the Class B coating from the qualifying tests for the coating he has chosen, and shall maintain the coating thickness on actual faying surfaces of the structure at or below this maximum allowable coating thickness.

Areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted with inorganic zinc coating to the specified thickness.

Dry spray, or overspray, as defined in the Steel Structures Painting Manual, Volume 1, "Good Painting Practice," of the "SSPC: The Society for Protective Coatings," shall be removed prior to application of subsequent coats or final acceptance. Removal of dry spray shall be by screening or other methods that minimize polishing of the inorganic zinc surface. The dry film thickness of the coating after removal of dry spray shall be in conformance with the provisions for applying the single undercoat, as specified herein.

The inorganic zinc coating will be tested for adhesion and cure by the Engineer. The locations of the tests will be determined by the Engineer. The sequence of the rinsing and testing operations shall be determined by the Contractor. The testing for adhesion and cure will be performed no sooner than 72 hours after application of the single undercoat of inorganic zinc coating. Satisfactory access shall be provided to allow the Engineer to determine the location of the tests and to test the inorganic zinc coating cure. The inorganic zinc coating shall pass the following tests:

Adhesion

- The inorganic zinc coating shall have a minimum adhesion to steel of 4 MPa when measured at no more than 6 locations per span on each girder using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Contractor, shall: (1) verify compliance with the adhesion requirements, (2) furnish test results to the Engineer, and (3) repair the coating after testing.

Cure

- The inorganic zinc coating, when properly cured, shall exhibit a solid, hard, and polished metal surface when firmly scraped with the knurled edge of a quarter. Inorganic zinc coating that is powdery, soft, or does not exhibit a polished metal surface, as determined by the Engineer, shall be repaired by the Contractor, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.
- The surface pH of the inorganic zinc primer shall be checked in conformance with ASTM Designation: D4262 by wetting the surface with deionized water and applying pH paper with a capability of measuring in increments of 0.5 pH units. Application of finish coats will not be permitted until the surface pH is less than 8.

Except as approved by the Engineer, a minimum curing time of 72 hours shall be allowed between application of inorganic zinc coating and water rinsing.

Exposed area of inorganic zinc coating, where finish coats are specified,shall be water rinsed in conformance with the requirements in Section 59-1.03, "Application," of the Standard Specifications. Areas of the coating that are removed by the

water rinsing shall be reapplied in conformance with the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications and these special provisions.

The exterior surfaces of undercoated areas and bolts, visible in the finished work, of the orthotropic box girder, steel barrier, bike path, and bike path cantilever beam, with the exception of riding surfaces, shall receive a minimum of 2 finish coats of an exterior grade latex paint supplied by the manufacturer of the inorganic zinc coating.

The first finish coat shall be applied within 48 hours following the water rinsing.

The finish coat paint shall be formulated for application to inorganic zinc coating and shall conform to the following:

A.

Property	Value	ASTM Designation
Pigment content, percent	24 max.	D 3723
Nonvolatile content, mass percent	49 min.	D 2369
Viscosity, KU	75 min. to 90 max.	D 562
Fineness of dispersion, Hegman	6 min.	D 1210
Drying time at 25°C, 50% RH, 100-µm wet film Set to touch, minutes Dry through, hours	 30 max. 1 max.	D 1640
Adhesion	4A	D 3359, Procedure A

B. No visible color change in the finish coats shall occur when tested in conformance with the requirements in ASTM Designation: G 53 using FS 40 UV-B bulbs for a minimum of 38 cycles. The cycle shall be 4 hours of ultraviolet (UV) exposure at 60°C and 4 hours of condensate exposure at 40°C.

C. The vehicle shall be an acrylic or modified acrylic copolymer with a minimum of necessary additives.

The first finish coat shall be applied in 2 applications. The first application shall consist of a spray applied mist application. The second application shall be applied after the mist application has dried to a set to touch condition as determined by the procedure described in Section 7 of ASTM Designation: D1640. The first finish coat color shall match Federal Standard 595B No. 36628. The total dry film thickness of both applications of the first finish coat shall be not less than 50 µm.

Except as approved by the Engineer, a minimum drying time of 12 hours shall be allowed between finish coats.

The second finish coat color shall match Federal Standard 595B, No. 26408. The total dry film thickness of the applications of the second finish coat shall be not less than 50 µm.

The 2 finish coats shall be applied in 3 or more applications to a total dry film thickness of not less than 100 µm nor more than 200 µm.

The total dry film thickness of all applications of inorganic zinc coating and finish coat paint shall be not less than 200 µm nor more than 350 µm.

PAYMENT

Payment for clean and paint structural steel shall conform to the provisions in Section 59-2.16, "Payment," of the Standard Specifications and these special provisions.

Cleaning and painting structural steel, of the types listed in the Engineer's Estimate, will be paid for on the basis of lump sum prices.

Full compensation for water rinsing and conforming to the requirements for adhesion and cure, including providing access for testing and repairing painted surfaces, shall be considered as included in the contract lump sum price paid for clean and paint structural steel and no additional compensation will be allowed therefor.

10-1.54 CLEAN AND PAINT STRUCTURAL STEEL (MODULAR JOINT SEAL ASSEMBLY)

Exposed new metal surfaces of modular joint seal assembly, except where galvanized, shall be cleaned and painted in conformance with the provisions in Section 59-2, "Painting Structural Steel," and Section 91, "Paint," of the Standard Specifications and these special provisions.

Whenever the Standard Specifications refer to "Steel Structures Painting Council," the reference shall be replaced with "SSPC: The Society for Protective Coatings."

Section 59-2.01, "General," of the Standard Specifications is amended by adding the following paragraphs after the first paragraph:

- Unless otherwise specified, no painting Contractors or subcontractors will be permitted to commence work without having the following current "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council) certifications in good standing:

A. For cleaning and painting structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (SSPC-QP 1).
B. For removing paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure For Evaluating Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)" (SSPC-QP 2).
C. For cleaning and painting structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3). The AISC's Sophisticated Paint Endorsement (SPE) quality program will be considered equivalent to SSPC-QP 3.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for modular joint seal assemblies.

Prior to performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in Section "Working Drawings," elsewhere in these special provisions, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

A. The name of each Contractor or subcontractor to be used.
B. Proposed methods and equipment to be used for any paint application.

The Engineer shall have 10 working days to review the PQWP submittal after a complete plan has been received. No painting or paint removal shall be performed until the PQWP for that work is reviewed by the Engineer. Should the Engineer fail to complete the review within this time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the PQWP, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

It is expressly understood that the Engineer's review of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's review shall not constitute a waiver of any of the requirements of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding review of the PQWP.

CLEANING

Exposed new metal surfaces shall be dry blast cleaned in conformance with the requirements in Surface Preparation Specification No. 10, "Near White Blast Cleaning," of the "SSPC: The Society for Protective Coatings." Blast cleaning shall leave surfaces with a dense, uniform, angular anchor pattern of not less than 40 µm nor more than 86 µm as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel shall conform to the requirements in Abrasive Specification No. 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings" and shall not contain hazardous material. Mineral and slag abrasives shall comply with the requirements for Class A, Grade 2 to 3 as defined therein.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications and a Material Safety Data Sheet shall be furnished prior to use for each shipment of blast cleaning material for steel.

PAINTING

Blast cleaned surfaces shall receive a single undercoat, and a final coat where specified, consisting of a waterborne inorganic zinc coating conforming to the requirements in AASHTO Designation M 300, Type II, except that: 1) the first 3 sentences of Section 4.7, "Primer Field Performance Requirements," and the entire Section 4.7.1 shall not apply, and 2) zinc dust shall be Type II in conformance with the requirements in ASTM Designation: D 520. The inorganic zinc coating shall be listed on the qualified products list which may be obtained from the Transportation Laboratory.

The color of the final application of inorganic zinc coating shall match Federal Standard 595B No. 36373.

Inorganic zinc coating shall be used within 12 hours of initial mixing.

Application of inorganic zinc coating shall conform to the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications.

Inorganic zinc coating shall not be applied when the atmospheric or surface temperature is less than 7°C or more than 29°C, nor when the relative humidity exceeds 85 percent.

The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 4 hours after blast cleaning.

The total dry film thickness of all applications of the inorganic zinc undercoat, including the surfaces of outside existing members within the grip under bolt heads, nuts and washers, shall be not less than 100 µm nor more than 200 µm, except that the total dry film thickness on each faying (contact) surface of high strength bolted connections shall be between 25 µm and the maximum allowable dry film thickness for Class B coatings as determined by certified testing in conformance with Appendix A of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" of the Research Council on Structural Connections (RCSC Specification). Unless otherwise stated, all inorganic zinc coatings used on faying surfaces shall meet the slip coefficient requirements for a Class B coating on blast-cleaned steel, as specified in the RCSC Specification. The Contractor shall provide results of certified testing showing the maximum allowable dry film thickness for the Class B coating from the qualifying tests for the coating he has chosen, and shall maintain the coating thickness on actual faying surfaces of the structure at or below this maximum allowable coating thickness.

Areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted with inorganic zinc coating to the specified thickness.

Dry spray, or overspray, as defined in the Steel Structures Painting Manual, Volume 1, "Good Painting Practice," of the "SSPC: The Society for Protective Coatings," shall be removed prior to application of subsequent coats or final acceptance. Removal of dry spray shall be by screening or other methods that minimize polishing of the inorganic zinc surface. The dry film thickness of the coating after removal of dry spray shall be in conformance with the provisions for applying the single undercoat, as specified herein.

The inorganic zinc coating shall be tested for adhesion and cure. The locations of the tests will be determined by the Engineer. The sequence of the testing operations shall be determined by the Contractor. The testing for adhesion and cure will be performed no sooner than 72 hours after application of the single undercoat of inorganic zinc coating. At the Contractor's expense, satisfactory access shall be provided to allow the Engineer to determine the location of the tests and to test the inorganic zinc coating cure. The inorganic zinc coating shall pass the following tests:

Adhesion

- The inorganic zinc coating shall have a minimum adhesion to steel of 4 MPa when measured at no more than 6 locations per span on each girder using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Contractor, at the Contractor's expense, shall: (1) verify compliance with the adhesion requirements, (2) furnish test results to the Engineer, and (3) repair the coating after testing.

Cure

- The inorganic zinc coating, when properly cured, shall exhibit a solid, hard, and polished metal surface when firmly scraped with the knurled edge of a quarter. Inorganic zinc coating that is powdery, soft, or does not exhibit a polished metal surface, as determined by the Engineer, shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

The final coat of inorganic zinc coating shall be applied after testing for adhesion, testing for cure, and completion of all operations that may damage or discolor the steel surface, including correction of runs, sags, thin and excessively thick areas in the paint film, skips and holidays, dry spray, or areas of non-uniform appearance.

The area to receive the final coat of inorganic zinc coating shall be lightly roughened by abrasive blasting using an abrasive no larger than 600 µm. Abrasive blasting shall remove no more than 15 µm of inorganic zinc. The surface to be lightly roughened shall be free from moisture, dust, grease or deleterious material. The undercoated areas of the under surfaces of bottom flanges shall be protected from abrasive blast cleaning operations.

The final coat of inorganic zinc coating shall be applied to the required dry film thickness in one uniform application within 24 hours after light roughening. The dry film thickness of the final coat shall be not less than 25 µm nor more than 75 µm.

Except at bolted connections, the total dry film thickness of all applications of the single undercoat and final coat of inorganic zinc coating shall be not less than 125 µm nor more than 275 µm.

Finish coats will not be required on modular joint seal assemblies.

Full compensation for clean and paint structural steel (modular joint seal assembly) shall be considered as included in the contract price paid per meter for modular joint seal assemblies of types and locations listed in the Engineer's Estimate and no separate payment will be made therefor.

10-1.55 MISCELLANEOUS METAL (BRIDGE)

Miscellaneous metal (bridge) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Attention is directed to "Welding" of these special provisions.

Miscellaneous metal (bridge) shall consist of the miscellaneous bridge metal items listed in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications, and the following:

A. Access doors and covers at all piers
B. Stairs at piers
C. Ladders at piers
D. Fender boarding ladders
E. High strength rods at fenders

Self-tapping screws used for sleeve connections shall be hex-head stainless steel, installed in holes drilled to fit the self-tapping screws, conforming to the requirements of ASTM Designation: A 276, Type 316.

At the Contractor's option, fiberglass pipes and fittings with the same diameter and minimum bend radius as those shown on the plans, may be substituted for welded steel pipe in deck drain systems.

Fiberglass pipe and fittings shall conform to the requirements in ASTM Designation: D 2996, and shall have a minimum short-term rupture strength of 207 MPa. The adhesive type recommended by the manufacturer shall be used for joining pipe and fittings. Fiberglass pipe not enclosed in a box girder cell or encased in concrete shall be manufactured from ultraviolet-resistant resin pigmented with concrete-gray color, or be coated with a concrete-gray resin-rich exterior coating. Paint shall not be used. Fiberglass pipe treated with ultraviolet protection shall withstand a minimum of 2500 hours of accelerated weathering when tested in conformance with the requirements in ASTM Designation: G 154. Lamps shall be UV-B (313 nm wavelength). The resting cycle shall be 4 hours of ultraviolet (UV) exposure at 60°C, and then 4 hour of condensate exposure at 50°C. After testing, the surface of the pipe shall exhibit no fiber exposure, crazing, or checking, and only a slight chalking or color change.

Support spacing for fiberglass pipe shall be the same as shown on the plans for welded steel pipe. Pipe supports shall have a width of not less than 38 mm.

A Certificate of Compliance for fiberglass pipe and fittings shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall include all laboratory test results conforming to the provisions specified herein.

For drainage piping NPS 8 or smaller, which is: (1) enclosed in a box girder cell and exposed for a length not greater than 6 m within the cell, or (2) encased in concrete, the Contractor shall have the option of substituting polyvinyl chloride (PVC) plastic pipe and fittings, with the same diameter and minimum bend radius as shown on the plans, for welded steel pipe.

The PVC plastic pipe and fittings shall be Schedule 40 conforming to the requirements of ASTM Designations: D 1785. The maximum support spacing for PVC plastic pipe shall be 2 m.

Couplings used to connect PVC plastic pipe or fiberglass pipe to steel shall be threaded or flanged. The sleeve connections shown on the plans shall not be used for either PVC plastic pipe or fiberglass pipe.

If PVC plastic pipe or fiberglass pipe is substituted for welded steel pipe, the quantity of drainage piping will be computed on the basis of the dimensions and details shown on the plans, and no change in the quantities to be paid for will be made because of the use of PVC plastic pipe or fiberglass pipe.

Cast-in-place inserts shall be the ferrule loop type.

Metal parts of concrete anchorage devices shall be fabricated from stainless steel conforming to the requirements of ASTM Designation: A 276, Type 316.

10-1.56 BRIDGE DECK DRAINAGE SYSTEM

This work shall consist of furnishing and installing bridge deck drainage system as shown on the plans, in accordance with the provisions in Section 75, "Miscellaneous Metal," and Section 59, "Painting," of the Standard Specifications, and these special provisions.

Attention is directed to "Welding" of these special provisions.

Scuppers shall be fabricated steel scuppers as shown on the plans.

All welds for scupper assembly shall be complete penetration groove welds unless otherwise directed by the Engineer

After galvanization of the scupper, all inside surfaces shall be coated with bridge deck membrane waterproofing.

Inlet gratings shall be ductile iron castings. The bearing surface of the inlet gratings shall be machined so that the grating has a full and even bearing on the scupper, and shall fit into the scupper without rocking.

Pipe and pipe fittings, such as elbows and tees, shall be ductile iron and shall conform to the requirements of ASTM Designation: A-377M (ANSI 21.51). All pipe and pipe fittings shall be groove cut around the full pipe circumference at

both ends. The grooves shall be radius cut in accordance with AWWA C606. The grooves shall be such that a keyed housing clamp coupling shall fit into them. All joints in the pipe shall be made with groove type couplings. All pipe bends (elbows) shall be of the long radius type.

Couplings for joining pipe to pipe, pipe to fitting, or fitting to fitting, shall be ductile iron and shall conform to the requirements of ASTM Designation: A536. All couplings shall be gasketed, double keyed, housing clamps designed to lock and seal the joint between two grooved pipes, or fittings, when the housing clamp is bolted and tightened in place. The gasket shall be a molded or extruded compound of Butyl or EDPM, suitable for water service.

Hoppers shall be fabricated from steel plates.

Pipe brackets and supports shall conform to the requirements of ASTM Designation: A-575, Grade 1015 and 1020. Supports for horizontal piping shall be spaced at 1500 mm maximum. Supports for vertical piping shall be spaced 1750 mm maximum. Anchors shall meet or exceed the requirement of US government, GSA Specification No. FS-S-325 Group I, Type I, Class I. Nuts and bolts shall conform to the requirements of ASTM Designation: A307.

Prior to acceptance of the downspout system, the system shall be flushed out and tested to insure that it is flowing at full capacity. Any obstruction in the downspout system preventing the free flow of drainage or its operation at full capacity shall be removed.

All metallic portions of the downspout system shall be painted in the field in accordance with the provisions in Section 59-3, "Painting Galvanized Surfaces," of the Standard Specifications.

MEASUREMENT AND PAYMENT.—Bridge deck drainage system will be measured and paid for as lump sum.

The contract price paid lump sum for bridge deck drainage system shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing bridge deck drainage system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.57 MISCELLANEOUS METAL (SUBSTATION, SERVICE PLATFORMS, AND WALKWAYS)

Miscellaneous metal (substation, service platforms and walkways) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Attention is directed to "Welding" of these special provisions.

Miscellaneous metal (substation, service platforms and walkways) shall consist of the following:

A. Gratings
B. Checkered Plates
C. Guardrails
D. Railings
E. Handrails
F. Ladders
G. Hatchcovers
H. Hinged covers
I. Steel rope railing and posts
J. Framing at pier table
K. All anchors, fastenings, hardware, accessories and other supplementary parts necessary to complete the work.

GENERAL

Product data.--Submit manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications.

Shop assembly.--Preassemble items in shop to the greatest extent possible to minimize field welding and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark all units for reassembly and installation.

Checkered floor plates shall be commercial quality steel with standard raised pattern.

Pipe shall be ASTM Designation: A 53, grade B.

Grating shall conform to Section 56-1.02F, "Steel Walkway Gratings," of the Standard Specifications. Grating shall be hot-dip galvanized and not painted.

Steel rope and accessories shall conform to Section 83-1.02E, "Cable Railing," of the Standard Specifications.

Galvanizing.—Steel be hot-dip galvanized after fabrication in accordance with Section 75-1.05, "Galvanizing," of the Standard Specifications, unless otherwise noted. The weight of galvanized coating shall be at least 460 grams per square meter of surface area, except grates shall have at least 610 grams per square meter of surface area.

Steel pipe railings and hand railings.--Pipe handrailing and guardrails shall consist of handrailing elements supported by metal brackets (wall type) or handrailing elements supported by tubular steel posts (post type).

Ends of railing pipe shall be closed, except for a 3 mm diameter weep hole at the low point.

All corners on railings shall be rounded. Simple and compound curves shall be formed by bending pipe in jigs to produce uniform curvature; maintain cylindrical cross-section of pipe throughout the bend without buckling, twisting or otherwise deforming exposed surfaces of the pipe.

Wall brackets, end closures, flanges, miscellaneous fitting and anchors shall be provided for interconnections of pipe and attachment of railings and handrails to other work. Inserts and other anchorage devices shall be furnished for connecting railings and handrails to concrete or masonry.

Steel railing shall be galvanized after fabrication. After galvanizing, all elements of the railing shall be free of fins, abrasions, rough or sharp edges, and other surface defects and shall not be kinked, twisted or bent.

PAYMENT

Payment for miscellaneous metal (substations, service platforms and walkways) shall conform to the provisions in "Service Platforms", "Walkways", and "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.58 HINGED DOORS (SUBSTATIONS)

Hinged doors for substations shall consist of furnishing and installing hinged doors and frames in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Manufacturer's descriptive data, installation instructions for fire rated assemblies and a door schedule shall be submitted for approval. The door schedule shall include a description of the type, location and size of each door and frame. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

PRODUCTS

Metal door

Metal door shall be flush, seamless steel door factory prepared and reinforced to receive hardware and having cold rolled stretcher leveled sheet steel face sheets not less than 1.2 mm thick (18-gage). Face sheets shall be bonded with thermosetting adhesive to rigid board honeycomb or precured foam core; or face sheets shall be welded to all parts of an assembled grid of cold formed pressed metal stiffeners and framing members located around edges, ends, openings and at all locations necessary to prevent buckling of face sheets. Seams shall be tack welded, filled and ground smooth. Bottom edge and internal stiffeners of grid type core shall have moisture vents. Welds on exposed surfaces shall be ground smooth. Louvered or glazed openings shall be provided where shown on the plans.

Where fire rated doors are required, doors shall be listed and labeled for the fire rating shown on the plans.

Active leaf of double door shall have a full height astragal of 3 mm flat bar or folded sheet strip, not less than 1.5 mm thick (16-gage), welded on the outside of the active leaf.

Door shall be cleaned and treated by the bonderized process or approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Pressed metal frame

Pressed metal frame shall be not less than 1.5 mm thick (16-gage) sheet steel with integral stop, mitered corners, face welded and ground smooth corners. Frames shall be reinforced for all hardware and shall be cleaned and treated by the bonderized process or an approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Sealants

Sealants shall be ultraviolet and ozone resistant, gun grade polysulfide or polyurethane, multicomponent, Federal Specification: TT-S-227.

Galvanizing

Doors, frames and frame components shall be manufactured from cold-rolled steel conforming to ASTM Designation: A 366; or hot-dipped galvanized steel having an A60 zinc coating conforming to ASTM Designation: A 924. Galvanized steel shall be treated to insure proper paint adhesion. All component parts used in galvanized doors and frames shall meet the galvanize specifications.

INSTALLATION

Doors and frames shall be installed rigidly, securely, plumb and true and in such a manner that the doors operate freely without rubbing or binding. Clearance between frame and door shall be not more than 3 mm. The exterior frame shall be sealed weathertight.

Pressed metal frames shall be secured with clips and anchors as shown on the plans.

Fire rated assemblies shall be installed according to the manufacturer's recommendations.

Fire rated assemblies shall include doors, door frames, automatic smoke-actuated closers, self-closing mechanisms, panic hardware, wire glass, and fire rated louvers. Assemblies shall be approved by the California State Fire Marshal.

Painting

Except for the primer application specified herein, doors and frames shall be cleaned, prepared and painted in accordance with the requirements specified in "Painting (Substations, Service Platforms, Walkways)" elsewhere in these special provisions.

PAYMENT

Payment for hinged doors (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.59 ACCESS DOORS (SUBSTATIONS)

Access doors for substations shall consist of furnishing and installing access doors in accordance with the details shown on the plans and these special provisions

SUBMITTALS

Manufacturer's descriptive data and installation instructions shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

PRODUCTS

Access doors

Access doors shall be factory assembled and hot-dipped galvanized steel. Door panel shall be 1.90 mm thick (14-gage) and door frame shall be 1.5 mm thick (16-gage). The door and frame assembly shall have standard screw driver operated cam locks, concealed springs or continuous piano hinge and inside release handle. Access doors shall be by Babcock-Davis Hatchways, Bar-Co Access Doors, Inryco-Milcor, J.L. Industries, or equal.

INSTALLATION

Access doors shall be installed in accordance with the manufacturer's recommendations.

The access door assemblies shall be painted to the match the color of the adjacent surrounding surfaces.

PAYMENT

Payment for access doors (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.60 FINISH HARDWARE (SUBSTATIONS)

Finish hardware for substations shall consist of furnishing and installing hardware items for doors in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Manufacturer's technical information and catalog cuts for each item of door hardware and a door hardware schedule shall be submitted for approval prior to installation. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

Manufacturer's catalog cuts shall include catalog numbers, material, grade, type, size, function, design, quality and finish of hardware.

The door hardware schedule shall indicate the location and size of door opening, the door and frame material, and the size, style, finish and quantity of the hardware components required.

FINISHES

Hardware shall be provided with standard US 32D metal plated finish or Satin Aluminum sprayed finish where indicated.

KEYING INSTRUCTIONS

New facilities shall have a building master key system established.

Locks shall have cylinders with figure eight interchangeable cores with six pin barrels. Permanent cores and keys shall be delivered to the Engineer for final installation at completion of project.

The Contractor shall also provide figure eight interchangeable cores for use during construction, which shall remain the property of the State.

The Contractor shall provide cylinders for use during construction. Construction cylinders shall remain in place until permanent cylinders are installed. Construction cylinders shall remain the property of the Contractor.

Key bows shall be stamped "State of California" and "Do Not Duplicate".

PRODUCTS

General

Door hardware equal in material, grade, type, size, function, design, quality and manufacture to that specified herein may be submitted for approval.

Butt hinges

Butt hinges shall be bronze or stainless steel, 1 1/2-pair per door unless otherwise specified or shown on the plans. Nonremovable pins shall be provided at outswing exterior doors. Hinge size shall be 114 mm x 114 mm unless otherwise noted.

Standard weight hinges shall be:

Hager	BB 1279
McKinney	TB 2714
Stanley	BB 179
or equal.	

Heavy weight hinges shall be:

Hager	BB 1168
McKinney	T4B 37869
Stanley	BB 168
or equal.	

Mortise locksets, latchsets and privacy sets

Mortise locksets, latchsets and privacy sets shall be steel case with 32 mm x 203 mm face plate and 70 mm backset. Door and frame preparation for mortise locksets, latchset and privacy sets shall conform to ANSI A115.1.

Lever operated lockset shall be:

Best	35H 6FW 15H
Falcon	LM521 DG
Schlage	L9453P x 06
or equal.	

Cylindrical locksets, latchsets and privacy sets

Cylindrical locksets, latchsets and privacy sets shall be steel chassis, 54 mm diameter, 70 mm backset. Door and frame preparation for cylindrical lockset, latchsets and privacy sets shall conform to ANSI A115.1.

Lever operated latchset shall be:

Best	83K ON 9C
Falcon	LY101 DG
Schlage	D10S RHO
or equal.	

Door closers

Parallel arms for closers shall be installed at outswing exterior doors. Closers shall have sprayed finish to match other hardware on door.

Door closers shall be:

LCN	4040
Norton	85001
Dorma	7800
or equal.	

Panic devices

Rim type panic devices shall be installed at single doors and on the active leaf of pairs of doors, unless indicated otherwise. A vertical rod device shall be provided for the inactive leaf of pairs of doors. Dogging devices shall be omitted at UL rated door openings.

Panic devices with outside key operation shall be:

Corbin	3727
Monarch	XX-R-T
Von Duprin	88TP
or equal.	

Panic devices with exit only operation shall be:

Corbin	3729
Monarch	XX-R-BA
Von Duprin	88EO
or equal.	

Panic devices with vertical rod operation shall be:

Corbin	3120
Monarch	XX-V-N
Von Duprin	8827
or equal.	

Kickplates

Kickplates shall be 254 mm in height x 51 mm less than door width x 1.52 mm (16-gage).
Kickplates shall be:

Builders Brass	37
Quality	48
Trimco	6000
or equal.	

Mop plates

Mop plates shall be stainless steel, 1.52 mm (16-gage), 152 mm in height x 51 mm less than the door width.
Mop plates shall be:

Builders Brass
Ives
or equal.

Floor mounted stops

Floor mounted stops shall be dome type. The height of the stop shall be determined by the clearance required when a threshold is used or not used.
Stops for openings without thresholds shall be:

Builders Brass	8061
Quality	331
Trimco	1210
or equal.	

Stops for openings with thresholds shall be:

Builders Brass	8063
Quality	431
Trimco	1213
or equal.	

Wall or door mounted door stop

Wall or door mounted door stop shall have a 95 mm projection and 3-point anchoring.
Wall or door mounted door stop shall be:

Builders Brass	W96
Quality	38
Trimco	1236-1/4-2
or equal.	

Wall mounted door stop and holder

Wall mounted door stop and holder shall be:

Builders Brass	W140, W141X
Quality	36, 136
Trimco	1202, 1207
or equal.	

Wall bumpers

Wall bumpers base diameter shall be 64 mm with a 25 mm projection.
Bumpers shall be:

Builders Brass	WC9
Quality	302
Trimco	1272-1/4-CCS
or equal.	

Finger pull shall be approximately 89 mm x 38 mm x 13 mm deep, recessed into the door:

Builders Brass	9365-aluminum
Ives	SP223-B26D
or equal.	

Floor guide shall be non-adjustable, 1.52 mm (16-gage) steel with nylon covered steel uprights, for 35 mm bypassing door.

Automatic door bottom

Automatic door bottom shall be heavy duty, full mortise.
Bottom shall be:

Pemko	434 AR
Zero	360
or equal.	

Thresholds, rain drips, door sweeps and door shoes

Thresholds, rain drips, door sweeps and door shoes shall conform to the sizes and configurations shown on plans. Thresholds at door openings with accessibility requirements shall not exceed 13 mm in height.

Threshold, rain drip, door sweep and door shoe manufacturers shall be Pemko, Reese, Zero, or equal.

Threshold bedding sealant

Threshold bedding sealant shall conform to Federal Specification: SS-C-153.

Weatherstrip and draft stop

Weatherstrip and draft stop shall conform to the sizes and shapes shown on plans. Assemblies shall be UL listed and shall be provided where shown on the plans or as specified in these special provisions.

Weatherstrip and draft stop manufacturers shall be Pemko, Reese, Zero, or equal.

INSTALLATION

Hardware items shall be accurately fitted, securely applied, and adjusted and lubricated in accordance with the manufacturer's instructions. Installation shall provide proper operation without bind or excessive play.

Hinges shall be installed at equal spacing with the center of the end hinges not more than 244 mm from the top and bottom of the door. Locksets, latchsets, privacy sets and panic exit mechanisms shall be 1024 mm from the finished floor. Kickplates shall be mounted on the push side of the doors, 25 mm clear of door edges.

Thresholds shall be set in a continuous bed of sealant material.

Door controls shall be set so that the effort required to operate doors with closers shall not exceed 3.9 kg maximum for exterior doors and 2.7 kg maximum for interior doors. The effort required to operate fire doors may be increased above the values shown for exterior and interior doors but shall not exceed 6.8 kg maximum.

Door stops located on concrete surfaces shall be fastened rigidly and securely in place with expansion anchoring devices. Door stops mounted elsewhere shall be securely attached with wood screws or expansion devices as required.

Backing shall be provided in wall framing at wall bumper locations.

Hardware, except hinges, shall be removed from surfaces to be painted before painting.

Upon completion of installation and adjustment, the Contractor shall deliver to the Engineer all dogging keys, closer valve keys, lock spanner wrenches, and other factory furnished installation aids, instructions and maintenance guides.

DOOR HARDWARE GROUPS AND SCHEDULE

Hardware groups specified herein shall correspond to those shown on the plans:

GROUP 1

1 1/2-pair butt hinges
1 each Mortise lockset
1 each Threshold
1 each Weatherstripping
1 each Door stop
1 each Door closer

GROUP 2

1 1/2-pair butt hinges
1 each Mortise lockset
1 each Threshold
1 each Weatherstripping
1 each Door stop
1 each Door closer

GROUP 3

1 1/2-pair butt hinges
1 each Cylindrical privacy set
1 each Thresholds
1 each Door stop
1 each Door closer

PAYMENT

Payment for finish hardware (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.61 METAL PANELS (SUBSTATIONS)

Metal panels for substations shall consist of furnishing and installing manufactured metal panels, in accordance with the details shown on the plans and these special provisions.

Metals panels shall clad partitions between substation and exterior (at stairs), between rooms of substation, and between substation and bridge interior.

Metal system shall consist of pre-finished metal panels, gutters, fasteners, sealants, and accessories and components, not mentioned, which are required for a complete, securely fastened and weathertight installation.

SYSTEM DESCRIPTION

Design Requirements

The panel system shall conform to the wind design requirements for uplift or outward pressures in accordance with Chapter 16 of the Uniform Building Code for the wind speed and exposure, seismic forces, and thermal movement of bridge.

SUBMITTALS

Product Data

Manufacturer's technical product data, installation instructions, and recommendations for each type of sheathing material shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

Product data shall include the manufacturer's name and a complete material description of all components of the metal sheathing system.

Samples

Material samples shall include a 305 mm x 305 mm sample of the panels for each color to be installed and a sample of each anchor clip and fastening device.

Shop Drawings

Shop drawings shall include the shape, size, thickness, and method of attachment for each component used in the work; the layout and spacing of fasteners; details of connections and closures; and details for expansion joints and weathertight joints.

Design calculations for the fastening system of the roof and wall panels with the substrate shown on the plans shall be submitted to verify compliance with the design requirements.

Shop drawings and design calculations shall be stamped and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California. The expiration date of the registration shall be shown. The Engineer's signature shall be original.

Working Drawings

Working drawings showing the layout and details of the roofing and siding system shall be submitted for approval.

Working drawings shall include the shape, size, thickness, and method of attachment for each component used in the work; the layout and spacing of fasteners; details of connections and closures; and details for expansion joints and weathertight joints.

Design calculations for the fastening system of the roof and wall panels with the substrate shown on the plans shall be submitted to verify compliance with the design requirements.

Working drawings and design calculations shall be stamped and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California. The expiration date of the registration shall be shown. The Engineer's signature shall be original.

After all working drawings and supplement are received, the Contractor shall allow the Engineer 60 working days to review the submittal.

QUALITY ASSURANCE

Certificates of Compliance.--Certificates of Compliance shall be furnished for the metal sheathing system in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

DELIVERY, HANDLING AND STORAGE

Delivery and handling.--Metal panels shall be protected against damage and discoloration.

Storage.--Metal panels shall be stored above ground, with one end elevated for drainage and protected against standing water and condensation between adjacent surfaces.

PRODUCTS

Base metal

Base metal shall be cold formed, 0.71 mm (24-gage), galvanized sheet steel with G90 coating, conforming to ASTM Designation: A 446, Grade A except where a higher strength is required for performance, extra smooth, or cold formed aluminum-zinc alloy-coated, commercial quality, sheet steel with AZ55 coating conforming to ASTM Designation: A 792, Grade 40, extra smooth.

Configuration

Metal panels shall have primary vertical ribs spaced at not less than 200 mm or more than 305 mm, with 2 intermediate ribs located between the primary ribs. The depth of the primary ribs shall be between 19 mm and 42 mm in depth.

Metal panels shall have symmetrically shaped trapezoidal ribs spaced approximately 180 mm on center. The depth of the ribs shall be approximately 38 mm.

Metal Finishes

Coatings shall be applied before or after forming and fabricating panels, as required for maximum coating performance capability.

Colors shall be as selected by the Engineer from the manufacturer's standard color palette.

Fluoropolymer coating

Finish shall be the manufacturer's standard Kynar coating with a baked on primer (0.005 mm) and a finish coat of 0.02 mm nominal for a total dry film thickness of approximately 0.025 mm nominal.

Interior finish (facing interior of partitions themselves) shall consist of a 0.004 mm epoxy primer and a backer coat.

Trim

Trim shall be formed from the same material, gage and in the same finish as the metal panels.

Fastener clips

Fastener clips shall be non-corrosive, ferrous metal fasteners as recommended by the metal panel system manufacturer to resist the design loads.

Fasteners

Fasteners shall be as recommended by the metal panel system manufacturer. Sheet metal screws shall not be used except to fasten trim and flashings.

Sealant and sealant tape

Sealant and sealant tape shall be as recommended by the panel system manufacturer.

Closures

Closures shall be rubber, neoprene, closed cell plastic or pre-finished metal. Closures at base of walls at room sides shall be pre-finished metal.

FABRICATION

Unless otherwise shown on the plans, or specified herein, panels shall be fabricated in continuous lengths, for the height of the partitions, from floor to underside of structures.

Flashings shall be fabricated in the longest practical lengths.

Panels shall be factory formed. Field formed panels are not acceptable.

INSTALLATION

Panels Installation

The panels shall be installed and fastened in accordance with the details shown on the plans and the approved working drawings. Cutting and fitting shall present a neat and true appearance with exposed burrs removed. Openings through panels shall be cut square and shall be reinforced as recommended by the metal system manufacturer.

Metal panels shall be adjusted in place and properly aligned for the detailed conditions before fastening. Panels shall not be warped, bowed or twisted. The surface finish on the panels shall not be cracked, blemished or otherwise damaged.

Fasteners shall not be driven through panels.

Miscellaneous metal shapes installation

Trim, caps, and other pre-finished metal work shall be positioned to the correct alignment for each detailed condition. Metal work shall be securely attached to backing construction using fasteners at the spacing shown on approved working drawings. Pre-finished metal to be installed over concrete shall be back-coated with asphaltic paint as recommended by the metal roofing system manufacturer.

Metal panels, trim, and other pre-finished metal that are marred, punctured, incorrectly bent, or incorrectly installed will be considered damaged and shall be replaced with undamaged units.

Expansion joints shall conform to the manufacturer's recommendations and to SMACNA "Architectural Sheet Metal Manual."

The metal panel system shall be installed weathertight. Closures shall be tight fitting and shall be provided at the ends of panels, at the boundary of the structure, and as indicated on the approved working drawings.

CLEAN UP AND CLOSE OUT

Clean up

Adjacent surfaces shall be protected during sealant work. Excess sealant shall be removed as the installation progresses.

Panels, molding, trim, and other pre-finished metal surfaces shall be cleaned after installation as recommended by the manufacturer. Exposed cuts shall be touched-up with a matching durable primer and paint as recommended by the metal system manufacturer.

Touch up

Damaged paint surfaces shall be touched up by using an air dry touch up paint supplied by the metal system manufacturer. Only a small brush shall be used for touching up. No spraying of touch up paint is to be performed.

Damaged units

Panels and other components of the work which have been damaged or have deteriorated beyond successful repair shall be removed and replaced.

PAYMENT

Payment for metal panels (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.62 METAL BRIDGE RAILING

Bikepath railing shall conform to the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

The Contractor shall submit complete working drawings to the Engineer in accordance with the provisions in Section "Working Drawings," elsewhere in these special provisions. The working drawings shall include the proposed methods to control the bikepath railing longitudinal alignment.

10-1.63 CONCRETE BARRIER

Concrete barriers shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

Bar reinforcing steel for use in concrete barriers shall conform to the provisions in "Epoxy-coated Reinforcement," of these special provisions.

At the Contractor's option, epoxy-coated bar reinforcement for use in concrete barriers may be used in conformance with the following provisions:

A. Bar reinforcement to be epoxy-coated shall conform to the ASTM Designation and grade required or permitted by Section 52-1.02A, "Bar Reinforcement," for the location or type of structure involved. The epoxy-coated bar reinforcement shall conform to the requirements in ASTM Designation: A 775/A 775M, except as provided herein. Fabrication and project site handling of the epoxy-coated bar reinforcement shall conform to the requirements in ASTM Designation: D 3963/D 3963M, except as provided herein.
B. Appendix X1, "Guidelines For Job-Site Practices," of ASTM Designation: A 775/A 775M shall apply except as provided herein. The term "shall" shall replace the term "should" in this appendix. Section X1.2 shall not apply.
C. Coatings shall be light green in color.
D. Except for field welding of butt splices, all welding of reinforcement shall be complete prior to epoxy coating the reinforcement.
E. When any portion of a reinforcing bar requires epoxy coating, the entire bar shall be coated.
F. Within areas where epoxy-coated reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be plastic-coated or epoxy-coated to prevent corrosion of the devices or damage to the coated reinforcement.

G. Prior to coating, the Contractor shall furnish to the Transportation Laboratory, a representative 110 g sample from each batch of epoxy coating material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

H. Two 700-mm long samples of coated bar reinforcement from each size and from each load shipped to the project site shall be furnished to the Engineer for testing. These samples shall be representative of the material furnished. These samples, as well as any additional random samples taken by the Engineer, may be tested for specification compliance. Additional sampling, and all tests performed by the Engineer, may be performed at any location deemed appropriate by the Engineer. Failure of any sample to meet the requirements of the specifications will be cause for rejection.

I. If any bar tested for coating thickness or for flexibility of coating fails to meet the requirements for coated bars in Section 8 of ASTM Designation: A 775/A 775M, 2 retests on random samples taken from bars represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated bars represented by the samples may be certified as meeting the test requirements.

J. Epoxy-coated reinforcement shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray and weather. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation around the reinforcement to prevent condensation under the covering. Epoxy-coated reinforcement shall not be stored within 300 meters of ocean or tidal water for more than 60 days.

K. All visible damage to the coatings caused by shipping, handling or installation shall be repaired as required for repairing coating damaged prior to shipment as specified in ASTM Designation: A 775/A 775M. When the extent of coating damage prior to repair exceeds 2 percent of the bar surface area in any 300-mm length, repair of the bar will not be allowed and the coated bar will be rejected.

L. The patching material and process shall be suitable for field application. The patching material shall be prequalified as required for the coating material and shall be either identified on the container as a material compatible with the bar reinforcement coating, or shall be accompanied by a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications certifying that the material is compatible with the bar reinforcement coating. Damaged areas shall be patched in conformance with the patching material manufacturer's recommendations. If damage to a bar occurs during field bending, the area shall be patched immediately with the prequalified patching material.

M. Except for lap splices, splices for epoxy-coated bar reinforcement shall be coated with a corrosion protection covering that is on the Department's list of approved products. The covering shall be installed in conformance with the manufacturer's recommendations and as directed by the Engineer. The list is available from the Transportation Laboratory.

N. A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished for each shipment of epoxy-coated bar reinforcement certifying that the coated bars conform to the requirements of ASTM Designation: A 775/A 775M and Section 52-1.02B, "Epoxy-coated Bar Reinforcement." The Certificate of Compliance shall include all the certifications specified in ASTM Designation: A 775/A 775M and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

Full compensation for epoxy-coated bar reinforcement shall be considered as included in the contract price paid per meter for concrete barrier of the type or types listed in the Engineer's Estimate and no separate payment will be made therefor.

10-1.64 STEEL BARRIER

Steel barrier shall conform to the details shown on the plans and to the section in "Steel Structures," of these special provisions and these special provisions.

The Contractor shall submit complete working drawings to the Engineer in accordance with the provisions in Section "Working Drawings," elsewhere in these special provisions. The working drawings shall include the proposed methods to control the steel barrier longitudinal alignment.

The contract price per meter for steel barrier (Type 732 modified) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and erecting the steel barrier, complete in place, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.65 REINFORCED, RECYCLED PLASTIC OR COMPOSITE PLASTIC LUMBER

Reinforced, Recycled Plastic (RRP) or Composite Plastic (CP) lumber shall consist of furnishing and installing RRP or CP lumber, and hardware assemblies as shown on the plans and as specified in these special provisions.

Recycled plastic shall meet the requirements of a recycled product. Recycled product shall be defined as all materials, goods, and supplies, no less than 50 percent of the total weight of which consists of secondary and post consumer waste with not less than 10 percent of its total weight consisting of post consumer waste. Post consumer waste is defined as a finished material which would have been disposed of as a solid waste, having completed its life cycle as a consumer item, and does not include manufacturing waste. Secondary waste is defined as fragments of finished products or finished products of a manufacturing process, which has converted a resource into a commodity of real economic value, and includes post consumer waste, but does not include excess virgin resources of the manufacturing process.

The cross-sectional dimensions of the plastic lumber shall not vary more than ±13 mm nor shall the length vary more than ±25 mm from the dimensions shown on the plans.

RRP and CP lumber that is damaged shall be replaced by the Contractor and at the Contractor's expense.

WORKING DRAWINGS.--The Contractor shall submit working drawings to the Engineer in accordance with the provisions in Section "Working Drawings," elsewhere in these special provisions.

The working drawings shall show complete details of component layout and attachment details and shall be supplemented by manufacturer's material test reports, manufacturer's performance data, and two copies of the printed literature for the product.

MATERIALS AND FABRICATION FOR RRP LUMBER.--The plastic for RRP lumber shall be a mixture of one or more of the following thermoplastics: high density polyethylene, medium density polyethylene, low density polyethylene, or high density polypropylene. The lumber shall be mixed with appropriate colorants to produce a black or dark brown color, and with ultra violet inhibitors and antioxidants so that the resulting plastic portion of the product meets the physical property requirements specified herein. RRP lumber shall consist of a dense outer skin, not less than 5 mm thick, surrounding a less dense core.

The RRP lumber shall be produced continuously and homogeneously without joints and with the cross-sectional dimensions within 13 mm of those shown on the plans. Any interior voids in the lumber shall not exceed 13 mm diameter. At an exposed end of the member, there shall not be more than one void greater than 25 mm in diameter , and no more than 4 voids greater than 6 mm in diameter. RRP lumber shall have a smooth outer skin with a minimum of exposed voids and shall be straight and true, free of twist, curvature, bulging and other undesirable deformations.

RRP lumber shall be reinforced with fiberglass reinforcing elements. The reinforcing elements shall extend continuously through the length of the member, without splices. During the casting or extruding process, reinforcing elements must be held firmly in the position indicated by the manufacturer. Each piece of RRP lumber shall be permanently marked with the manufacturer's name.

RRP lumber shall be cut, beveled, drilled, countersunk, and otherwise fabricated in accordance with the manufacturer's recommendations by technicians who are skilled and experienced in the trade. Fabrication shall be done in the manufacturer's facilities to the greatest extent possible.

RRP lumber shall be shipped in a manner that will minimize scratching or damage to outer surfaces. RRP lumber shall be stacked on dunnage above ground such that it may be readily inspected, and stored in a manner that will avoid undue injury. RRP lumber shall be handled with rope slings. Sharp instruments shall not be used in handling the lumber. RRP lumber damaged in shipping or handling will be rejected.

MATERIALS AND FABRICATION FOR CP LUMBER.-- The plastic for the shell of CP lumber shall be produced from polyester or epoxy resin reinforced with E glass and shall be mixed with the appropriate colorants, ultraviolet inhibitors and antioxidants, so that the resulting plastic shell meets the physical property requirements specified herein.

The core material for CP lumber shall be a lightweight aggregate polymer concrete meeting physical property requirements described herein.

The CP lumber shall be produced continuously and homogeneously without joints and with the cross-sectional dimensions within 13 mm of those shown on the plans. The CP lumber shall be seamless with a smooth outer surface and shall be straight and true, free of twist, curvature, bulging and other undesirable deformation. Any interior voids in the core material shall not exceed 13 mm diameter. Each piece of CP lumber shall be permanently marked with the manufacturer's name.

CP lumber shall be cut, beveled, drilled, countersunk, and otherwise fabricated in accordance with the manufacturer's recommendations and by technicians who are skilled and experienced in this trade. Fabrication shall be done in the manufacturer's facilities to the greatest extent possible.

Cut ends of the CP lumber shall be sealed with a cap securely held in place with an adhesive recommended by the manufacturer. The adhesive shall show no more than a 10% decrease in strength when tested in accordance with ASTM Designation: D3164 following two cycles of exposure in accordance with ASTM Designation: D1183, Procedure D. The procedure shall be modified so that the cold temperature phase of the procedure shall be at -20°±3°C and the high temperature phase shall be at 60°±3°C.

CP lumber shall be coated with a black (Federal Standard 595B No. 37030) or dark brown (Federal Standard 595B No. 30097) coating to a minimum dry film thickness of 1.5 mils. No visible color change in the coating shall occur when tested in accordance with ASTM Designation: D4329 using UVB-313 bulbs operating at a UV intensity of 0.47 W/m_ measured at 310 nm for 100 cycles. The cycle shall be 4 hours of ultraviolet (UV) exposure at 60°C and 4 hours of condensate (CON) exposure at 40°C The coating shall have a minimum initial adhesion value of 1 MPa when tested in accordance with ASTM Designation: D4541. The coating shall show no more than a 10% decrease in its initial adhesion strength following two exposure cycles in accordance with ASTM Designation: D1183, Procedure D as modified above.

CP lumber shall be shipped in a manner that will minimize scratching or damage to outer surfaces. CP lumber shall be stacked on dunnage above ground so that it may be readily inspected and shall be stored in a manner that will avoid undue injury. CP lumber shall be handled with rope slings. Sharp instruments shall not be used in handling the lumber. CP lumber damaged in shipping or handling will be rejected.

PHYSICAL PROPERTY REQUIREMENTS.--The RRP and CP lumber shall have physical properties as listed in the following table:

PROPERTY	TEST	REQUIREMENT	
		RRP	CP
Density	ASTM D792, Procedure A; ASTM E12	Skin: 880-1010 kg/m^3 Core: 720-880 kg/m^3	Shell: 1760 kg/m^3, min.
Water Absorption	ASTM D570 (maximum weight increase)	Skin: 0.5% max. at 24 hrs. Core: 1.0% max. at 2 hrs 3.0% max at 24 hrs.	Shell: 0.1% max. at 2 hrs. 0.2 % max. at 24 hrs.
Brittleness	ASTM D746	Skin: No break at -40°C at 267 m-N/m	Shell: No break at -45°C at 267 m-N/m
Impact Resistance	ASTM D746, Modified	Skin: 214 m-N/m, min.	Shell: 1334 m-N/m, min.
Hardness	ASTM D2240	Skin: 45-75 (Shore D)	Shell: 45-75 (Shore D)
Ultraviolet Deterioration	ASTM D4329 UVB-313 (See Note 1)	Skin: For 500 hrs. exposure: Shore D durometer hardness shall not change more than 1%	Shell: 2000 hrs. exposure: less than 10% loss if structural strength (See Note 2)

Abrasion	ASTM D4060	Skin: Weight loss:<0.5 g wear index: 2.5-3.0 cycles: 10,000 wheel: CS17 load: 1 kg	
Chemical Resistance	ASTM D543	Sea Water < 1.5% weight increase Gasoline < 7.5% weight increase No. 2 Diesel < 6.0% weight increase	
Stiffness, minimum lb-in^2 (for rectangular sections, value specified is for the weak axis)		1.40×10^8 for 8 x 10 lumber 1.52×10^8 for 8 x 12 lumber 2.76×10^8 for 10 x 10 lumber 3.38×10^8 for 10 x 12 lumber 4.60×10^8 for 12 x 12 lumber	4.54×10^8 for 8 x 10 lumber 5.41×10^8 for 8 x 12 lumber 8.74×10^8 for 10 x 10 lumber 10.4×10^8 for 10 x 12 lumber 17.9×10^8 for 12 x 12 lumber
Ignition Temperature	ASTM D1929-91a	over 343°F	over 343°F
Marine Borers		total resistance	total resistance
Dry Rot		total resistance	total resistance
Shrinkage/ Swelling		negligible	negligible

Note 1: ASTM D4329 using UVB 313 bulbs operating at a UV intensity of 0.47 W/m^2 /nm measured at 310 nm. The exposure cycle shall be 4 hours of ultraviolet (UV) exposure at 60°C and 4 hours condensate (CON) exposure at 40°C.

Note 2: The exposure cycle shall be the same as in Note 1. Structural values to be measured:

ASTM D638 - tensile strength, tensile modulus

ASTM D790 - flexural strength, flexural modulus

ASTM D256 - Izod impact

The fiberglass reinforcing elements for the RRP lumber shall have the following properties:

PROPERTY	TEST	REQUIRE-MENT
Flexural Strength	ASTM D790	483 MPa, min.
Compression Modulus	ASTM D695	276 MPa, min.
Tensile Strength	ASTM D638	483 MPa, min.

The core for the CP lumber shall have the following properties:

PROPERTY	REQUIRE-MENT
Density	1760 kg/m^3, min.
28 Day Compressive Strength	35 MPa, min.

All hardware shall be stainless steel anchor devices as shown on the plans. All couplings, bolts and lag bolts, shall be ASTM A 276, Type 316 stainless steel.

CHOCKS AND FILLER BLOCKS.--Unreinforced Recycled Plastic (RP) may be used in lieu of RRP for chocks and filler blocks, when RRP lumber is used as the fender material. This material shall meet all of the requirements for RRP except that the fiberglass reinforcement is deleted.

MEASUREMENT AND PAYMENT.--RRP, CP and RP lumber will be measured by cubic meter. The estimated quantity of RRP or CP lumber designated as final pay in the Engineer's Estimate will not be revised as specified in Section 9-1.015, "Final Pay Items."

The contract price paid per cubic meter for furnish and install RRP or CP lumber shall include full compensation for furnishing all labor, materials including all hardware, anchor devices, couplings, bolts, and lag bolts, tools, equipment and incidentals, and for doing all work involved in furnishing and installing RRP, and CP and RP lumber, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.66 ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE PANEL

Ultra High Molecular Weight (UHMW) shall consist of furnishing and installing UHMW panels and shall conform to the details shown on the plans and as described in these special provisions.

MATERIALS.—The UHMW panels shall be manufactured with a maximum 50 percent regenerated or recycled material; and with a molecular weight of 3,000,000 to 6,000,000 in accordance with ASTM D 4020, compression molded, stress relieved, and including an ultraviolet stabilizer. The color of the panels shall be black. The UHMW shall be approved by the Engineer. Physical characteristics shall conform to the following requirements:

A. Static coefficient of friction to steel (dry) shall be less than 0.025.
B. Specific gravity shall be greater than 0.92 (ASTM D 792)
C. No water absorption shall be shown under long term immersion (ASTM D 510)
D. The minimum tensile stress capacity shall be 25 MPa and the minimum impact shear capacity shall be 10 MPa.

The UHMW panels shall be anchored to the in-place, plastic lumber fender walers using stainless steel anchor devices as shown on the plans. All couplings, bolts, and lag bolts shall be ASTM A 276, Type 316 stainless steel.

CONSTRUCTION.—The UHMW panels shall be delivered to the site and stored in a manner which will prevent their damage. A certifying statement from the manufacturer shall accompany each delivery, and shall verify that the material and workmanship comply with the current ASTM standards for ASTM D 4020 and these special provisions. Two copies of the certifications from the manufacturer shall be furnished to the Engineer. Materials without manufacturer's certification shall be rejected.

Immediately prior to installation, the Contractor shall inspect the panels for damage and the results of the inspection shall be reported to the Engineer. Materials which, in the Engineer's opinion, are defective or damaged, shall be repaired or replaced in kind by the Contractor at the Contractor's expense.

All lag screw heads shall be countersunk flush with the surface of the UHMW panels. All lag screw locations shall be pre-drilled into the receiving plastic lumber walers with bits having the same diameter as the bolt shank.

The minimum clear distance from the heads of all lag screws to the end or edge of the plastic lumber walers shall be 50 mm. The minimum edge distance from the centerline of lag screws to the edge of a UHMW panel shall be 50 mm.

UHMW panels shall be installed abutting each other with a 6.5 mm gap between two panels and all joints between panels shall be flush.

UHMW panels at all corners shall be constructed of a single unit formed by heat bending in accordance with the manufacture's recommendations. Butt joints at corner locations will not be permitted.

PAYMENT.—

The contract price paid per square meter for UHMW polyethylene panel shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing UHMW polyethylene panel, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.67 FIRE EXTINGUISHERS AND CABINETS (SUBSTATIONS)

Fire extinguishers and cabinets for substations shall consist of furnishing and installing fire extinguishers with cabinets or mounting brackets in accordance with the details shown on the plans and these special provisions.

GENERAL

Fire Extinguishers shall conform to the requirements in National Fire Protection Association (NFPA) 10, "Portable Fire Extinguishers."

Fire extinguishers shall be Underwriters Laboratories or Factory Mutual Laboratories approved for the type, rating and classification of extinguisher specified. Fire extinguisher shall be fully charged, multi-purpose dry chemical type, with charge indicator, hose and nozzle, and attached service record tag. Fire extinguisher shall be of the capacity and type rating shown on the plans.

Subject to contract compliance, manufacturers shall be J.L. Industries; Larsen's Manufacturing; Potter-Roemer; or equal.

SUBMITTALS

Product data.--Manufacturer's descriptive data and installation instructions shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

PRODUCTS

Mounting bracket

Mounting bracket shall be the manufacturer's standard painted, surface mounted type.

Fire extinguisher cabinet

Fire extinguisher cabinet shall be factory fabricated, constructed of steel with a clear plastic panel in a steel door frame, and shall have a baked enamel finish. Color to be selected by the Engineer from the manufacturer's standard colors.

Fire extinguisher cabinet shall be surface-mounted, semi-recessed or fully recessed as shown on the plans.

INSTALLATION

Fire extinguishers shall be installed in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing agencies.

Fire extinguisher mounting brackets and cabinets shall be attached to structure, square and plumb, in accordance with the manufacturer's recommendations.

IDENTIFICATION

Bracket-mounted.--Extinguishers shall be identified with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style and location as selected by the Engineer.

Cabinet-mounted.--Extinguishers in cabinets shall be identified with letter spelling "FIRE EXTINGUISHER" applied to the cabinet door. Letter size, styles, and color shall be selected by the Engineer from manufacturer's standard arrangements.

SERVICING

General.--Fire extinguishers shall be service, charged, and tagged not more than 5 days prior to contract acceptance.

PAYMENTPayment for fire extinguishers and cabinets (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.68 TOILET ACCESSORIES (SUBSTATIONS)

Toilet accessories for substations shall consist of furnishing and installing toilet accessories in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Product data.--Manufacturer's descriptive data and installation instructions and details shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

PRODUCTS

Toilet tissue dispenser

Toilet tissue dispenser shall be dual roll, surface mounted, stainless steel with satin finish, approximately 150 mm x 290 mm x 150 mm deep. Dispenser shall utilize standard toilet tissue rolls. The top roll shall automatically drop into place after the bottom roll is depleted. One dispenser per toilet stall

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Combination paper towel dispenser and waste receptacle

Combination paper towel dispenser and waste receptacle shall be wall-mounted unit of stainless steel with satin finish. The approximate size shall be 355 mm x 1880 mm x 190 mm deep. The paper towel dispenser shall have a capacity of 1000 single fold paper towels. The waste receptacle shall have a capacity of not less than 37 liters. One unit per lavatory.

Acceptable manufacturers are Bradley; Bobrick; or equal.

Liquid Soap Dispenser

Soap dispenser shall be surface mounted unit of stainless steel with exposed surfaces in architectural satin finish. The approximate size shall be 208 mm x 122 mm x 73 mm deep. The liquid soap dispenser shall have a capacity of 40 oz. liquid soap. Soap valve shall be chrome plated brass housing with ABS plastic and stainless steel mechanism. One unit per lavatory.

INSTALLATION

Toilet accessories shall be installed in accordance with the manufacturer's recommendations. Fasteners for mounting accessories shall be concealed and tamper proof.

Expansion anchors shall be used for mounting accessories on masonry or concrete walls.

Toilet accessories shall be mounted after painting work is complete.

All toilet room accessories shall be mounted plumb, secure and rigid.

Support assembly for folding seat shall bear solidly on the wall without rocking and shall be fastened rigidly and securely to the wall in accordance with the manufacturer's recommendations.

PAYMENT

Payment for toilet accessories (substations) shall conform to the provisions in "Substation Architectural Eastbound and Substation Architectural Westbound" elsewhere in these special provisions.

10-1.69 THERMOPLASTIC TRAFFIC STRIPE

Thermoplastic traffic stripes (traffic lines) shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

Thermoplastic material shall conform to the requirements in State Specification 8010-19A.

10-1.70 PAINT TRAFFIC STRIPE

Painted traffic stripes (traffic lines) shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

Painted traffic stripes for the pavement detail 25M, as shown on the plans, shall consist of a 2-coat 100 mm wide yellow stripe and a 1-coat 75 mm wide black stripe. The black strip shall be applied concurrently with the second coat of the yellow stripe.

Painted traffic stripes for the pavement detail 27BM, as shown on the plans, shall consist of a 2-coat 100 mm wide white stripe and a 1-coat 75 mm wide black stripe. The black strip shall be applied concurrently with the second coat of the white stripe.

10-1.71 PAVEMENT MARKERS

Pavement markers shall be placed in conformance with the provisions in Section 85, "Pavement Markers," of the Standard Specifications and these special provisions.

Retroreflective pavement markers shall comply with the specific intensity provisions for reflectance after abrading the lens surface in conformance with the "Steel Wool Abrasion Procedure" specified for pavement markers placed in pavement recesses in Section 85-1.05, "Retroreflective Pavement Markers," of the Standard Specifications.

SECTION 10-2. (BLANK)

SECTION 10-3. ELECTRICAL SYSTEMS

10-3.01 DESCRIPTION

Traffic operations system, electrical facilities (San Francisco-Oakland Bay Bridge), roadway lighting, sign illumination, call box system and bike path lighting shall conform to the provisions in Section 86, "Signals, Lighting and Electrical Systems," of the Standard Specifications and these special provisions.

The Contractor's attention is directed to the two separate binders as supplements to the special provisions and plans. The binders contain details for the "Circuit Schedule" and "Conduit and Tray Schedule," Binder 1 is for the westbound direction and Binder 2 is for the eastbound direction.

Lighting equipment is included in the "Skyway," San Francisco – Oakland Bay Bridge (Bridge No. 34-0006) structure.

The work to be done, in general, under traffic operations system shall consists of the following as shown on the plans and described elesewher in these special provisions:

1. Install and test all camera stations including all associated conduit.
2. Install State-furnished changeable message sign system.
3. Install and test microwave vehicle detection sensor systems including associated conduit and junction boxes.
4. Install and test preformed loops including associated conduit and junction boxes.
5. Install and test all fiber optic cables, splice closures, fiber optic data modems and fiber optic transceivers.
6. Install all State-furnished controller cabinet assemblies.

The work to be done, in general, under electrical facilities (San Francisco – Oakland Bay Bridge) shall consists of the following as shown on the plans and described elesewhere in these special provisions:

A. SUBSTATION ARCHITECTURAL WESTBOUND

1. Install lighting, lighting panel, light switches, disconnect switches, receptacles, security door switches and smoke detectors.
2. Install all conduits and junction boxes, including anchors, fittings, and supports.
3. Install pull and terminate cable itemized on the plans and cable required for a complete smoke detection system.
4. Conduct a functional test of all equipment.

B. SUBSTATION ARCHITECTURAL EASTBOUND

1. Install lighting, lighting panel, light switches, disconnect switches, receptacles, security door switches and smoke detectors.
2. Install all conduits and junction boxes, including anchors, fittings, and supports.

3. Install pull and terminate cable itemized on the plans and cable required for a complete smoke detection system.
4. Conduct a functional test of all equipment.

C. SUBSTATION WESTBOUND

1. Install unit substation, 480 V Low Voltage Control Center (LVCC)-B, utility panel, transformers, battery charger and rectifier, Distribution Panel (DP)-B, and battery system. Install Remote Terminal Unit (RTU), Supervisory Control and Data Acquisition (SCADA) communication and telephone terminal boxes.
2. Install conduit, cable tray, and junction boxes including anchors, fittings, and supports.
3. Install and terminate conductors and cable itemized under "Cost Break-down" elsewhere in these special provisions.
4. Pull all cable in the conduit and cable tray shown on the plans.
5. Install the equipment grounding, including interface with bridge grounding. Conduct a functional test of all equipment.
6. Install all materials required to interface with the YBI / Main Span contract and the Oakland contract.

D. SUBSTATION EASTBOUND

1. Install unit substation, LVCC-A, utility panel, transformers, battery charger and rectifier, panel DP-A, and battery system. Install RTU, SCADA communication and telephone terminal boxes.
2. Install conduit, cable tray and junction boxes including anchors, fittings, and supports.
3. Install and terminate conductors and cable itemized under "Cost Break-down" elsewhere in these special provisions.
4. Pull all cable in the conduit and cable tray shown on the plans.
5. Install the equipment grounding, including interface with bridge grounding. Conduct a functional test of all equipment.
6. Install all materials required to interface with the YBI / Main Span contract and the Oakland contract.

E. ROADWAY LEVEL WESTBOUND

1. Install roadway electroliers, utility panels, receptacles and call boxes.
2. Install SCADA RTU System, Navigation Lighting System, and Traffic Operations System components on the service platforms.
3. Install all conduit, pull boxes, wireways and junction boxes, including anchors, fittings and supports.
4. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions.
5. Pull all cable in the conduit as shown on the plans. Terminate equipment ground conductors on the roadway level equipment. Conduct a functional test of all equipment.
6. Install all materials required to interface with the YBI / Main Span contract and the Oakland contract.
7. Install components and fabricate mounting racks on the service platforms.

F. ROADWAY LEVEL EASTBOUND

1. Install roadway electroliers, bike path fixtures, utility panels, receptacles and call boxes.
2. Install SCADA RTU System, Navigation Lighting System, and Traffic Operations System components on the service platforms.
3. Install all conduit, pull boxes, wireways and junction boxes, including anchors, fittings and supports.
4. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions.
5. Pull all cable in the conduit as shown on the plans. Terminate equipment ground conductors on the roadway level equipment. Conduct a functional test of all equipment.
6. Install all materials required to interface with the YBI / Main Span contract and the Oakland contract.
7. Install components and fabricate mounting racks on the service platforms.
8. Install, align, and secure conduit inside the Bike Path Steel Box.
9. Install sealed joints at the points of conduit penetration of the Bike Path Steel Box.

G. GIRDER LEVEL WESTBOUND

1. Install girder, girder access and pier light fixtures, light switches, and receptacles.
2. Install all cable tray, conduit, pull boxes, and junction boxes, including anchors, fittings and supports.
3. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions.
4. Pull all cable in the cable tray and conduit shown on the plans except cable for the SCADA RTU System and the Pile Corrosion Monitoring System.
5. Install the equipment grounding system. Conduct a functional test of all equipment.
6. Install all materials required for interface with the YBI / Main Span contract and the Oakland contract.
7. Install components and fabricate mounting racks.

8. Install all 15 kV splice boxes.

H. GIRDER LEVEL EASTBOUND

1. Install girder, girder access and pier light fixtures, light switches, and receptacles.
2. Install all cable tray, conduit, pull boxes, and junction boxes, including anchors, fittings and supports.
3. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions.
4. Pull all cable in the cable tray and conduit shown on the plans except cable for the SCADA RTU System, the Strong Motion Detection System and the Pile Corrosion Monitoring System.
5. Install the equipment grounding system. Conduct a functional test of all equipment.
7. Install all materials required for interface with the YBI / Main Span contract and the Oakland contract.
8. Install components and fabricate mounting racks.
9. Install all 15 kV splice boxes

I. NAVIGATION LIGHTING SYSTEM

1. Install navigation channel marker and pier marker lights and navigation relay cabinets.
2. Install all navigation lighting conduit to the cable trays, pull boxes in the piers, and junction boxes, including anchors, fittings and supports.
3. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions.
4. Pull all cable in the navigation lighting conduit and cable trays as shown on the plans.
5. Terminate ground conductors at the navigation lighting system equipment.
6. Conduct a functional test of all equipment after installation.

J. SCADA REMOTE TERMINAL UNIT SYSTEM

1. Install SCADA RTU's, communication terminal boxes, and telephone terminal boxes.
2. Install and terminate communication and telephone cable.
3. Terminate communication and telephone cable from the YBI contract.
4. Install communication and telephone cable to the Oakland contract interface and terminate these cables at the last Skyway terminal boxes.
5. Conduct a functional test of all equipment as directed by the Engineer.

K. STRONG MOTION DETECTION SYSTEM

1. Install sensor enclosures, down-hole enclosures, down-hole pull boxes, junction boxes, watertight connectors and strong motion detection system conduit, including anchors, fittings and supports, to the cable trays.
2. Install and terminate cable itemized under "Cost Break-down" elsewhere in these special provisions and pull cable through the system conduit and cable trays.
3. Install State-furnished steel casings and caps.

L. PILE CORROSION MONITORING SYSTEM

1. Install transducer test boxes and stainless steel conduit.

10-3.02 ABBREVIATIONS

The following abbreviations are added to those listed in Section 1-1.02, "Abbreviations," of the Standard Specifications:

BNC	Bayonet Nut Connector
CCD	Charge Coupled Device
CCITT	International Telegraph and Telephone Consultative Committee
CE Mark	European proof of conformity to standards, "CE" is French for "Conformite Europeenne"
CPU	Central Processing Unit
CSA	Canadian Standards Association
C-UL	Canadian Underwriters Laboratories
DLCI	Data Link Control Identifier
DMA	Direct Memory Access
EEMAC	Electrical Equipment Manufactures Advisory Council
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMI/RFI	Electromagnetic Interference/Radio Frequency Interference
ESO	Electrical Safety Orders of the Division of Industrial Relations, State of California
FCC	Federal Communications Commission
GFCI	Ground Fault Current Interrupter
THD	Total Harmonic Distortion
IACK	Interrupt Acknowledge
IDC	Insulation Displacement Connector
ICEA	Insulated Cable Engineering Association
IEC	International Electrotechnical Commission
I/O	Input / Output
IP-##	Ingress Protection (IP) Rating
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
JEDEC	Joint Electron Device Engineering Council
JIS	Japanses Industrial Standard
NEC	National Electrical Code
NETA	International Electrical Testing Association Inc.
NO	Normally Open
NC	Normally Closed
NFPA	National Fire Protection Association
NTSC	National Television Systems Committee
OSHA	Occupational Safety and Health Administration
OSI	Open Systems Interconnect
PVC	Polyvinyl Chloride
REA	Rural Electrification Administration
RTD	Resistance Temperature Detector
SCADA	Supervisory Control And Data Acquisition
SCSI	Small Computer Systems Interface
SDLC	Serial Data Link Control
TIA	Telecommunications Industry Association
VME	Versa Module Eurocard
TELCO	Telephone company
YBI	Yerba Buena Island

10-3.03 COST BREAK-DOWN

Cost break-downs shall conform to the provisions in Section 86-1.03, "Cost Break-Down," of the Standard Specifications and these special provisions.

The Engineer shall be furnished a cost break-down for each contract lump sum item of work described in this Section 10-3.

The cost break-down shall be submitted to the Engineer for approval within 15 days after the contract has been approved. The cost break-down shall be approved, in writing, by the Engineer before any partial payment for the items of electrical work will be made.

The cost break-down shall be divided in the following categories. Within each category, each item of work shall be broken down, as a minimum, to include the following listed items in addition to those listed in the Standard Specifications:

Substation Architectural Westbound

Substation Architectural Westbound electrical installation is shown on the Substation Architectural Westbound architectural electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors – list each size and type.
c. Conduit clamps and hangers – list each size and type.
d. Exit lights – list each type, model and wattage.
e. Light switches – list each type.
f. Building grounding system – list size and type conductor.
g. Smoke detector system – list each type.
h. Receptacles – list each type.
i. Equipment rental – list each over $500.00 – list size and type.
j. Lighting panel – list size and type.

Substation Architectural Eastbound

Substation Architectural Eastbound electrical installation is shown on the Substation Architectural Eastbound architectural electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors – list each size and type.
c. Conduit clamps and hangers – list each size and type.
d. Exit lights – list each type, model and wattage.
e. Light switches – list each type.
f. Building grounding system – list size and type conductor.
g. Smoke detector system – list each type.
h. Receptacles – list each type.
i. Equipment rental – list each over $500.00 – list size and type.
j. Lighting panel – list size and type.

Substation Westbound

Substation Westbound electrical installation is shown on the Substation Westbound electrical plans with the additional items to include:

a. Cables – list each size and type.
b. Pulling other system cables – list each size and type.
c. Conduit anchors, fittings and supports – list each size and type.
d. Cable trays – list each size and type.
e. Cable tray supports, hangers and anchors – list each size and type.
f. Cable tray straps – list each size and type.
g. Equipment grounding system – list size and type conductor.
h. Termination, splice and junction boxes – list each size and type.
i. Unit substation – list size and type.
j. 480 V Low Voltage Control Center (LVCC-B) – list size and type.
k. Battery charger and rectifier – list size and type.
l. 125 V (dc) battery – list size and type.
m. Safety switch for battery – list size and type.
n. 125 V (dc) panel – list size and type.
o. 30 kVA lighting and utility transformers – list size and type.
p. Utility panel – list size and type.
q. Equipment required for functional testing – list size and type.
r. Equipment rental - list each over $500.00 – list size and type.
s. Electrical hardware – list size and type.
t. 15 kV splice boxes – list each size and type.

Substation Eastbound

Substation Westbound electrical installation is shown on the Substation Eastbound electrical plans with the additional items to include:

a. Cables – list each size and type.
b. Pulling other system cables – list each size and type
c. Conduit anchors, fittings and supports – list each size and type.
d. Cable trays – list each size and type.
e. Cable tray supports, hangers and anchors – list each size and type.
f. Cable tray straps – list each size and type.
g. Equipment grounding system – list size and type conductor.
h. Termination, splice and junction boxes – list each size and type.
i. Unit substation – list size and type.
j, 480 V Low Voltage Control Center (LVCC-A) – list size and type.
k. Battery charger and rectifier – list size and type.
l. 125 V (dc) battery – list size and type.
m. Safety switch for battery – list size and type.
n. 125 V (dc) panel – list size and type.
o. 30 kVA lighting and utility transformers – list size and type.
p. Utility panel – list size and type.
q. Equipment required for functional testing – list size and type.
r. Equipment rental - list each over $500.00 – list size and type
s. Electrical hardware – list size and type.
t. 15 kV splice boxes – list each size and type.

Roadway Level Westbound

Roadway Level Westbound electrical installation is shown on the Roadway Level Westbound electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors, fittings and supports – list each size and type.
c. Wireways on service platforms – list size and type.
d. Equipment grounding conductors – list size and type.
e. Equipment grounding termination – list size and type.
f. Junction boxes – list each size and type.
g. Lifting devices – list size and type.
h. Receptacles – list size and type.
i. Lighting and utility transformers – list size and type.
j. Utility and lighting panels – list size and type.
k. Equipment required for functional testing – list size and type.
l. Equipment rental - list each over $500.00 – list size and type.
m. Electrical hardware – list size and type.
n. Mounting rack – list components and fabrication method.

Roadway Level Eastbound

Roadway Level Eastbound electrical installation is shown on the Roadway Level Eastbound electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors, fittings and supports – list each size and type.
c. Wireways on service platforms – list size and type.
d. Equipment grounding conductors – list size and type.
e. Equipment grounding termination – list size and type.
f. Junction boxes – list each size and type.
g. Lifting devices – list size and type.
h. Receptacles – list size and type.
i. 30 kVA lighting and utility transformers – list size and type.
j. Utility and lighting panels – list size and type.
k. Equipment required for functional testing – list size and type.
l. Equipment rental - list each over $500.00 – list size and type.

m. Electrical hardware – list size and type.
n. Mounting rack – list components and fabrication method.
o. Sealed joints for bike path steel box conduit penetrations – list components and fabrication method.

Girder Level Weastbound

Girder Level Westbound electrical installation is shown on the Girder Level Westbound electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Pulling other system cables - list each size and type.
c. Conduit anchors, fittings and supports – list each size and type.
d. Cable trays – list size and type and installation method.
e. Cable tray anchors, fittings and supports – list each size and type.
f. Hinge connections – list each size, type and installation method.
g. Bridge and equipment grounding system – list size and type.
h. Equipment grounding termination – list size and type.
i. Termination boxes – list each size and type.
j. Junction boxes – list each size and type.
k. 15 kV splice boxes - list each size and type.
l. Receptacles – list size and type.
m. Light switches – list size and type.
n. Equipment required for functional testing – list size and type.
o. Equipment rental - list each over $500.00 – list size and type.
p. Electrical hardware – list size and type.
q. Mounting rack – list components and fabrication method.
r. Embed strut channel – list size and type.

Girder Level Eastbound

Girder Level Eastbound electrical installation is shown on the Girder Level Eastbound electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Pulling other system cables - list each size and type.
c. Conduit anchors, fittings and supports – list each size and type.
d. Cable trays – list size and type and installation method.
e. Cable tray anchors, fittings and supports – list each size and type.
f. Hinge connections – list each size, type and installation method.
g. Bridge and equipment grounding system – list size and type.
h. Equipment grounding termination – list size and type.
i. Termination boxes – list each size and type.
j. Junction boxes – list each size and type.
k. 15 kV splice boxes - list each size and type.
l. Receptacles – list size and type.
m. Light switches – list size and type.
n. Equipment required for functional testing – list size and type.
o. Equipment rental - list each over $500.00 – list size and type.
p. Electrical hardware – list size and type.
q. Mounting rack – list components and fabrication method.
r. Embed strut channel – list size and type.

Navigation Lighting System

Navigation Lighting System is shown on the Navigation Lighting System electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors, fittings and supports – list each size and type.
c. Junction boxes – list each size and type.
d. Navigation relay cabinet – list each size and type.
e. Equipment required for functional testing – list size and type.

f. Equipment rental – list each over $500.00 – list size and type.
g. Electrical hardware – list size and type.
h. Threaded bolt sleeve – list size and type.

Supervisory Control and Data Acquisition Remote Terminal Unit System

Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU) System is shown on the SCADA Remote Terminal Unit System electrical plans with the additional items to include:

a. Remote Terminal Units (8 each) – list size and type.
b. Telephone terminal boxes – list size and type.
c. SCADA communication terminal boxes – list size and type.
d. Communication cable – list each size and type.
e. Telephone cable – list each size and type.
f. Equipment required for functional testing – list size and type.
g. Equipment rental - list each over $500.00 – list size and type.

Traffic Operations System

Traffic Operations System is shown on the Traffic Operations System electrical plans with the additional items to include:

a. Cable – list each size and type.
b. Conduit anchors, fittings and supports – list each size and type.
c. Preformed loops – list type.
d. Preformed loop pull box – list type.
e. Temporary enclosures for cable during construction – list size and type.
f. Microwave Vehicle Detection Sensor (MVDS) – list type.
g. MVDS mounting brackets, conduit and conduit connector – list size and type.
h. MVDS pull box – list type.
i. Camera station – list each component type.
j. Camera mount – list size and type.
k. Fiber optic cable splice closures – list type and size.
l. Cabinet equipment – list type.
m. Fiber optic cable – list type and installation method.
n. Equipment required for functional testing – list size and type.
o. Equipment rental - list each over $500.00 – list size and type.

Strong Motion Detection System

Strong Motion Detection System is shown on the Strong Motion Detection System electrical plans with the additional items to include:

a. Seismic cable – list size and type.
b. Interconnect cable – list size and type.
c. Telephone cable – list size and type.
d. Conduit anchors, fittings and supports – list each size and type.
e. Down-hole pull boxes – list each size and type.
f. Junction boxes – list each size and type.
g. Down-hole enclosures – list each size and type.
h. Sensor and recorder enclosures – list size and type.

Pile Corrosion Monitoring System

Pile Corrosion Monitoring System is shown on the Pile Corrosion Monitoring System electrical plans with the additional items to include:

a. Transducer test box – list size and type.
b. Stainless steel conduit – list by each size and installation method.
c. Telephone cable – list size and type.
d. Conduit anchors, fittings and supports – list each size and type.
e. Down-hole pull boxes – list each size and type.
f. Junction boxes – list each size and type.

g. Down-hole enclosures – list each size and type.
h. Sensor and recorder enclosures – list size and type.

10-3.04 CONSTRUCTION CONTRACT INTERFACE RESPONSIBILITY

The Contractor shall complete the intertie construction between the Skyway and the YBI and Main Span Contract, located at Hinge A, and the Skyway and the Oakland Contract, located at Hinge E, as shown on the plans. All mating of conduits, trays and grounding conductors at the two construction split points, including splicing of 15 kV cables, communications, signal, fiber-optic and control cables shall be performed by the Contractor. Sufficient lengths of "pigtails" will be provided by the other two contractors to bridge the construction split points, to the nearest splice box. All cable splices shall be enclosed in termination or splice boxes.

The Contractor shall perform acceptance tests of each termination and splice in accordance with latest applicable ICEA, International Electrical Testing Association Inc. (NETA) and IEEE standards. The tests shall include but not be limited to continuity, backscattering, attenuation and loss measurements of fiber-optic cables, including DC High Potential Tests, continuity and megger tests, as applicable, for each splice performed.

Reference is made to project plan Sheet EE-129, "Details Contract Interface Block Diagrams," for construction details.

10-3.05 CONDUIT

All conduit installed on the bridge shall be Type 2 unless otherwise specified. Conduit within the box girders and detector termination conduit shall be Type 1. All conduit installed in the barrier strip that are embedded into concrete shall be Type 1 or Type 2. Any conduit in the barrier strip that is not fully embedded in concrete shall be Type 2.

When a standard coupling cannot be used for joining Type 1 conduit, a UL listed threaded union coupling conforming to the provisions in Section 86-2.05C, "Installation," of the Standard Specifications, or a concrete-tight split coupling, or concrete-tight set screw coupling shall be used.

Pull ropes for use when installing cables in conduit shall consist of flat, woven, lubricated, soft-fiber polyester tape with a minimum tensile strength of 8000 N and shall have printed sequential measurement markings at least every meter.

After conductors have been installed, the ends of conduits terminating in pull boxes, enclosures, and cabinets shall be sealed with an approved type of sealing compound.

GALVANIZED RIGID STEEL CONDUIT, THREADED COUPLINGS, AND ELBOWS

The galvanized rigid steel (GRS) conduit, threaded couplings, and elbows shall conform to Section 86-2.05, "Conduit," of the Standard Specifications for Type 1 where shown on the plans.

POLYVINYL CHLORIDE COATED GALVANIZED RIGID STEEL CONDUIT, THREADED COUPLINGS, AND ELBOWS

The polyvinyl chloride (PVC) coated galvanized rigid steel (GRS) conduit, threaded couplings, and elbows shall conform to "Galvanized Rigid Steel Conduit, Threaded Couplings, and Elbows" as specified elsewhere in these special provisions shall conform to Section 86-2.05, "Conduit," of the Standard Specifications for Type 2 where shown on the plans.

POLYVINYL CHLORIDE COATED GALVANIZED RIGID STEEL CONDUIT BODIES

The polyvinyl chloride (PVC) coated galvanized rigid steel (GRS) conduit bodies shall conform to the following requirements before the PVC coating is applied:

a. The PVC-coated GRS conduit bodies shall conform to Federal Specification W-C-586D, and UL Standard No. 514B. The PVC-coated GRS conduit bodies zinc surfaces shall remain intact and undistributed on both the inside and outside throughout the preparation and application processing.
b. The PVC-coated GRS conduit bodies shall be "Hot-Dipped" galvanized inside and out after fabrication with "Hot-Dipped" galvanized threads. The zinc coating for PVC-coated GRS conduit bodies will be tested in accordance with ASTM Designation: A239.
c. The "Hot-Dipped" galvanized threads, the exterior, and the interior for the PVC-coated GRS conduit bodies shall have a urethane coated of a nominal thickness of 50 microns.
d. The PVC-coated GRS conduit bodies shall conform to the following requirements when the PVC coating is applied:

(1). All PVC-coated GRS conduit bodies shall conform to NEMA Standard No. RN-1.
(2). The bond between the coatings and the metal shall be greater than the tensile strength of the coatings.
(3). All PVC-coated GRS conduit bodies shall have an exterior PVC coating of a minimum thickness of 1 mm applied by dipping in liquid plastisol.

(4). All Hubs on PVC-coated GRS conduit bodies shall have a PVC sleeve extending one pipe diameter or 53 mm whichever is less. The inside diameter (I.D.) of the sleeve to be equal to the outside diameter (O.D.) of the uncoated pipe.
(5). Stainless steel encapsulated screws shall be supplied with all form 7 and form 8 PVC-coated GRS conduit bodies.
(6). The PVC coating on all form 8 PVC-coated GRS conduit bodies shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering the top of the conduit body around the opening.
(7). The PVC coating on all form 8 conduit body covers shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering at the bottom of the cover and mating with the flange of the conduit body.
(8). All PVC-coated GRS conduit bodies for conduits less than 103 mm shall be form 7 conduit bodies.

10-3.06 SUPPORT HARDWARE FOR CONDUITS, CABLE TRAYS AND WIREWAYS

STAINLESS STEEL POWER-STUD ANCHOR-THREADED VERSION

Stainless steel power-stud, anchor-threaded version shall have a one-piece anchor body with the length identification code. The anchor bodies shall be manufactured from Type 316 stainless steel and shall have an expansion mechanism, which consists of a pair interlocking independent wedges.

Anchors that have less than a 40 mm hole depth can be installed anywhere in the box. If the anchor will require a hole depth of greater than 40 mm, the Engineer will consult with the Structural Engineer of Record prior to approving the location and depth of the anchor. The f"c for the superstructure is 55 MPa. The average strength of the concrete will therefor be almost 62 MPa. As a consequence it will be difficult to drill.

Anchor Component	Component Material
Anchor Body	Type 316L Stainless Steel
Nut	Type 316L Stainless Steel
Washer	Type 316L Stainless Steel
Expansion Wedge	Type 316L Stainless Steel

BIKE PATH STEEL BOX PENETRATION SEAL JOINT

Sealed joint at the points of conduit penetration of the bike path steel box shall be designed and constructed in conformance with the provisions in these special provisions.

Working drawings shall be submitted as described in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

The sealed joint shall only be constructed when the inside of the bike path steel box is free of water. The sealed joint shall be a watertight seal that is sufficiently durable, as approved by the Engineer, to remain watertight for fifty years from the time of installation.

The plans show schematic routing of conduit installed inside of the bike path steel box. The Contractor shall align and secure conduit inside the bike path steel box, as approved by the Engineer, between the pull box and the lighting fixture or call box.

Full compensation for bike path steel box penetration seal joints shall be considered as included in the contract lump sum price paid for roadway level eastbound and no separate payment will be made therefor.

EMBED STRUT CHANNEL

Embed strut channels cast in performed concrete shall be installed done at the time of casting and not after. Embed struts shall be manufactured from 12-gage hot rolled steel. Load ratings shall have a safety factor of 3 in 136 kg. A electro-galvanizing and dichromate finishing process shall be applied after fabrication to achieve a 13 µm electro-galvanizing plating. The channels shall be of a standard size to accommodate standard channel fittings and nuts.

MOUNTING RACKS

Mounting racks shall be constructed from 12-gage steel channel. The steel shall be fabricated by a formed hot rolled steel method and have a 13 µm electro-galvanizing plating applied after fabrication. All fittings and hardware used for construction of the mounting racks shall be of steel with the same electro-galvanizing plating.

THREADED BOLT SLEEVES AND BOLTS

Threaded bolt sleeves required for the navigation light mounting plate shall conform to the requirements in ASTM Designation: A 36 and shall be installed by the concrete fabricator. The bolts shall conform to the requirements in ASTM Designation: A 37.

ELECTRICAL HARDWARE

All electrical hardware, including but not limited to, bolts, nuts, washers, lock washers, fastening screws, expansion anchors, U-bolts and hold-down clamps shall be Type 316L stainless steel unless otherwise noted.

CONDUIT AND TRAY SUPPORTS

The anchoring and supports of trays and conduits as shown on the plans are general for locations and methods only. The Contractor shall determine the metal framing strut support construction methods and details, at each support location, including location and length of support channel. Once determined, the Contractor shall submit to the Engineer for review and approval at least 30 working days prior to ordering or fabrication conduit and tray supports.

The Engineer will consult with the Structural Engineer of Record prior to approving concrete anchors requiring a depth of greater than 40 mm. Therefor it is recommended that support channels be embedded in the pre-fabricated concrete girder sections, during manufacture, for all trays and all major conduit runs. The following tray and conduit weight tables shall be used by the Contractor for determining the spacing of supports. The tables show the maximum probable mass of insulated copper conductors assuming maximum tray and conduit fill.

Conduit size in mm:	41	53	63	78	103
Mass in kg/m:	6.15	9	12.9	18.75	28.5

Tray size in mm:	305	610	762
Mass in kg/m:	37.5	75	93.75

Maximum tray support span shall be 4.9 meters.
Maximum conduit support span shall be 3.0 meters.

CABLE TRAY LADDER TYPE

Cable tray systems are defined to include, but are not limited to straight sections of ladder type cable trays, bends, tees, elbows, dropouts, supports and accessories.

Quality Assurance

The Contractor shall furnish to the Engineer a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," for each cable tray ladder types. The certificate shall be signed by the manufacturer's quality control representative and shall state that all materials and workmanship comply with the specifications and approved shop plans. The manufacturer shall be a firm regularly engaged in manufacture of cable trays and fittings of types and capacities required, whose products have been in satisfactory use in similar services. The cable tray ladder types shall comply with the following standards NEMA VE1, NEC Article 318, Underwriters Laboratory and NFPA 70B.

Cable Tray Sections and Components

Straight section and fitting side rails and rungs shall be made of ASTM Designation: A 570 and A 611 steel. The cable tray system shall be hot-dip galvanized after fabrication in conformance with the requirements in ASTM Designation: A 123. The cable tray side rails shall be stamped with the manufacturer's name, part number and material type. Transverse members (rungs) or corrugated bottoms shall be welded to the side rails with steel welding wire.

Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 229 mm on center. Rung spacing in fittings shall be 229 mm and measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface radius edge of 25 mm. Each rung must be capable of supporting a 91 kg concentrated load above the cable load at the center of the cable tray with a safety factor of 1.5. Tray sizes shall have 127-mm minimum usable load depth or as noted on the plans.

Straight tray sections shall have side rails fabricated as I-beams. Tray widths shall be as shown on plans. Tray fittings shall include all reducers, and vertical and horizontal bends. All fittings must have a minimum radius of 610 mm. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between an adjacent section of tray shall not exceed 330 μΩ. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray. (The splice plate shall be able to support the full load of the tray). Splice plates shall be manufactured of high strength steel. All hardware shall be stainless steel. Cable tray shall be supported at intervals of not more than 4.74 m. All conduit terminating at trays shall provide a continuous cable route by using bushings specifically suited for attaching conduit to the tray rail and for providing ground continuity.

Cable trays shall meet NEMA Class Designations 16B. The cable trays shall be manufactured by B-Line Systems, located in Chalfant, California or other approved manufacturer.

CABLE TRAY SOLID TROUGH TYPE

The solid trough type tray shall be the same as ladder type cable tray specified elsewhere in these special provisions except for the following. It shall be a solid bottom trough type tray with two longitudinal members (side rails) with a corrugated bottom welded to the side rails. The peaks of the corrugated bottom shall have a minimum flat cable-bearing surface of 70 mm and shall be spaced on 152-mm centers. The cable trays may be manufactured by B-Line Systems, located in Chalfant, California or other approved manufacturer. Solid bottom trays with covers shall be used for communications and signal wire trays. Tray fittings shall include all reducers, and vertical and horizontal bends. Cable tray shall be supported at intervals of not more than 4.74 m. All conduit terminating at trays shall provide a continuous cable route by using bushings specifically suited for attaching conduit to the tray rail and for providing ground continuity.

NEMA TYPE 4X WIREWAY

The wireway shall be NEMA Type 4x Continuous Hinge Feed-Through Wireway. It shall be 14-gage Type 304 stainless steel. The seams shall be continuously welded and ground smooth, no holes or knockouts. It shall have 10-gage stainless steel flanges with smooth, rounded edges on all sections and fittings preventing damage to the insulation of the wire. The stainless steel heavy butt hinges and door clamp assembly shall assure a complete seal between covers and bodies. The gasket and adhesive shall be oil-resistant. The solid oil-resistant gasket shall be positioned between flanges when sections and fittings are bolted together. The wireway shall meet the latest edition of the following industry standards NEMA Type 4X Enclosure, UL 870 and have a 2B finish. The physical size and dimensions shall be as shown on the plans. The wireway shall be manufactured by B-Line Systems (located in Chalfant, California), Hoffman or other approved manufacturer.

CABLE INSTALLATION IN CABLE TRAY

All cable installed in cable trays shall be dressed neatly, arranged in bundles by function and strapped to the cable tray at intervals no less than 600 mm using plastic ties.

10-3.07 PULL BOXES, SPLICE AND JUNCTION BOXES

BARRIER PULL BOXES (TYPE 9 AND 9A)

Type 9 and 9A barrier pull boxes shall be as shown on the plans and detailed on Standard Plan ES-9C, except the pull box shall have captive stainless steel cover screws.

BARRIER PULL BOXES (TYPE PB-1A)

Type PB-1A barrier pull boxes shall be used for weatherproof receptacles to be installed in the barriers. The pull box size shall be two gang tandem, sufficient for one outdoor barrier receptacle, and made of steel. The pull boxes shall be constructed of minimum 2-mm thick steel. All corner joints to be continuous seam welded. The physical size and dimensions shall be as shown on the plans. The barrier pull boxes (Type PB-1A) shall be extra deep.

OUTDOOR BARRIER RECEPTACLES

The receptacles to be installed in the barriers outdoor shall be rated 15 A, 120 V, weatherproof and with threaded caps which effectively seal the housing when not in use.

NEMA TYPE 4X STAINLESS STEEL PULL BOXES (TYPE PB-1D AND TYPE PB-2B)

The body and the cover plate of the NEMA Type 4X enclosure shall be made of 14-gage Type 304 or Type 316 stainless steel. The seams shall be continuously welded and ground smooth, no holes or knockouts. It shall have a seamless foam-in-place gasket that assures watertight and dust-tight seal. The gasket and adhesive shall be oil-resistant. All exterior hardware shall be Type 304 or Type 316 stainless steel.

The enclosure shall meet the latest edition of the following industry standards NEMA Type 4X Enclosure, UL870.

The box engraving, physical size and dimensions shall be as shown on the plans. The enclosure shall be manufactured by B-Line Systems, located in Chalfant, California, Hoffman or other approved manufacturer.

NEMA TYPE 12 PULL BOXES SINGLE DOOR (TYPE PB-2A, PB-3A, AND PB-4D)

The NEMA Type 12 single door pull box shall conform to the following:

Construction

a. Enclosure bodies are either 14-gage or 16-gage steel. All doors are 14-gage steel.
b. Seams shall be continuously welded and ground smooth, no holes or knockouts.
c. Shall have external mounting feet or be wall mounted.
d. Door and body stiffeners shall be provided in larger enclosure.
e. Rolled lip around three sides of door and all sides of enclosure opening excludes liquids and contaminants.
f. Door clamps are quick and easy to operate.
g. Door shall be removed by pulling heavy gage continuous hinge pin.
h. Hasp and staple for padlocking shall be provided.
i. Data pocket shall be high-impact thermoplastic.
j. Oil-resistant gasket attached with oil-resistant adhesive and held in place with steel retaining strips shall be provided.
k. Collar studs shall be provided for mounting panels.
l. The box engraving, physical size and dimensions shall be as shown on the plans.
m. Finish shall be white inside with ANSI 61 gray outside finish over phosphatized surfaces. Optional panels shall be white.

Industry Standards
a. UL 508 Type 12.
b. NEMA/EEMAC Type 12.
c. JIC standard EGP-1-1967 (14-gage only).
d. CSA Type 12.
e. IEC 529, IP-65.

NEMA TYPE 4X ENCLOSURES STAINLESS STEEL (TYPE PB-6C AND 7C)

General Enclosure Specification

The body and the door of the NEMA Type 4X enclosure shall be made of 14-gage Type 304 or Type 316 stainless steel. The seams shall be continuously welded and ground smooth, no holes or knockouts. It shall have a seamless foam-in-place gasket that assures watertight and dust-tight seal. It shall have a body stiffener in the larger size enclosures. The gasket and adhesive shall be oil-resistant. Enclosure shall have rolled lip around three sides of the door and all sides of the enclosure to assure a proper seal. All exterior hardware shall be Type 304 or Type 316 stainless steel. Enclosure shall have a hasp and staple for padlocking.

The door shall be removed by pulling stainless steel continuous hinge pin. The enclosure shall meet the latest edition of the following industry standards NEMA Type 4X Enclosure, UL870, and have a 2B finish.

The enclosure engraving, physical size and dimensions shall be as shown on the plans. The enclosure shall be manufactured by B-Line Systems, located in Chalfant, California, Hoffman or other approved manufacturer.

Navigation Lighting Relay Cabinet Enclosure (Type 6C)

The cabinet enclosure shall include selector switches, general-purpose relays (10 A switching capacity), current-sensing relays, indicating lights, terminal blocks, fuses and nameplates as shown on the plans. A photo electric control external from the cabinet enclosure shall be included as part of the system and shall be as described on the plans. All components to be installed on the panel shall be corrosion resistant and watertight.

SCADA and Telephone Termination Enclosure (Type 7C)

The cabinets shall include terminations for 50 twisted pair communications leads. Noise suppression resistors with a 1-percent tolerance shall be provided for each pair.

NEMA TYPE 12 ENCLOSURES STAINLESS STEEL (TYPE PB-7B and PB-7D)

The NEMA Type 12 stainless steel enclosures shall be single door junction box have the following specification:

Construction
a. Enclosure bodies are either 14-gage or 16-gage steel. All doors are 14-gage steel
b. Seams continuously welded and ground smooth, no holes or knockouts
c. External mounting feet or wall mounted
d. Door and body stiffeners in larger enclosure
e. Rolled lip around three sides of door and all sides of enclosure opening excludes liquids and contaminants
f. Door clamps are quick and easy to operate
g. Door removed by pulling heavy gage continuous hinge pin

h. Hasp and staple for padlocking
i. Data pocket is high-impact thermoplastic
j. Oil-resistant gasket attached with oil-resistant adhesive and held in place with steel retaining strips
k. Collar studs provided for mounting panels
l. The box engraving, physical size and dimensions shall be as shown on the plans

Finish
White inside with ANSI 61 gray outside finish over phosphatized surfaces. Optional panels are white.

Industry Standards
a. UL 508 Type 12
b. NEMA/EEMAC Type 12
c. JIC standard EGP-1-1967 (14-gage only)
d. CSA Type 12
e. IEC 529, IP-65

NEMA TYPE 4X FIBERGLASS ENCLOSURE (Type 8A)

Lighting and Utility Transformer panelboards, to be located outside on the platforms, shall be installed inside a NEMA Type 4X Fiberglass Enclosure. Fiberglass enclosures shall be molded polyester with seamless foam-in-place gasket to assure watertight and dust tight seal. The enclosure shall meet the requirements of UL508 for Type 4X enclosures. The enclosures are to have corrosion resistant polyester latches with corrosion resistant morel hinge pin and bail. The enclosure shall be manufactured by B-Line Systems, Hoffman, Mac Products or equal. The size of the enclosures is to be determined by the Contractor.

The Contractor may use a NEMA Type 4X Stainless Steel enclosure in lieu of a fiberglass enclosure.

15 kV SPLICE BOX

The high voltage splice box shall be NEMA Type 12 and minimum 1680 mm long, 915 mm wide, and 406 mm deep (nominal inside dimensions). The box shall conform to all applicable requirements in NEC, Article 370(D). Each cover shall be secured with at least ten stainless steel bolts. Cover makings for high voltage splice box shall read "High Voltage" and be permanently marked and readily visible. Enclosures and covers shall be stainless steel, Type 304 or 316, 14-gage minimum with seams continuously welded and ground smooth. High voltage splice box shall be installed at each high voltage cable splice location.

FIBEROPTIC SPLICE CLOSURE

The fiber optic splice closure shall consist of an outer closure, an inner closure and splice trays, as specified in these special provisions.

The fiber optic splice closure shall be designed for a temperature range from -30°C to +70°C.

The size of the closure shall allow for all the fibers of the largest fiber optic trunk cable to be spliced to a second cable of the same size, plus 12 additional pigtails. The closures shall be not more than 864 mm in length and not more than 203 mm in diameter. The closures shall be designed for fusion splicing.

All materials in the closures shall be non-reactive and shall not support galvanic cell action. The outer-closure shall be compatible with the other closure components, the inner closure, splice trays, and cables.

The end plate shall consist of two sections and shall have capacity for two fiber optics communication cables and 12 fiber optics pigtails or four fiber optic cables.

The outer-closure shall protect the splices from mechanical damage, shall provide strain relief for the cable, and shall be resistant to salt corrosion.

The outer-closure shall be waterproof, and re-enterable. The outer-closure shall be flash-tested at 103 kPa.

The inner-closure shall be of metallic construction.

The inner-closure shall be compatible with the outer closure and the splice trays and shall allow access to and removal of individual splice trays.

The splice trays shall be compatible with the inner-closure and shall be constructed of rigid plastic or metal.

Adequate splice trays shall be provided to splice all fibers of the communication cable with the greatest fiber count entering the closure, plus 12 pigtails.

The Contractor shall install the fiber optic splice closure on the cable trays where splicing is required. Splices to the distribution cable shall be mid-span access splices, allowing access to individual fibers at selected points without cutting the remaining fibers. The fiber optic splice closures shall be securely fastened to the cable tray using standard hardware found in communications manholes.

The Contractor shall provide all mounting hardware required to securely mount the closures to the cable tray.

The fiber optic splice closure shall be mounted horizontally in a manner as shown on the plans that allows the cables to enter at the end of the closure without exceeding any minimum bending radius specification.

Upon completion of the splices, the splice trays shall be secured to the inner closure.

The closure shall be sealed using a procedure recommended by the manufacturer that will provide a waterproof environment for the splices.

Care shall be taken at the cable entry points to ensure a tight salt resistant and waterproof seal is made which will not leak upon aging. It is acceptable to have multiple pigtails enter the fiber optic splice closure through one hole as long as all spaces between the cables are adequately sealed.

10-3.08 CONDUCTORS, CABLES AND WIRING

Splices shall be insulated by heat-shrink tubing of the appropriate size after thoroughly painting the spliced conductors with electrical insulating coating.

The minimum insulation thickness, at any point, for Type USE, RHH or RHW wire shall be 1.0 mm for conductor sizes No. 14 to No. 10, inclusive, and 1.3 mm for No. 8 to No. 2, inclusive. The minimum insulation thickness, at any point, for Type THW and TW wires shall be 0.69 mm for conductor sizes No. 14 to No. 10, inclusive, 1.02 mm for No. 8, and 1.37 mm for No. 6 to No. 2, inclusive.

600 VOLT SINGLE CONDUCTOR CABLE

All 600-volt single conductor cable shall be the following unless otherwise noted on the plans. The cables shall be insulated with a composite EPR/CSPE insulation rated for 600 volts. The cables shall be UL listed as Type RHH, RHW-2, or USE-2, VW-1 600 V. All cables No. 1/0 and larger shall be UL Type TC rated.

The conductor shall be soft annealed uncoated copper Class B stranded per ASTM B-8. The composite EPR/CSPE insulation shall meet the requirements of ICEA S-68-516, NEMA WC-8, and UL Standards 44 and 854. The composite insulation thickness shall be as follows:

Conductor Size	EPR/CSPE Thickness
No. 14 - No. 10	1.14 mm
No. 8	1.52 mm
No. 6 - No. 2	1.91 mm
No. 1 - No. 4/0	2.54 mm
250 kcmil – 500 kcmil	3.30 mm
750 kcmil – 1000 kcmil	3.68 mm

The cable surface shall be printed in a contrasting color with the following information:

a. Manufacturers' name
b. Plant number
c. Conductor size
d. Cable Type
e. Voltage Rating

The cable shall be manufactured by The Okonite Company, BICC Cables, Pirelli, or equal. Manufacturer shall furnish a notarized certificate of compliance to demonstrate cable furnished is in compliance with ICEA S-68-516 and UL 44.

600 VOLT MULTI-CONDUCTOR CABLE

All 600 volt rated multi-conductor cables shall be the following unless otherwise noted on the plans drawings. The cables shall be insulated with ethylene propylene rubber, assembled as a multi-conductor cable with flame resistant fillers and binder tape with an overall PVC jacket. The cables shall be capable of operating continuously in both wet and dry locations at conductor temperature of 90°C for normal operation, 130°C for emergency overload rating, and 250°C short circuit rating.

The conductors shall be soft annealed uncoated copper Class B stranded in conformance to the requirements in ASTM Designations: B 8. The single conductors shall be ethylene propylene rubber insulated meeting the requirements of UL 1581 and ICEA S-68-516. Color coding for sizes No. 10, 12, 14 and 16 AWG shall conform to the requirements in ICEA Method I Table K-2. Sizes No. 8 and larger shall be numerically coded using ICEA Method 4. The insulation thickness shall be as follows:

Conductor Size	EPR Thickness
No. 16	0.64 mm
No. 14 - No. 10	0.76 mm
No. 8 - No. 2	1.14 mm
No. 1/0 - No. 4/0	1.39 mm
250 kcmil – 500 kcmil	1.64 mm
750 kcmil - 1000 kcmil	2.03 mm

The insulated conductors (and grounding conductor if required) shall be cabled together with flame resistant fillers and binder tape. The jacket shall be extruded PVC meeting the physical and dimensional requirements of ICEA S-68-516. The cable shall pass the vertical tray flame test requirements of IEEE 383 and 1202 and UL 1277. The cable shall be UL listed as Type TC.

The cable surface shall be printed in a contrasting color with the following information:

a. Manufacturers' name.
b. Plant number.
c. Number of conductors.
d. Conductor size.
e. Cable Type.
f. Voltage Rating.

The cable shall be manufactured by The Okonite Company, BICC Cables, Pirelli, or equal. The manufacturer shall furnish a notarized certificate of compliance to demonstrate cable furnished is in compliance with ICEA S-68-516 and UL 1277.

CLOSED CIRCUIT TELEVISION CABLES

Television control (TVC) cable shall consist of 15 No. 18 conductors, unshielded and with an outer jacket. Each conductor shall have a minimum of 16 tinned copper strands with a minimum of 400-µm insulation. Individual conductor insulation shall be chrome PVC with a nominal thickness of 1 mm. The outside diameter of the jacket shall not exceed 14 mm.

Color code for TVC cable shall be:

1. Black
2. White
3. Red
4. Green
5. Orange
6. Blue
7. White/ Black
8. Red/ Black
9. Green/ Black
10. Orange/ Black
11. Blue/ Black
12. Black/ White
13. Red/ White
14. Green/ White
15. Blue/ White

Television power (TVP) conductors shall consist of three No. 14 (120 VAC, 120 VAC neutral, equipment ground) individually insulated, stranded copper conductors in conformance with the provisions in Section 86-2.08, "Conductors," of the Standard Specifications. The conductors shall be color coded black, white, and green respectively.

Television control power (TVCP) cable shall consist of twelve No. 18 conductors, unshielded with an outer jacket. Each conductor shall have a minimum of 16 tinned copper strands with a minimum of 400 µm insulation. Individual conductor insulation shall be polyvinyl chloride (PVC), rated for 300 V (see color code below). The jacket shall be chrome PVC with a nominal thickness of 1 mm. The outside diameter of the jacket shall not exceed 12 mm.

Color code for TVCP cable shall be:

1. Black

2. White
3. Red
4. Green
5. Orange
6. Blue
7. White/ Black
8. Red/ Black
9. Green/ Black
10. Orange/ Black
11. Blue/ Black
12. Black/ White

Television video (TVL) cable shall consist of an RG-6/U coaxial cable. Each cable shall be provided with a solid No. 18 copper clad steel center conductor and shall conform to the following requirements:

Electrical	TVL
Capacitance (picofarads/m nominal)	54.1
Impedance (ohms-nominal)	75
Velocity of propagation (nominal)	84%
D.C. loop resistance (ohms/100 m)	11.7

Attenuation at 20˚C:

Frequency (MHz)	TVL (Nominal dB/ 100 m)
5.0	1.90
30	3.64
108	6.40

Physical Specifications	TVL Nominal O.D. (mm)
Copper-clad steel center conductor	1.00
Foam polyethylene dielectric	4.57
Sealed APA tape with 1.6 mm overlap	4.75
Woven aluminum braid	5.39
Sealed APA tape with 1.6 mm overlap	5.49
Woven aluminum braid	6.12
Flooding compound	
PVC outer jacket	7.55

(APA = Aluminum polyolefin and aluminum with adhesive)
TVL cable shall be terminated with BNC plug connector at both ends.

Coaxial Cable Connectors (TVL Coaxial Cables)
Coaxial cable connectors for attaching Type TVL coaxial cable shall meet the following requirements:

1. Electrical:

Impedance	75 Ω nominal
Return loss	30 dB minimum (5 MHz to 300 MHz)
Rated working voltage	500 V rms

2. Mechanical:

Type of construction	Integral sleeve BNC
Method of attachment	Crimp-crimp
Composition	Bodies – alloy Finish - chromate conversion, silver plating, or other corrosion resistant metal

3. Environmental:

Temperature	-10˚C to +50˚C
Moisture	Weather resistance design

The mating connector for TVL cable in junction box shall be provided. The center contact of this jack shall be beryllium copper.

Testing

Testing of TVL cables and connectors shall be performed in accordance with the provisions in Section 86-2.14B, "Field Testing," of the Standard Specifications and these special provisions.

Cable lengths found to have faults shall be replaced and re-tested. The Contractor shall dispose of the removed faulty cable.

Prior to the beginning of work, each length of coaxial cable shall be tested for attenuation and faults to ensure compliance with specifications contained herein using a time domain reflectometer (TDR). For the purpose of these special provisions, a fault in a long length of cable is defined by one or more of the following:

a. Return loss measurements indicating that attenuation exceeds 3 dB at 5 MHz to 30 MHz in a portion of cable less than 3 m long.
b. A return loss measurement indicating that there is a short in the cable.
c. A return loss measurement indicating a cut or open circuit in the cable.
d. A visual inspection which reveals exposure of or damage to the cable shielding.

SHIELDED TWISTED PAIR CABLE

All shielded twisted pair No. 18 (0.832 mm^2) multi-conductor communication cables (fifty pairs, six pairs and two pairs) shall be solid annealed copper (per ASTM Designations: B 3 and ASTM B 8). The insulated single conductors shall be twisted into pairs. The insulation shall be flame-retardant cross-linked polyethylene with color code in conformance with the requirements in ICEA Method 1. The insulation shall be 0.76 mm nominal.

The cable components are cabled with non-hygroscopic fillers, as necessary, and an overall binder tape. The individual pairs shall be shielded with a 0.19 mm Aluminum/polymer tape with tinned copper drain wire applied helically over the pairs. The overall shield shall be a 0.19 mm Aluminum/polymer tape with tinned copper drain wire applied helically over the cable core.

The overall jacket shall be 2.8 mm Flame-retardant and sunlight resistant polyvinyl chloride (PVC). A nylon ripcord shall be applied longitudinally under the overall jacket to facilitate jacket removal.

The cable shall be suitable for Cable Tray use and have the following ratings and listings:

a. UL Type TC - 600 volt.
b. UL Class XL.
c. UL Subject 13 & 1277.
d. IEEE 383 & 1202.
e. ICEA S-66-524 - 600 volt.

The cable shall be manufactured by Belden Cable, The Okonite Company, BICC Cables, Pirelli, or equal. The manufacturer shall furnish a notarized certificate of compliance to demonstrate cable furnished is in compliance with ICEA S-68-516 and UL 44.

Communication Cable Splices

Splices should be avoided if possible. If necessary, splices for shielded No. 18 multi-conductor, twisted pair cables shall be as recommended by the cable manufacturer and suitable for the environment that the splice is located. The Contractor shall submit the cable manufacturer's recommended splicing method to the Engineer for approval prior to using the method. The Engineer shall approve splice locations.

15 kV CABLE

The 15 kV shielded single conductor power cable shall be 15 kV, 133 percent insulation rated power cable designed to operate at conductor temperatures of 90°C normal, 130°C emergency, and 250°C short circuit conditions as defined by ICEA S-93-693 (NEMA WC-7) and UL Standard 1072. The cable shall be suitable for installations above or below grade, indoors or outdoors, and in wet or dry locations. The qualifying cable shall be UL labeled as MV-90, Sunlight Resistant and for cable tray (CT) use in accordance with UL Standard 1072.

Conductors

The conductors shall be compressed, Class B stranded copper and shall be in accordance with the requirements of ICEA S-93-693. The copper conductors shall consist of all bare strands or tin-coated strands in the outer layer in conformance with the requirements in ASTM Designations: B 3, B 8 and B 33.

Conductor Shield

The conductor shield shall be an extruded, black-colored, non-conducting thermoset material in conformance with the provisions in Section 2.7 of ICEA S-93-693. The minimum average thickness shall be 0.5 mm.

Insulation

The insulation shall be a discharge resistant, ethylene propylene (EP) based compound and be listed by Underwriters Laboratories. The minimum average thickness of the insulation shall be 5.59 mm. The manufacturer shall perform the Insulation Corona Discharge Resistance Test (3.9.3.3 of ICEA S-93-693) tested in conformance with the requirements in ASTM Designation: D 2275-89, "Standard Test Method for Voltage Endurance of Solid Electrical insulating materials Subjected to Partial Discharges (Corona) on the Surface," and submit the results to the Engineer before acceptance of the cable.

Insulation Shielding

The insulation shielding shall consist of a nonmetallic conducting material extruded directly over the insulation and a 0.12-mm bare copper tape. The nonmetallic layer shall be black-colored with properties and thickness conforming to the requirements of Table 4a of ICEA S-93-693 and Tables 14.2 and 14.3 of UL-1072. The layer shall be free stripping from the EP insulation. The 0.12-mm bare copper tape shall be helical applied with a 15 percent overlap, directly over the nonmetallic layer.

Overall Jacket

The overall jacket shall be extruded black-colored Polyvinyl Chloride (PVC) material with physical properties and thickness in accordance with Section 4.4.5 and Table 4-6 of ICEA S-93-693 and shall be surface printed as required by UL Standard 1072.

Production Testing

Production testing shall consist of the following:

a. Continuous DC Spark testing of the non-conducting stress control layer prior to extrusion of the EP insulation.
b. Mooney Viscosity, Scorch Viscosity, and Specific Gravity of each batch of the EP insulation prior to extrusion.
c. AC Voltage Withstand test for a 5-minute duration, of each finished cable at 35 kV.
d. Volume Resistivity of the nonmetallic shield.
e. DC Resistance of all insulated conductors and metallic shields.
f. Dimensional Verification of all extruded layers.
g. Absence of water in conductors and interfaces confirmed.

Cable Accessories

The manufacturer of the splices and terminations shall have specialized in manufacturing of heat shrinkable cable accessories. The manufacturer of the splices and terminations shall be the Raychem Corporation or approved equal.

The cable splicer shall have experience and be certified by the splice and cable termination manufacturer. The splicer shall provide a resume documenting his experience and qualifications to be approved on this project.

Cable Terminations

The Termination shall be IEEE 48, Class 1, heat-shrinkable cable terminations in kit form, capable of properly terminating cables specified in this section. Terminations for single-conductor cables shall consist of heat-shrinkable

radiation crosslinked high dielectric constant linear stress relief material and heat-shrinkable radiation crosslinked non-tracking outer insulation. Terminations shall contain a high relative permittivity electric stress relief mastic for insulation shield cutback treatment and a heat-activated sealant for environmental sealing.

In addition to the components described above, three-conductor kits shall contain heat-shrinkable components to seal the cable jacket, phase conductors, ground wire and rejacket phase and ground conductors.

Cable Splices

The Splices shall be IEEE 404, heat shrinkable cable splices in kit form, capable of properly splicing cables specified in this section. Splice kits shall contain all necessary components to reinstate primary cable insulation, metallic shielding and grounding systems and overall jacket to the equivalent of the cable itself. Splices shall be of a uniform cross-section and shall consist of heat-shrinkable radiation crosslinked insulation. The outer insulating layer shall be bonded to a conducting layer for shielding. The splice shall be rejacketed with a heavy-wall, heat-shrinkable sealant lined sleeve to provide a waterproof hot melt adhesive seal. Splices shall contain heat-shrinkable radiation cross-linked high dielectric constant linear stress relief material. Splices shall contain a high relative permittivity electric stress relief mastic for insulation shield cutback treatment and a heat-activated sealant for environmental sealing. Kits shall allow splicing cables with different types of insulation, conductor sizes, and shielding construction. Kits shall accommodate commercially available standard connectors.

Splices of high voltage cable shall be avoided if possible. Where necessary, because of constructibility reasons, splice locations shall be approved by the Engineer. In general, splices of high voltage cables shall be scheduled so that the length of cable between splices is approximately 400 meters. All 15 kV splices shall be enclosed on a 15 kV splice box (Type PB-3A). A splice shall be scheduled at the construction boundaries. Where possible, longer cable runs are encouraged.

Cable End Sealing Caps

The End Seal Caps shall be heat-shrinkable crosslinked polymeric end sealing caps capable of sealing cables specified in this section. End caps shall be precoated with a heat activated sealant.

DC High Potential Test

Perform DC high potential test of each conductor in accordance with NEMA WC 5.

FIBER OPTIC OUTSIDE PLANT CABLE

General

Each fiber optic outside plant cable (FOP) for this project shall be all dielectric, gel filled, duct type, with loose buffer tubes and shall conform to these special provisions. The fiber optic (SMFO) cables shall interconnect the equipment at the communications hub building with the equipment at the communications nodes. SMFO fibers shall contain singlemode (SM) dual-window (1310 nm and 1550 nm) fibers.

Fiber optic cables shall be supplied in the configurations as shown on the plans and specified in these special provisions.

The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all dielectric central member. Aramid yarn and fiberglass shall be used as a primary strength member, and a medium or high density polyethylene outside jacket shall provide for overall protection.

All fiber optic (F/O) cable on this project shall be from the same manufacturer, who is regularly engaged in the production of this material.

The cable shall be qualified as compliant with Chapter XVII, Title 7, Part 1755.900 of the Code of Federal Regulations, "REA specification for filled fiber optic cables."

Fiber Characteristics

Each optical fiber shall be glass and consist of a doped silica core surrounded by concentric silica cladding. All fibers in the buffer tube shall be usable fibers, and shall be sufficiently free of surface imperfections and occlusions to meet the optical, mechanical, and environmental requirements of these specifications.

The coating shall be a dual layered, ultraviolet (UV) cured acrylate. The coating shall be mechanically or chemically strippable without damaging the fiber.

The cable shall comply with the optical and mechanical requirements over an operating temperature range from -40°C to +70°C. The cable shall be tested in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components." The change in attenuation at extreme operational temperatures (-40°C to +70°C) for the fiber shall not be greater than 0.20 dB/km, with 80 percent of the measured values no greater than 0.10 dB/km. The attenuation shall be measured at 1310 nm and 1550 nm.

Fibers within the finished cable shall meet the requirements in the following table:

Fiber Characteristics Table

Parameters	Value
Mode:	Single
Type:	Step Index
Core diameter:	8.3 µm (nominal)
Cladding diameter:	125 µm ±1.0 µm
Core to Cladding Offset:	=1.0 µm
Coating Diameter:	250 µm ±15 µm
Cladding Non-circularity, Defined as: [1-(min. cladding dia ÷max. cladding dia.)]x100	=2.0%
Proof/Tensile Test:	50 kpsi, min.
Attenuation: @ 1,310 nm @ 1,550 nm	=0.4 dB/km =0.4 dB/km
Attenuation at the Water Peak:	=2.1 dB/km @ 1383 ±3nm
Chromatic Dispersion:	
Zero Dispersion Wavelength:	1301.5 to 1321.5 nm
Zero Dispersion Slope:	=0.092 ps/(nm^2*km)
Maximum Dispersion:	=3.3 ps/(nm*km) for 1285 - 1330 nm <18 ps/(nm*km) for 1550 nm
Cut-Off Wavelength:	<1250 nm
Mode Field Diameter: (Petermann II)	9.3 ±0.5 µm at 1310 nm 10.5 ±1.0 µm at 1550 nm

Color Coding

Optical fibers shall be distinguishable from others in the same buffer tube by means of color coding according to the following:

1. Blue (BL)
2. Orange (OR)
3. Green (GR)
4. Brown (BR)
5. Slate (SL)
6. White (WT)
7. Red (RD)
8. Black (BK)
9. Yellow (YL)
10. Violet (VL)
11. Rose (RS)
12. Aqua (AQ)

The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

Cable Construction

A. General

The fiber optic cable shall consist of, but not be limited to, the following components:

1. Buffer tubes
2. Central member
3. Filler rods
4. Stranding
5. Core and cable flooding
6. Tensile strength member
7. Ripcord
8. Outer jacket

B. Buffer Tubes

Loose buffer tubes shall provide clearance between the fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes and shall not adhere to the inside of the tube. Each buffer tube shall contain 12 fibers.

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound shall be a homogenous hydrocarbon-based gel with anti-oxidant additives. It shall be used to prevent water intrusion and migration. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member by a method, such as the reverse oscillation stranding process, that will prevent stress on the fibers when the cable jacket is placed under strain.

Each buffer tube shall be distinguishable from other buffer tubes in the cable by using the same color coding as specified above for fibers.

C. Central Member

The central member, which functions as an anti-buckling element, shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. To ensure the proper spacing between buffer tubes during stranding, a symmetrical, linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

D. Filler Rods

Fillers may be included in the cable cross-section. Filler rods shall be either solid medium or high density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

E. Stranding

Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

F. Core and Cable Flooding

The cable core interstices shall be filled with a polyolefin based compound to prevent water ingress and migration. The flooding compound shall be homogeneous, non-hygroscopic, electrically non-conductive, and non-nutritive to fungus. The compound shall also be nontoxic, dermatologically safe and compatible with all other cable components.

G. Tensile Strength Member

Tensile strength shall be provided by high tensile strength aramid yarns and fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

H. Ripcord

The cable shall contain at least one ripcord under the jacket for easy sheath removal.

I. Outer Jacket

The jacket shall be free of holes, splits, and blisters and shall be medium or high density polyethylene (PE) with minimum nominal jacket thickness of 37 mils. Jacketing material shall be applied directly over the tensile strength members and flooding compound and shall not adhere to the aramid strength material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable", the number of fibers, year of manufacture, and sequential measurement markings every meter. The actual length of the cable shall be within ±1 percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.

General Cable Performance Specifications

The F/O cable shall withstand water penetration when tested with a one-meter static head or equivalent continuous pressure applied at one end of a one-meter length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in conformance with the requirements in EIA-455-82 (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

A representative sample of cable shall be tested in conformance with the requirements in EIA-455-81A (FOTP-81), "Compound Flow (Drip) Test for Filled Fiber Optic Cable". No preconditioning period shall be conducted. The cable shall exhibit no flow (drip or leak) at 80°C as defined in the test method.

Crush resistance of the finished F/O cables shall be 220 N/cm applied uniformly over the length of the cable without showing evidence of cracking or splitting when tested in conformance with the requirements in EIA-455-41 (FOTP-41), "Compressive Loading Resistance of Fiber Optic Cables". The average increase in attenuation for the fibers shall be =0.10 dB at 1550 nm (singlemode) for a cable subjected to this load. The cable shall not exhibit any measurable increase in attenuation after removal of load. Testing shall be in conformance with the requirements in EIA-455-41 (FOTP-41), except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes.

The cable shall withstand 25 cycles of mechanical flexing at a rate of 30 ±1 cycles/minute. The average increase in attenuation for the fibers shall be no greater than 0.20 dB at 1550 nm (singlemode) at the completion of the test. Outer cable jacket cracking or splitting observed under 10x magnification shall constitute failure. The test shall be conducted in conformance with the requirements in EIA-455-104 (FOTP-104), "Fiber Optic Cable Cyclic Flexing Test," with the sheave diameter a maximum of 20 times the outside diameter of the cable. The cable shall be tested in accordance with Test Conditions I and II of (FOTP-104).

Impact testing shall be conducted in conformance with the requirements in EIA-455-25 (FOTP-25) "Impact Testing of Fiber Optic Cables and Cable Assemblies." The cable shall withstand 20 impact cycles. The average increase in attenuation for the fibers shall be no greater than 0.20 dB at 1550 nm (singlemode). The cable jacket shall not exhibit evidence of cracking or splitting.

The finished cable shall withstand a tensile load of 2700 N without exhibiting an average increase in attenuation of greater than 0.20 dB (singlemode). The test shall be conducted in conformance with the requirements in EIA-455-33 (FOTP-33), "Fiber Optic Cable Tensile Loading and Bending Test." The load shall be applied for one-half hour in Test Condition II of the EIA-455-33 (FOTP-33) procedure.

Packaging and Shipping Requirements

Documentation of manufacturer’s compliance to the required optical fiber specifications shall be provided to the Engineer prior to ordering the material.

Attention is directed to "Fiber Optic Testing," elsewhere in these special provisions.

The completed cable shall be packaged for shipment on reels. The cable shall be wrapped in a weather and temperature resistant covering. Both ends of the cable shall be sealed to prevent the ingress of moisture.

Each end of the cable shall be securely fastened to the reel to prevent the cable from coming loose during transit. The 1,828 mm of cable length on each end of the cable shall be accessible for testing.

Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. A shipping record shall also be included in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation and bandwidth), factory test results, cable identification number and any other pertinent information.

The minimum hub diameter of the reel shall be at least thirty times the diameter of the cable. The F/O cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable.

Installation procedures and technical support information shall be furnished at the time of delivery.

Cable Installation

Prior to installation of the optical fiber cable, the Contractor shall test the cable on the shipping reel conforming to the provisions as described in “Arrival on Site,” elsewhere in these special provisions. The Contractor shall submit the manufacturer's recommended procedures for pulling the fiber optic cable to the Engineer for review and approval at least 20 working days prior to installing cables. Mechanical aids may be used to assist cable installation. A tension measuring device or breakaway swivel shall be placed between the end of the cable grip and pull rope, to ensure that the tension does not exceed 100 percent of recommended tension. The cable grips for installing fiber optic cable shall have a ball bearing swivel to prevent the cable from twisting during installation.

During cable installation, the bend radius shall be maintained at a minimum of twenty times the outside diameter of the cable. The cable shall not be stressed beyond the minimum bend radius at any time during installation.

F/O cable shall be installed using a cable pulling lubricant recommended by the F/O cable and the innerduct manufacturer and a non-abrasive pull tape conforming to the provisions described under "Conduit" elsewhere in these special provisions. The Contractor’s personnel shall be stationed at each splice vault and pull box through which the cable is to be pulled to lubricate and prevent kinking or other damage.

F/O cable shall be installed without splices except where specifically allowed on the plans or described in these special provisions. The 12 SMFO cables used for distribution shall be spliced only at splice vaults associated with cameras or video

nodes. The trunk cables shall be spliced only at splice closures associated with distribution cables. The slack shall be divided equally on each side of the splice closure.

A minimum of 18 meters of slack shall be provided for each unspliced cable at each splice vault. A minimum of 9 meters of slack shall be provided for each cable at each fiber optic splice closure.

Following installation of the cable in duct, all duct entrances in cabinets, pull boxes and vaults shall be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.

Unless shown or provided otherwise, only one F/O cable shall be installed in each innerduct.

Splicing

Optical fibers shall be spliced using the fusion type and shall not exceed 0.07 dB loss per splice.

The completed splices shall be placed in a splice tray. The splice tray shall then be placed in the splice closure.

Termination splices shall join the fibers in the F/O cable span to the fibers in pigtails. The individual fibers shall be looped one full turn within the splice tray to avoid macro bending. A 254-mm minimum bend radius shall be maintained during installation and after placing in the optical fiber splice tray. Each fiber shall be individually restrained in a splice tray. The optical fibers in buffer tubes and the placement of the optical fibers in the splice tray shall be such that there is no discernable tensile force on the optical fiber.

All fibers shall be labeled in the splice tray with permanent vinyl markers. Pigtail ends shall also be labeled to identify the destination of the fiber.

Passive Cable Assemblies and Components

The F/O cable assemblies and components shall be compatible components, designed for the purpose intended, and manufactured by a company regularly engaged in the production of material for the fiber optic industry. All components or assemblies shall be best quality, non-corroding, with a design life of at least 20 years. All components or assemblies of the same type shall be from the same manufacturer.

Fiber Optic Cable Terminations

1. General

Fiber optic cable terminations shall include pigtails and jumpers. Breakout cables shall comply with the specifications for pigtails. Fiber optic outside plant cable entering a building shall be routed through rigid steel conduit as required by the NEC, except where a transition to F/O inside plant (FOIP) cable is shown on the plans. The cable shall continue within the conduit to the designated termination point for distribution "breakout".

All components shall be the size and type required for the specified fiber.

All FOIP cable on this project shall be from the same manufacturer, who is regularly engaged in the production of this material.

2. Distribution Breakout

Fiber optic cables arrives within the hub building, main or intermediate distribution frame (MDF/IDF) room, shall be routed within conduit to a wall or ceiling mounted cable storage cabinet, as shown on the plans, where a minimum of 6 meter of spare cable shall be coiled for future use. The cable shall be terminated in a fiber distribution frame (FDF).

The cable jacket, aramid yarn and filler rods shall be removed exposing the buffer tubes. The exposed length of the buffer tubes shall be at least the length recommended by the hardware manufacturer which allows the tubes to be secured to the splice tray. Buffer tubes shall be secured to the splice tray. The remainder of the tubes shall be removed to expose lengths of the individual fibers sufficient for routing on the splice tray, as described in "Splicing" elsewhere in these special provisions. Moisture blocking gel shall be removed from the exposed buffer tubes and fibers. The manufacturer's directions shall be followed to ensure that throughout the specified temperature range gel will not flow from the end of the buffer tube. The individual fibers shall be stripped and prepared for splicing.

Fiber Optic Cable Assemblies

Cable assemblies (jumpers and pigtails) shall be products of the same manufacturer. The cable used for cable assemblies shall be made of fiber meeting the performance requirements of these special provisions for the F/O cable being connected, except that the operating temperature shall be modified to be from -20°C to +70°C. The manufacturer's attenuation test results shall be provided for all cable assemblies.

1. Pigtails

Pigtails shall be of simplex (one fiber) construction, in 900-µm tight buffer form, surrounded by aramid for strength, with a connector on one end. The outer jacket shall be PVC with a nominal diameter of 3 mm, marked with the manufacturer's identification information. All pigtails shall be at least one meter in length. Pigtails installed in conduit shall

follow the installation procedures outlined for fiber optic cables, except that the pulling tension shall not exceed 890 N. All pigtails shall be factory fabricated.

2. Patchcords

Patchcords may be of simplex or duplex design. Duplex jumpers shall be of duplex round cable construction, and shall not have zipcord (siamese) construction. All patchcords shall be at least 2 meters in length, sufficient to avoid stress and allow orderly routing. Patchcords shall have connectors on both ends.

The outer jacket of duplex patchcords shall be yellow. The two inner simplex jackets shall be contrasting colors to provide easy visual identification for polarity. All patchcords shall be factory fabricated.

3. Connectors

Connectors shall be of the ceramic ferrule ST type. Outdoor ST connector body housing shall be glass reinforced polymer. No index-matching fluids, gels or anti-reflection coating shall be applied to the end of the fiber.

The ST connector operating temperature range shall be from -40°C to +70°C. Insertion loss shall not exceed 0.4 dB, and the return reflection loss shall be at least 35 dB. Connection durability shall be less than a 0.2 dB change per 500 mating cycles in conformance with the requirements in EIA-455-21A (FOTP-21). All terminations shall provide a minimum 222 N pull out strength. The installed ST connector loss shall be less than 0.9 dB. Factory test results shall be documented and submitted to the Engineer prior to installing any connectors. Connectors shall have a yellow color body or boot.

All connectors shall be factory-installed and tested. There shall be no installation of connectors in the field.

All unmated connectors shall be installed with protective caps.

4. ST Couplers

The ST couplers shall be made of nickel plated zinc or a glass reinforced polymer that is consistent with the material forming the associated ST connector body. The design mechanism for mounting the coupler to the fiber distribution unit (FDU) connector panel may be flanged or threaded but shall coincide with the FDU panel punch-outs.

All coupler sleeves shall be ceramic of the split clamshell or clover leaf design.

The temperature operating range for couplers shall be the same as that specified for the ST connectors.

Fiber Distribution

The fiber distribution unit shall consist of a EIA 482.6 mm rack, a compartment for termination and distribution cable tray and a compartment for a splice drawer. The termination and distribution cable trays shall accommodate 48 singlemode optical fibers. The termination and distribution cable trays shall have sufficient tray areas for excess optical fiber storage with provisions to assure that the optical fibers do not exceed a 51-mm bend radius. The termination and distribution cable trays shall include a designation strip for identification of the 48 singlemode optical fibers. Each splice drawer shall include two splice trays with each splice tray capable of accommodating 24 fusion type splices. Each splice drawer shall allow for storage of excess lengths of the optical fibers of fiber optic cables. Each fiber distribution unit shall be provided with cable clamps to secure fiber optic cables to the chassis.

Installation

The Contractor shall install sufficient quantity of fiber distribution units to terminate all fibers in the largest cable. The fiber distribution units shall be mounted in the equipment racks as shown on the plans. At each fiber distribution unit, the Contractor shall terminate the optical fibers of the two fiber optic cables. The optical fibers shall be spliced to the single mode optical fiber cables assemblies within the splice tray(s). The optical fibers shall be of appropriate lengths to allow for future splicing with the splice drawer and shall be appropriately identified (tagged). All splices shall be fusion type and shall be arranged within the splice trays of the fiber distribution unit in accordance with the organizational design of the splice trays. Appropriate protective coating shall be applied to all fusion splices.

Full compensation for fiber distribution unit shall be considered as included in the contract price paid for the item requiring fiber distribution unit and no separate payment will be made therefor.

Fiber Optic Testing

1. General

Testing shall include the tests on elements of the passive fiber optic components: (1) at the factory, (2) after delivery to the project site but prior to installation, and (3) after installation but prior to connection to any other portion of the system. The Contractor shall provide all personnel, equipment, instrumentation and materials necessary to perform all testing. The Engineer shall be notified two working days prior to all field tests. The notification shall include the exact location or portion of the system to be tested.

Documentation of all test results shall be provided to the Engineer within 2 working days after the test involved. The Contractor's attention is directed to "As-Builts" elsewhere in these special provisions, regarding the requirements for recording test results.

A minimum of 15 working days prior to arrival of the cable at the site, the Contractor shall provide detailed test procedures for all field testing for the Engineer's review and approval. The procedures shall include the tests involved and how the tests are to be conducted. Included in the test procedures shall be the model, manufacturer, configuration, calibration and alignment procedures for all proposed test equipment.

2. Factory Testing

Documentation of compliance with the fiber specifications as listed in the Fiber Characteristics Table shall be supplied by the original equipment manufacturer. Before shipment, but while on the shipping reel, 100 percent of all fibers shall be tested for attenuation. Copies of the results shall be (1) maintained on file by the manufacturer with a file identification number for a minimum of 7 years, (2) attached to the cable reel in a waterproof pouch, and (3) submitted to the Contractor and to the Engineer.

3. Arrival On Site

The cable and reel shall be physically inspected on delivery and the attenuation shall be measured for 100 percent of the fibers. The failure of any single fiber in the cable to comply with these specifications, is cause for rejection of the entire reel. Test results shall be recorded, dated, compared and filed with the copy accompanying the shipping reel in a weather proof envelope. Attenuation deviations from the shipping records of greater than 5 percent shall be brought to the attention of the Engineer. The cable shall not be installed until completion of this test sequence and the Engineer provides written approval. Copies of traces and test results shall be submitted to the Engineer. If the test results are unsatisfactory, the reel of F/O cable shall be considered unacceptable and all records corresponding to that reel of cable shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at the Contractor's expense. The new reels of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

4. Outdoor Splices

The Contractor shall verify the insertion loss quality of each splice as provided elsewhere in these special provisions, prior to sealing the splice closure.

5. Optical Time Domain Reflectometer Testing

Once the passive cabling system has been installed and is ready for activation, 100 percent of the fiber links shall be tested with the optical time domain reflectometer (OTDR) for attenuation at wavelengths of both 1310 nm and 1550 nm. Test results shall be recorded, dated, compared and filed with previous copies. A hard copy printout and an electronic copy of traces and test results shall be submitted to the Engineer in the format designated by the Engineer.

The OTDR shall be capable of recording and displaying anomalies of at least 0.02 dB.

6. Power Meter and Light Source

At the conclusion of the OTDR testing, 100 percent of the fiber links shall be tested end to end with a power meter and light source, in accordance with EIA Optical Test Procedure 171 and in the same wavelengths specified for the OTDR tests. These tests shall be conducted in both directions and the differential in test results shall not exceed 0.5 dB. Test results shall be recorded, compared, and filed with the other recordings of the same links. Test results shall be submitted to the Engineer.

7. Cable Verification Worksheet

The Cable Verification Worksheet shown in Appendix A shall be completed for 100 percent of all links in the fiber optic system, using the data gathered during cable verification. The completed worksheets shall be included as part of the system documentation in the As-Built Plans.

8. Test Failures

If the link loss measured from the power meter and light source exceeds the calculated link loss, or the actual location of the fiber ends does not agree with the expected location of the fiber ends (as would occur with a broken fiber), the Fiber Optic Link will not be accepted. The unsatisfactory segments of cable, or splices shall be replaced with a new segment of cable or splice at the Contractor's expense. The OTDR Testing, Power Meter and Light Source Testing and Cable Verification Worksheet shall be completed for the repaired link to determine acceptability. Copies of the test results shall be submitted to the Engineer. The removal and replacement of a segment of cable shall be interpreted as the removal and replacement of a single contiguous length of cable connecting two splices, two connectors. The removal of only the small section containing the failure and therefor introducing new unplanned splices, will not be allowed.

APPENDIX A
Cable Verification Worksheet

Contract No. _____ Contractor: _____

Operator: _____ Date: _____

Link Number: _____ Fiber Number: _____

Test Wavelength (Circle one): 1310 1550

Expected Location of fiber ends:
End 1: _____ End 2: _____

OTDR Test Results:			
Forward Loss:	_____	dB	1A
Reverse Loss: [(1A + 1B)/2]	_____	dB	1B
Average Loss:	_____	dB	1C
Power Meter and Light Source Test Results:			
Forward Loss:	_____	dB	2A
Reverse Loss:	_____	dB	2B
Average Loss [(2A + 2B)/2]:	_____	dB	2C
Calculated Fiber Loss			
Length of the link (from OTDR):	_____	km	3A
Allowed loss per km of fiber:	0.4 dB/km		3B
Total Allowed Loss due to the fiber (3A * 3B):	_____	dB	3C
Calculated Splice Loss			
Number of Splices in the Link:	_____		4A
Allowed Link Loss per Splice:	0.10 dB		4B
Total Allowed Loss due to Splices (4A * 4B):	_____	dB	4C
Calculated Link Loss			
Connector Loss:	0.9 dB		5A
Total Link Loss (5A + 3C + 4C):	_____	dB	5B
Cable Verification:			
Compare Power Meter Average Loss to Calculated Link Loss (2C - 5B):	_____	dB	6A

If the value of 6A is greater than zero, the link has failed the Test. See Test Failures elsewhere in these Special Provisions.

To Be Completed by Caltrans:

Resident Engineer's Signature: _____ Cable Link Accepted: _____

10-3.09 SEISMIC ANCHORING

All equipment shall be mounted and braced to withstand, without damage, seismic acceleration forces in both horizontal and vertical directions of 0.33 G, for installation in Seismic Zone 4, in accordance with the Uniform Building Code (UBC), Section 2312. The anchoring methods are to be submitted for review by the Engineer. The installation shall meet requirements of the Essential Services Building Seismic Safety Act, Senate Bill 230, Title 24.

10-3.10 STRUCTURE GROUNDING

The 500 kcmil grounding conductor, spanning the bridge, shall at each pier be connected to two-pier girder ground stations. The two 250 kcmil grounding conductors, to be embedded in all pier columns and exothermic welded to the pier footing collar, shall at each pier be connected to the two-pier girder ground stations. The bridge system ground is made up of the two-pier-grounding conductors, the 500 kcmil grounding conductor and the pier girder ground stations. All bridge electrical components shall be grounded to this system as shown on the plans.

10-3.11 TRAFFIC OPERATION SYSTEM

The traffic operation system shall include the installation of closed circuit television camera stations, changeable message sign stations, preformed loop detector stations, microwave vehicle detection sensor system, fiber optic data modems and fiber optic system, as shown on the plans and in conformance with these special provisions.

The contract unit prices paid for items listed in the Engineer's Estimate to be installed under traffic operation system shall cover all requirements and delivery to the project for installation by the Contractor. The cost of installing, testing after installation and receiving the Engineer's approval for traffic operation system, of those items listed below, shall require the proper operation and approval of their respective sub-systems they are part of:

Camera with housing.
Pan and tilt unit.
Camera control unit.
Video transmitter duplex data.
Preformed loop detector station.
Microwave vehicle detection sensor system.
Fiber optic data modem.
Fiber optic cables of various types.
Fiber optic splice closure.

TRAFFIC OPERATIONS SYSTEM EQUIPMENT TESTING

Prior to shipping to the project, the Contractor shall submit the following items to the State of California, Department of Transportation Laboratory, 5900 Folsom Blvd., Sacramento, CA 95819 for acceptance testing:

Camera units
Pan and tilt units
Camera control units
Video transmitter duplex data units

Approximately 30 days will be required for the testing. The Contractor will be notified upon completion of the testing and shall arrange for delivery of the equipment to a storage location designated by the Contractor. The costs of such testing and the transportation to and from the laboratory shall be borne by the Contractor.

CLOSED CIRCUIT TELEVISION CAMERA STATION

The Contractor shall install the following closed circuit television (CCTV) equipment at each camera station as described in these special provisions and as shown on the plans:

1. One camera unit with housing.
2. One pan and tilt unit.
3. One camera junction box.
4. One camera control unit.
5. One video transmitter duplex data.
6. One State-furnished Model 170 controller assembly (described elsewhere in these special provisions).
7. One fiber optic data modem (described elsewhere in these special provisions).

8. Cable, connectors and fittings (as required.)

1. Camera Unit With Housing

Each camera unit shall consist of a camera, lens, environmental housing and camera unit cable assembly. The camera, lens and environmental housing, combined, shall not weigh more than 6.8 kg. Each camera unit shall be interchangeable with the existing camera units already installed on various traffic operations system (TOS) projects without changes or adjustments to either the system or the camera unit.

Each camera unit shall be assembled, inspected, and tested in accordance with these special provisions prior to delivery to the job site. Installation, operations and maintenance manuals shall also be submitted at the time of delivery.

Applicable Documents - The following documents of the U.S. Military Specification (MIL-SPEC), Underwriters' Laboratory, Inc. (UL), Electronics Industries Association (EIA) Standards, and other Standards form parts of the specification to the extent specified in these standards. In the event of a conflict between the content of this section and the content of the specification, the standards defined in this section shall supersede.

Military Specification Documents	
MIL-I-45208A	Inspection System Requirements, Dec. 16, 1963
MIL-C-45662	Calibration System Requirements, June 10, 1980
MIL-STD-416A	Electromagnetic Interface Characteristics Requirements for Equipment, Subsystems & Systems, Aug. 1, 1968
MIL-E-5400T	Electronic Equipment, Airborne General Specification
MIL-STD-810	Environmental Test Methods, 19 July 1983
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys, June 3, 1970

Underwriters' Laboratory, Inc. and other documents	
UL-796	Printed Circuit Boards
EIA-170A	Electrical Performance Standards Color Television Studio Facilities
EIA RS-330	Electrical Performance Standards for Closed Circuit Television (CCTV) Camera 525/60 Interlaced

A. Camera

Approved Camera - The cameras listed below have been approved by the Engineer. Further information such as the source of the cameras can be provided upon demand. Any camera submitted by the Contractor that is not one of the approved cameras listed below shall be stringently compared to the specifications set forth in these special provisions before it is approved by the Engineer. Approved cameras are Cohu 8240 and Sony SSC-C374.

(1) General -

a. Each camera shall be self-contained and designed for continuous unattended 24-hour operation.
b. Camera performance shall meet or exceed EIA-170A standards.
c. Each camera shall have automatic sensitivity and black level control so that it operates without further adjustment when illumination ranges from the minimum specified herein to that of full daylight.
d. Each active electronic device within the camera shall be solid-state.
e. Each camera shall have a switch selectable electronic shutter. The shutter speed shall range from 1/60 of a second (off) to 1/10,000 of a second in 8 steps. The control of the electronic shutter rate shall be accessible through a side panel opening. Remote on/off control of the shutter shall be accomplished via an output connector on the rear of the environmental housing.

(2) Light sensitivity - At a scene with 50 percent light reflectivity and with light level on the scene measured to be 10 lux and greater, each camera with its 10:1 zoom lens shall generate a picture on the monitor specified in these special provisions which resolves all 10 shades of gray on the EIA Television Test Chart. Not every camera shall be required to resolve the same gray scale when the light level on the same scene is measured to be less than one lux.

(3) Electrical Power - Each camera shall operate when the applied voltage is between 95 to 130 VAC, 60 Hz ±0.3 Hz, single phase. The power consumption of camera shall not exceed 10 W. All camera circuitry shall be powered by a regulated, over-voltage protected DC power supply contained in the camera.

(4) Synchronization –

a. Each camera shall generate synchronization signals by means of a single integrated circuit.
b. Each camera shall operate with the internal EIA-170A crystal as the sync reference source with the field rate of 59.94 Hz.
c. Each camera shall have the capability of synchronizing to an external input source.
d. The synchronization signal at the video output shall conform to EIA-170A.

(5) Scanning - Each camera's mode of scanning shall be two-to-one interlaced at 525 lines, 60 fields per second, as specified by EIA-170A.

(6) Video Processing -

a. The video output level shall be maintained to within 3 dB for changes in scene brightness of 0.17 to 109 600 cd/m^2 using a motorized iris lens having a transmission range of F/1.2 to F/1200.
b. Each camera shall have a black-level control system.
c. Each camera shall have an automatic white (color) balance control to maintain proper color rendition by automatically referencing to white areas of the scene. Manual control of the white balance shall be accessible through side panel or remotely controlled via the rear connector on the environmental enclosure.
d. Automatic gain control (AGC). The switch selectable fixed gain response shall maintain the output video level to 90 percent video when the light level on the image sensor falls too low to maintain full video output. The video out will be maintained at 90 percent peak-average setting to optimize video output under varying lighting conditions. The controls for the on/off and peak average adjustments shall be accessible through the side panel of the camera.
e. One 75 Ω (±1 percent) source-terminated, single-ended video output jack shall be provided.
f. An adjustable white clipper shall be provided to limit highlight brightness.
g. The video output level shall be 1.0 V peak-to-peak composite (0.7 V video, 0.3 V sync) signal, polarity black negative, across a 75 Ω load impedance.
h. The minimum signal-to-noise ratio shall be 50 dB at 25°C.

(7) Imager -

a. Each camera shall be designed to use a 12.7 or 16.9 mm format solid-state, color, interline transfer charged-coupled device (CCD) imager.
b. The imager shall have a minimum resolution of 768 horizontal by 493 vertical active picture elements.
c. When provided with 6.89 lux of highlight illumination on the environmental housing window, the camera shall provide the following resolution with AGC off:

i. Horizontal center resolution shall be 460 TV lines minimum.
ii. Vertical resolution shall be 350 TV lines minimum in the center and all corners simultaneously.

(8) Mechanical -

a. All camera circuitry shall be on a printed circuit board which shall be removable and replaceable using no more than common hand tools.
b. Test points and adjustment identifications shall be etched or silk-screened on the boards.
c. Each camera shall be self-supporting and operable when removed from the environmental housing and shall have a lens adapter ring which accommodates a standard 16 mm C-mount. A back focal distance adjustment shall be provided.
d. Each camera shall utilize the rigidity of the environmental housing for strength against shock and vibration.

(9) Environmental Operation –

Each camera within its environmental housing shall withstand the following requirements:

a. Operate over an ambient temperature range on -10°C to +50°C with the use of heaters.
b. Peak random vibration of 5 g from 60 to 1000 Hz, with camera in operation.
c. Shock up to 15 g in all axes under non-operating conditions.
d. Exposure to sand, dust, fungus, and salt atmosphere as per MIL-E-5400T paragraphs 3.2.24.7, 3.2.24.8, 3.2.24.9, and 3.2.24.10.
e. Up to 100 percent relative humidity as per MIL-E-5400T, paragraph 3.2.24.2.

(10)Picture Quality -

a. The quality of the picture shall be such that most objects in low light levels can be distinguished without excess interference from undesirable picture attributes.
b. Undesirable picture attributes include blooming, transfer smear, and vertical register shifting.

B. Lens

(1) General -

a. Each lens shall be fully compatible with the camera provided.
b. Each lens shall have a maximum aperture of no less than F/1.2, and a minimum range of F/1.2 to F/1200.
c. Each lens shall be a 16-mm C-mount.
d. Each lens shall have a minimum zoom range of 10 to 1. The lens focal length for a 16.9-mm CCD camera shall be 10-100 mm, 10.5-105 mm or 11-110 mm. The lens focal length for a 12.7-mm CCD camera shall be shall be 8-80 mm. A 1.5-X extender shall be included with the lens.
e. Each lens shall be equipped with a motorized zoom and focus control.
f. Each lens shall have an automatic, motor-driven iris with manual override. The iris shall be controlled directly through the camera in automatic mode and from the camera control unit in the manual mode. The automatic iris shall provide continuous aperture adjustments of the lens as determined by the amount of light reaching the camera imager. The power supply and electronics for iris motor shall be contained within the environmental housing.
g. Each lens shall be fitted with an intra-spot neutral density filter.
h. Each lens must be able to respond to the following inputs from camera control unit (CCU) for lens control:

Focus near	+9.0VDC @ 100 mA
Focus far	-9.0VDC @ 100 mA
Zoom in	+9.0VDC @ 100 mA
Zoom out	-9.0VDC @ 100 mA
Iris closed	+9.0VDC @ 100 mA
Iris open	-9.0VDC @ 100 mA

i. The travel time for the upper limit stop to the lower limit stop for zoom and focus shall be from 5 seconds minimum to 10 seconds maximum.
j. Each lens shall have the capability of at least 10 pre-positioning positions.

(2) Environmental Operation

Each lens within its pressurized environmental enclosure shall withstand the following requirements:

a. Operate over an ambient temperature range on -10°C to +50°C with the use of heaters.
b. Peak random vibration of 5 g from 60 to 1000 Hz, with lens in operation.
c. Shock up to 15 g in all axes under non-operating conditions.
d. Exposure to sand, dust, fungus, and salt atmosphere as per MIL-E-5400T paragraphs 3.2.24.7, 3.2.24.8, 3.2.24.9, and 3.2.24.10.
e. Up to 100 percent relative humidity as per MIL-E-5400T, paragraph 2.24.2.

C. Environmental Housing

(1) General

a. Each camera and lens shall be mounted in a sealed, cylindrical, environmental housing which shall not exceed 165 mm in diameter and 560 mm in length.
b. The housing shall be fabricated of seamless aluminum tubing Type 6061-T6 and shall be finished with heat reflecting, weather resisting enamel. The rear plate shall be fabricated of Type 6061-T6 aluminum.
c. The front of the housing shall be closed with a clear optically flat glass or Lexan window.

d. The housing shall include a sun shroud which shall be strapped to the housing bindings in such a manner as to minimize heat conduction by maintaining air space between shroud and housing. The shroud shall shield the entire top portion of the housing from the sun, and shall extend a minimum of 76 mm in front of the housing's glass plate.
e. The housing shall not interfere with the widest viewing angle of the lens.
f. The housing shall include a thermostatically controlled heating pad rated at 115 VAC, 100 W maximum.
g. The backplate, which is an integral part of the housing, shall have a nameplate attached bearing the manufacturer's camera assembly model number and serial number.
h. Camera connector -

    i. The camera connector shall be designed to MIL-C-28462 Series 1 specifications with solder contacts. It shall be Type PT-07C-20-39 P, the male counterpart to Type PT-06A-20-39 S (SR).
    ii. The connector shall be made of the same shell material and pin arrangement as the Type PT-06A-20-39 S (SR) connector on the end of the wiring harness.
    iii. The pinout of the connector shall be as shown on the plans.
    iv. Each camera connector shall be mounted on the rear plate with an airtight connection and a watertight seal for each conductor on its connecting cable.

i. Each camera shall be designed for operating with the housing purged of air and filled with dry nitrogen to 35 kPa.
j. Valves -

    i. The housing shall have two valves, both on the rear end plate of the housing.
    ii. One valve shall be a standard Schrader valve. It shall have a tube running from the valve to the front end of the housing.
    iii. The other valve shall be an air escape/pressure relief valve preset to 140 kPa.
    iv. The two valves shall be arranged such that filling with dry nitrogen from the Schrader valve will force gas to flow from front end of the housing to the rear end and vent through the air escape valve.
    v. The leakage rate with both valves closed and the housing pressurized to 70 kPa, shall leak less than 7 kPa per year, and less than 0.7 kPa per month.

k. The enclosure shall be factory pressurized to 35 kPa with dry nitrogen.
l. The notation "CAUTION PRESSURIZED" shall be printed on the rear plate of the enclosure.
m. A safety pressure release bolt shall be incorporated such that the enclosure may not be opened without first releasing the internal pressure.
n. A low-pressure (LP) sensor with related circuitry shall be provided to send an LP alarm (dry contact closure) via the camera connector. The LP sensor threshold shall be preset to activate the LP alarm at 14 kPa.
o. Two units of desiccant shall be placed inside the housing but will not obstruct the camera view or operation.
p. A humidity level indicator strip with discrete indications for 10, 20 and 30 percent humidity, shall be installed inside the housing in a position that allows inspection, while facing directly, through the window without obstructing the view of the camera at the widest viewing angle of the lens.

(2) Mounting Base

a. A mounting base shall surround the enclosure to provide a tamper-resistant attachment of the environmental housing to the pan and tilt unit and securely hold the housing in either an upright or inverted position. The combined height of camera housing and mounting base shall be less than 254 mm. The mounting base attachment shall be as shown on the plans.
b. All fasteners and nuts used in attaching the mounting base to the environmental housing shall be of Type 18-8 stainless steel.
c. Each camera unit shall be provided with three stainless steel hex head bolts to secure the camera unit to the pan and tilt unit.

D. Camera Unit Cable Assembly

(1) General - Each camera unit cable assembly shall consist of box mounting socket connector and a wiring harness.

(2) Box Mounting Socket Connector

a. Each box mounting socket connector shall be in conformance with Military Part Numbering System Designation: MS-3102E-28-21S-F80.
b. One full set of crimp contacts shall be provided with each box mounting socket connector.
c. The pinout of the connector shall be as shown on the plans.

(3) Wiring Harness

a. The camera unit cable assembly wiring harness shall be 3 m long and shall be COHU AC27E or other cable approved by the Engineer. The coaxial cables' impedance shall be 75 Ω. One end of each wiring harness shall be Type PT06A-20-39S (SR) and shall mate with the camera connector. It shall have a 90-degree end bell, Bendix 10-25997-203 or equal, for strain relief. The end bell shall be positioned such that the opening is 180 degrees from the main key on the connector. The other end of each wiring harness shall be in conformance with Military Part Numbering System Designation: MS-3106E-28-21P, and shall mate with the box mounting socket connector.
b. All connectors shall be potted with an appropriate potting compound for environmental sealing.
c. All connectors' pinout shall be as shown on the plans.

2. Pan and Tilt Unit

A. General
(1) Each pan and tilt unit, with camera unit attached, shall pan 355 degrees minimum in either direction, and tilt 60 degrees minimum from horizontal position to either up or down positions.
(2) Each pan and tilt unit shall be capable of minimum ten preset positions for each pan and tilt operation.

B. Electrical
(1) Each pan and tilt unit shall operate with input voltage of 115 VAC, 60 Hz ±0.3 Hz.
(2) Each pan and tilt unit shall not exceed 200 W power consumption.
(3) The motors shall be impedance overload protected, two phase induction type, rated for continuous duty and shall be instantaneous reversing.
(4) The limit switches shall be rated 5 A, 10 million cycles and with external adjustments.
(5) Each pan and tilt unit shall be provided with box-mounting type connector.
(6) One mating connector with full set of crimp contacts and strain relief shall be provided with the box-mounting connector.

C. Mechanical
(1) The maximum load shall be 45 kg at 127 mm from tilt table to center of gravity in both upright and inverted position.
(2) Each pan and tilt unit shall have maximum dimensions of 400 mm high, 355 mm wide and 230 mm deep.
(3) Each pan and tilt unit shall not exceed the maximum mass of 27 kg.
(4) Each pan and tilt unit shall be constructed in aluminum casting and plate. All internal parts shall be corrosion protected.
(5) Each pan and tilt shall have textured semi-gloss beige enamel finish.
(6) All bearings shall be heavy duty ball or roller bearing.
(7) All gears shall be hardened steel.
(8) All gasket seals shall be designed for all weather protection.
(9) Each pan and tilt unit shall have a mounting hole pattern as shown on the plans.
(10) Each pan and tilt unit shall have a minimum pan torque rating of 34 N·m and an instantaneous minimum tilt torque of 68 N·m.
(11) The pan speed at no load shall be 6 to 8 degrees per second, nominal.
(12) The tilt speed at no load shall be 3 to 4 degrees per second, nominal.

D. Environmental
(1) Ambient operating temperature shall be from -10°C to 50°C.
(2) The pan and tilt unit shall be able to withstand vibration of 760 µm total excursion from 5 to 30 Hz and a peak random vibration of 5 g from 30 to 1000 Hz.
(3) The pan and tilt unit shall be able to withstand shock up to 15 g in all axes under non-operating conditions, conforming to MIL-E-5400R, Para. 3.2.24.6.
(4) The pan and tilt unit shall be able to operate in atmospheres up to 95 percent relative humidity, conforming to MIL-E-5400R, Para 3.2.24.4.

(5) The pan and tilt unit shall be able to withstand exposure to sand, dust, fungus, and salt atmosphere, conforming to MIL-E-5400R, Para 3.2.24.7, 3.2.24.8 and 3.2.24.9.

E. Pan and tilt unit mounting

The nuts and bolts securing the pan and tilt unit to the camera platform shall be hex head and made of stainless steel. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolts and nuts in place making it impossible to turn bolt or nut without tools. This coating shall last and be effective through at least 10 insertions and withdrawals of the bolt or nut.

3. Camera Junction Box

The camera junction box (JCB) shall be constructed as shown on the plans and described in these special provisions. All seams shall be continuously welded. All JCB mounting Hex head stainless steel nuts and bolts shall be 6 mm -20 x 25 mm. Steel surfaces on which JCB is to be mounted shall be drilled and tapped 6 mm -20 thread. Each JCB shall be fabricated from 14-gage sheet steel. Two 8-32 threaded studs for terminal strip mounting shall be welded on the bottom of the box as shown on the plans. After fabrication the JCB shall be hot-dip galvanized.

A twenty position terminal block with No. 8 lugs and cover shall be mounted on the bottom of the box. Permanent terminal position markings shall be used. A laminated wiring schematic shall be permanently attached to the inside of box cover showing wiring from the camera unit box mounting connector to the terminal block.

4. Camera Control Unit

Each part of the camera control unit (CCU) shall be electrically and physically interchangeable with the like part in any other CCU furnished under this contract. The CCU shall be installed inside State-furnished Model 334 cabinet as shown on the plans.

A. Mechanical

(1) Each CCU shall mount in 133 mm of EIA-310 rack space with a maximum depth of 356 mm.
(2) The front panel shall be white gloss color Number 17886 as per Federal Standard Color Chart 595B.
(3) The front and rear panel lettering shall be black color Number 17986 of Federal Standard Color Chart 595B.
(4) A high-impedance panel jack BNC (Bayonet Nut connector) connector shall be installed on the front panel as shown on the plans. This connector shall provide video input to a test monitor without affecting the remainder of the CCTV system. This connector shall be directly connected to the video input on the rear panel.
(5) A glass type, size 6.35 mm x 31.75 mm (AG) slow blow fuse shall be installed on the front panel. The fuse shall be replaceable from the outside of the front panel.
(6) Switches shall protrude no more than 25 mm from the front panel and shall be mounted as shown on the plans.
(7) The rear panel connectors shall be mounted as shown on the plans and shall meet the following requirements:

a. Connectors C1-C3 shall be of the following type or equivalent:

C1	AMP 206430-1
C2	AMP 206043-1
C3	AMP 206306-1

b. The pin and socket contacts for connectors C1-C3 shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 1.27 µm nickel and plated with 0.762 µm gold. Pin diameter shall be 1.575 mm. Contact size shall be 16.
c. Each C1, C2 and C3 connector shall use the AMP No. 601105-1 or No. 91002-1 contact insertion and the AMP No. 305183 contact extraction tool.
d. One mating connector with a full set crimp contacts and strain relief shall be supplied with connectors C1, C2 and C3.
e. The connectors C4 and C5 shall be a DB-25 socket connector.

(8) Serial cable assemblies (SCA1 and SCA2) with length of 3 m shall be provided to mate with C4 and C5, respectively.
(9) Pin and socket contacts for DB-25 connectors shall be copper alloy body; finished with 0.762 µm gold over 1.27 µm nickel.
(10) The rear and front panel BNC connectors shall be of copper material with bright nickel (tarnish resistant) finish for the body and silver finish for the contact.
(11) Each printed circuit board shall be vertically installed.

(12) Each LED shall be equal to Hewlett Packard High Intensity Red Un-tinted, Non-diffused LED (Part Number HLMP-D105). Each LED shall be mounted as shown on the plans.
(13) A front panel on/off switch shall turn the CCU on/off and shall also control AC power to the rear panel power output connector (C1). The indicator used for AC power shall be green when energized.
(14) One coaxial cable labeled "AVO" (Analog Video Output) terminated with BNC plug connectors on each end shall be provided. This cable shall be RG-59/U with overall length of one meter.

B. Electrical
(1) Each CCU shall have auto-iris override.
(2) Each CCU shall have circuitry to detect the absence and presence of video sync on its video input. Each CCU shall also have circuitry to monitor the low-pressure alarm contact closure from the camera unit. A local/remote control switch shall be provided to override the lens and pan and tilt controls through C4 when the switch is in local mode. When in local mode, the local control alarm shall be active. Alarm status shall be constantly monitored and updated. Upon receipt of a "status query" message, the CCU shall send alarm status message with data as follows:

"0"	None of the alarms active.
"1"	Local Control (LC) alarm active.
"2"	Low Pressure (LP) alarm active.
"3"	LP/LC alarms active.
"4"	Video Sync Absence (VSA) alarm active.
"5"	VSA/LC alarms active.
"6"	VSA/LP alarms active.
"7"	VSA/LP/LC alarms active.

The front panel alarm light shall be lit if any the alarms are active.
(3) Each CCU shall have circuitry for a source character generator. The source character generator shall display 16 alphanumeric characters superimposed on the video image. Each character shall be 28 TV lines high and shall be derived from a standard 5 x 7 dot matrix. The programmed characters shall be stored in a non-volatile memory. Upon receipt of "Set ID" message, the CCU shall position from the camera ID in the video image as follows:

"1"	Upper 15% limit of the left viewing area
"2"	Upper 15% limit of the right viewing area
"3"	Lower 15% limit of the left side viewing area
"4"	Lower 15% limit of the right side viewing area

The characters shall be superimposed on the video signal using non-additive mixing techniques.
(4) Each CCU shall be designed to prevent simultaneous operation of pan right/left, tilt up/down, zoom in/out, focus near/far or iris open/close.
(5) Each CCU shall have power supply(ies) for camera zoom, focus, motors, control and interface circuits. The voltage for zoom, focus and iris shall be selectable internally by one jumper for 12.0 VDC, 9.0 VDC or 5.0 VDC at 100 mA. The CCU shall be pre-configured with the voltage jumper select set to 9.0 VDC. The operation of zoom, focus and iris shall be as follows:

Zoom in	+VDC
Zoom out	-VDC
Focus near	+VDC
Focus far	-VDC
Iris close	+VDC
Iris open	-VDC

(6) The maximum power consumption for the CCU shall not exceed 450 W. Power consumption of equipment attached to pin 1 of connector C1 shall not exceed 100 W. Power consumption of equipment attached to pin 12 of connector C2 shall not exceed 200 W.
(7) Each CCU shall have eight independently operating 24 VDC relays (options 1 to 8). Each relay shall be single pole, double throw (SPDT), with contacts rated 1.25 A at 120 VAC.
(8) Each CCU shall be capable of a minimum of ten presets and capable of controlling camera units and pan and tilt units equipped with pre-positioning feedback potentiometers. Each CCU shall have circuitry to filter out any

electrical noise interference on each of the pre-positioning feedback voltage signal for the camera unit and pan and tilt unit.

(9) A system reset switch shall be a momentary-pushbutton type and be mounted on the front panel to function as external reset input to the microprocessor. System reset shall not cause existing pan and tilt and lens positions to change. System reset shall be executed without requiring the operator to hold the momentary-pushbutton for more than one second.

(10) The front panel of the camera control unit shall have LEDs and switches to provide the following control functions as shown on the plans.

Function	**Hardware**	**Indicator**
Zoom (In/Off/Out)	(ON)-OFF-(ON)	2 LED
Focus (Near/Off/Far)	(ON)-OFF-(ON)	2 LED
Pan (Left/Off/Right)	(ON)-OFF-(ON)	2 LED
Tilt (Up/Off/Down)	(ON)-OFF-(ON)	2 LED
Iris (Open/Off/Close)	(ON)-OFF-(ON)	2 LED
Iris override (Manual/Auto)	ON-OFF	1 LED
Option 1 (On/Off)	ON-OFF	1 LED
Option 2 (On/Off)	ON-OFF	1 LED
Option 3 (On/Off)	ON-OFF	1 LED
Option 4 (On/Off)	ON-OFF	1 LED
Option 5 (On/Off)	ON-OFF	1 LED
Option 6 (On/Off)	ON-OFF	1 LED
Option 7 (On/Off)	ON-OFF	1 LED
Option 8 (On/Off)	ON-OFF	1 LED
Alarm (On/Off)	ON-OFF	1 LED
Control (Local/Remote)	ON-OFF	
Reset	(ON)-OFF (momentary pushbutton)	

(11)

CCU connector assignments	
C1	4 contact connector
C2	14 contact connector
C3	37 contact connector
C4, C5	DB-25 connectors

C1 -- AC Power	
Position	Function
1	AC +
2	AC -
3	Equipment Ground
4	NA

C2 -- Pan and Tilt			
Pos.	Function	Pos.	Function
1	Pan right	8	Pan feedback
2	Pan left	9	Tilt feedback
3	AC-	10	Preset –VDC
4	Tilt up	11	NA
5	Tilt down	12	AC+
6	AC-	13	AC-
7	Preset +VDC	14	Ground

C3 -- Camera			
Pos.	Function	Pos.	Function
1	Zoom	20	Option 3 N.O.
2	Z/F/I Common	21	Option 3 Common
3	Focus	22	Option 3 N.C.
4	Iris	23	Option 4 N.O.
5	Iris Override Common	24	Option 4 Common
6	Iris Override	25	Option 4 N.C.
7	Preset +VDC	26	Option 5 N.O.
8	Zoom Preset feedback	27	Option 5 Common
9	Focus Preset feedback	28	Option 5 N.C.
10	Preset -VDC	29	Option 6 N.O.
11	LP alarm	30	Option 6 Common
12	LP alarm	31	Option 6 N.C.
13	NA	32	Option 7 N.O.
14	Option 1 N.O.	33	Option 7 Common
15	Option 1 Common	34	Option 7 N.C.
16	Option 1 N.C.	35	Option 8 N.O.
17	Option 2 N.O.	36	Option 8 Common
18	Option 2 Common	37	Option 8 N.C.
19	Option 2 N.C.		

Note:
N.O. = Normally open
N.C. = Normally closed
NA = Not Available

C4, C5 -- Serial communication ports to and from external device.			
Pos.	Function	Pos.	Function
1	NA	14	NA
2	Transmit Data	15	NA
3	Receive Data	16	NA
4	NA	17	NA
5	NA	18	NA
6	NA	19	NA
7	Signal Ground	20	NA
8	NA	21	NA
9	NA	22	NA
10	NA	23	NA
11	NA	24	NA
12	NA	25	NA
13	NA		

Serial cables			
SCA1		SCA2	
DB-25 Pin	DB-25 Pin	DB-25 Pin	DB-25 Socket
2	2	2	2
3	3	3	3
7	7	7	7

C. Environmental

(1) Each CCU shall operate in an ambient temperature environment range from -10°C to 50°C.

(2) Each CCU shall conform to MIL-STD-810D-516.1 and MIL-STD-810D-514.1 shock and vibration test.

D. CCU Messages

(1) Each CCU shall communicate through the C4 serial port with the following communication message codes:

DIRECTION	MESSAGE	CHARACTER		DATA
		1ST CODE	2ND CODE	
Transmit	Alarm status	A	space	"0"-"7"
Receive	Status query	Q	space	NONE
Receive	Pan stop	p	space	NONE
Receive	Tilt stop	t	space	NONE
Receive	Zoom stop	z	space	NONE
Receive	Focus stop	f	space	NONE
Receive	Iris stop	i	space	NONE
Receive	Pan left	L	space	NONE
Receive	Pan right	R	space	NONE
Receive	Tilt up	U	space	NONE
Receive	Tilt down	D	space	NONE
Receive	Zoom in	I	space	NONE
Receive	Zoom out	O	space	NONE
Receive	Focus near	N	space	NONE
Receive	Focus Far	F	space	NONE
Receive	Iris open	J	space	NONE
Receive	Iris close	K	space	NONE
Receive	Iris manual	M	space	NONE
Receive	Iris auto	m	space	NONE
Receive	Set ID word	C	"1"-"4"	16-ASCII char.
Receive	Home position 0-9	H	"0"-"9"	NONE
Receive	Home position program 0-9	P	"0"-"9"	NONE
Receive	Option on 1-8	S	"1"-"8"	NONE
Receive	Option off 1-8	s	"1"-"8"	NONE
Receive	Enter Echo mode	E	space	NONE
Receive	Exit Echo mode	^]C	This sequence is not in a communication packet	

(2) After receiving the "enter echo" command the CCU shall pass all characters from C5 to C4 and C4 to C5. The CCU shall disable all camera movement.

(3) When the "exit echo" mode sequence is received on C4, the CCU shall return to normal operation.

E. Serial Communications Protocol

(1) The communication protocol shall consist of 8 data bits, 1 stop bit and no parity.

(2) Communication handshaking shall use XON/XOFF.

(3) The communication packet shall contain the following items: ADDRESS, CODE, DATA, CHECKSUM, CR. The packet is sent as a string of ASCII printable characters. The ADDRESS, which has its $80 bit set in order to signal the start of the packet. The CHECKSUM is generated by Exclusive-ORing the ADDRESS, CODE, and DATA. The communication byte count shall be as follows:

ADDRESS	1
CODE	2
DATA	≥0
CHECKSUM	2
CR	1

(4) The receiver will compute the CHECKSUM. If the computed CHECKSUM is correct the receiver will send ACK, otherwise the receiver will send NAK.

5. Video Transmitter Duplex Data

The video transmitter duplex data (VTDD) shall be stand-alone type mounted securely on a shelf that fastened to EIA-310 standard equipment rack in each State-furnished Model 334 cabinet as shown on the plans. The size and mounting arrangements shall be consistent with the space allocated in the cabinet layout as shown on the plans. The equipment shall be mounted in a manner which allows easy access to all connections and indicators. All mounting hardware and mounting shall be provided by the Contractor.

The VTDD unit shall accept any NTSC baseband video signal and an EIA-232 data signal to convert to a signal suitable for launching into one singlemode optical fiber.

The video interface to VTDD shall be a nickel plated, bulkhead female BNC-style connector with a gold plated contact. The video transmitter shall accept a composite video signal at a level of 1.0 V peak to peak between sync tip and reference white, as measured on an oscilloscope. The transmitter shall operate as specified when the peak-to-peak value of the signal varies between 0.71 V and 1.4 V. The nominal input impedance shall be 75 Ω and the return loss shall be at least 30 dB in compliance with EIA RS-250 for an unbalanced to ground connection. Differential gain shall be less than 3 percent typical, 5 percent maximum at 3.58 MHz. Differential phase shall be less than 3 degree typical, 5 degree maximum at 3.58 MHz. Bandwidth at -3 dB points shall be between 2 Hz to 15 MHz. Weighted signal to noise ratio (SNR) shall be 60 dB for greater than or equal to -21 dBm input to the receiver.

The video signal and the EIA-232 data shall be applied to the optical source to produce a pulse rate modulated optical signal using pulse frequency modulation (PFM) technique. The VTDD shall have a laser emitter with a wavelength at 1550 nm to transmit simplex video and EIA-232 signals. The VTDD shall receive EIA-232 data using 1310 nm wavelength. The transmission range shall be up to 60 km via a singlemode fiber optic (9/125-μm). The transmitter shall interface to fiber with an ST style compatible connector. The video transmitter launch power shall be defined as the power launched by the transmitter into at least one meter of step index optical fiber with a nominal core diameter of 8.3 μm, a nominal cladding diameter of 125 μm and a theoretical numerical aperture of 0.275. The video transmitter launch power shall be at least 18 dB greater than the video receiver sensitivity. The optical modulation bandwidth required by the video transmitter for specified video link performance shall be 60 MHz, maximum.

The video transmitter shall include a power supply, which may be external to the remainder of the video transmitter components. The transmitter shall be powered from existing 120 VAC ±15 percent, 60 Hz ±5 percent power receptacle. The power supply shall supply all voltages required by the video transmitter for operation. The video transmitter shall have a panel indicator visible from the front that shows power "ON".

The video receiver duplex data (VRDD) unit will be installed under separate contract.

6. Cables, Connectors and Fittings

The camera unit cable assembly box mounting connector shall be mounted on one side of the JCB and shall be pre-wired to the 20 position terminal block as shown on the plans. The video signal pins of the camera unit cable assembly box mounting connector shall be terminated to a Bayonet Nut Connector (BNC) jack connector via Type RG-59/U coaxial cable stub.

The television control cable (TVC) and television power conductors (TVP) shall be wired to the 20 position terminal block as shown on the plans. The television control power (TVCP) cable shall go through but does not terminate inside the JCB. A watertight strain-relief box connector shall be installed at the JCB hole for the TVCP cable.

7. Installation of Camera Station

The work to be done at each camera station, as shown on the plans, as a minimum, shall consist of the following:

A. Attach pan and tilt unit to the mounting plate.
B. Attach camera unit to the pan and tilt unit.
C. Install JCB junction box.
D. Terminate TVC and TVP inside JCB junction box.
E. Terminate television video cable (TVL) inside JCB junction box with a BNC plug connector.
F. Install camera unit cable assembly wiring harness (Type JC).
G. Terminate TVCP with pan and tilt mating connector.
H. Connect TVCP to the pan and tilt unit.
I. Terminate TVL inside controller cabinet with BNC plug connector.
J. Terminate TVP, TVCP and TVC with CCU mating connectors C1, C2 and C3, respectively.
K. Adjust limit stops of the pan and tilt unit as directed by the Engineer.
L. Adjust camera unit to provide the optimum picture for the full range of daylight and night time conditions as directed by the Engineer.

8. Camera Unit Mounting

The camera unit shall be secured to the pan and tilt unit using the stainless steel bolts provided with the camera unit. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolt and nut in place, making it impossible to turn the bolt or nut without tools. This coating shall last through and be effective through at least ten insertions and withdrawals of the bolt or nut.

The work to be done between the camera mount and the controller cabinet, as shown on the plans, as a minimum, shall consist of the following:

Install and terminate TVL, TVC, TVCP, and TVP, in the appropriate conduit, as shown on the plans.

The work to be done at each CCTV controller cabinet, as shown on the plans, as a minimum, shall consist of the following:

A. Install CCU.
B. Connect TVC, TVCP, TVP and TVL to CCU via their respective connectors.
C. Install the VTDD unit.
D. Connect CCU to VTDD.

The Contractor shall furnish all materials necessary to provide a complete and functional camera station in accordance with these special provisions. Miscellaneous equipment, and materials not mentioned but necessary to provide a complete and fully operational camera station shall be furnished by the Contractor as incidental to the work for which no additional compensation will be allowed therefor.

All items furnished under this contract shall be new and shall be the latest version.

The Contractor shall be responsible for demonstrating proper operation of the camera station using test software and diagnostics which shall be provided to the Engineer as incidental items at no additional cost. Testing procedures are described elsewhere in these special provisions.

9. Camera Station Testing

Upon completion of work, each camera station shall be subjected to post-installation tests as outlined herein. All testing shall be performed by the District Electrical Systems Branch personnel, arranged by the Engineer and in the presence of the Contractor. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing. Upon receipt of the notification, the Engineer shall contact the Electrical Systems Branch at Telephone: (510) 286-4770. The Contractor shall provide all necessary equipment required to access the CCTV equipment for testing.

The testing shall consist of five consecutive days of continuous satisfactory operation of each camera station. If any material and equipment furnished and installed by the Contractor in this project is found defective or otherwise unsuitable, or the workmanship does not conform with the accepted standards, the Contractor shall replace such defective material and equipment at no cost to the State.

Rejected material or equipment may be offered again by the Contractor for consideration provided all non-compliance has been corrected and pre-tested by the Contractor. After all defects have been corrected, the camera station shall be re-tested until five consecutive days of continuous satisfactory operation is obtained.

The post-installation tests shall consist of, but not be limited to, inspection and functional testing in accordance with these special provisions.

Inspection shall consist of, but not be limited to, verification of correct wiring terminations, correct cable interconnections, good workmanship and compliance with these special provisions.

Functional testing shall include, but not be limited to, the following:

A. Verification of all local mode CCTV operations using the CCU front panel controls.
B. Verify video signal output from CCU with a National Television Systems Committee (NTSC) monitor.
C. Verify the correct operation of the auto/manual iris and power zoom.
D. Verify the correct operation of the pan and tilt unit. The pan and tilt unit shall be functionally tested over 355 degrees in the horizontal plane and ±60 degrees in the vertical plane. The pan and tilt unit limit stops shall then be adjusted to optimize the camera viewing coverage of the freeway as directed by the Engineer.
E. Verify the correct operation of the preset positions.

CHANGEABLE MESSAGE SIGN STATION

The changeable message sign (CMS) station shall consist of installing the following equipment, as shown on the plans and as directed by the Engineer:

1. One Model 500 changeable message sign system.

2. One changeable message sign disconnect switch.
3. One fiber optic data modem (described elsewhere in these special provisions).

1. Model 500 Changeable Message Sign System

Model 500 changeable message sign (CMS) systems consist of a Model 500 changeable message sign, a Model 170 controller assembly in a completely wired Type 1 or similar cabinet and the required wiring and auxiliary equipment required to control the CMS shown on the plans and in conformance with these special provisions.

The Model 500 changeable message signs, wiring harness and Model 170 controller assembly including controller unit and completely wired cabinet, but without anchor bolts, will be State-furnished in conformance with the provisions in "Materials" of these special provisions.

Model 500 changeable message sign system components shall conform to the requirements in "Specifications for Changeable Message Sign System," issued by the State of California, Department of Transportation, and to the addendums thereto current at the time of project advertising. Model 170 controller assemblies shall conform to the requirements in "Traffic Signal Control Equipment Specifications," issued by the State of California, Department of Transportation, and to the addendums thereto current at the time of project advertising.

Attention is directed to "Sign Structures" of these special provisions.

The sign assembly shall be installed on the sign structure. The controller cabinet foundation shall be constructed as shown on the plans for Model 334 cabinets (including furnishing and installing anchor bolts), the controller cabinet shall be installed on the foundation, and the field wiring connections shall be made to the terminal blocks in the sign assembly and in the controller cabinet.

Field conductors No. 12 and smaller shall terminate with spade terminals. Field conductors No. 10 and larger shall terminate in spade or ring terminals.

A listing of field conductor terminations, in each State-furnished changeable message sign and controller cabinet, will be furnished free of charge to the Contractor at the site of the work.

The location of the foundation for each controller cabinet will be determined by the Engineer.

State forces will maintain the sign assemblies. The Contractor's responsibility shall be limited to conformance with the provisions in Section 6-1.02, "State-Furnished Materials," of the Standard Specifications.

2. Changeable Message Sign Disconnect Switch

Each changeable message sign (CMS) shall have a disconnect switch, which shall be a UL-listed 100 A, 4-pole, non-fusible switch rated for 600 V maximum. The CMS disconnect switch shall have an electrical interlock to prevent accidental operation and a line terminal shield to prevent accidental contact with the terminals. The CMS disconnect switch shall be housed in a NEMA 3R enclosure with a door latch and provisions for a padlock. The housing shall have a front-operated handle for provisions to lock the handle in the OFF position. The housing shall be mounted on the side of the controller cabinet.

PREFORMED LOOP DETECTOR STATION

The Contractor shall install the following preformed loop detector station equipment at each station as described in these special provisions and as shown on the plans:

1. Ten preformed inductive loops.
2. One preformed loop pull box.
3. One State-furnished Model 170 controller assembly (described elsewhere in these special provisions).
4. One fiber optic data modem (described elsewhere in these special provisions).

Preformed inductive loops shall be the type shown on the plans.

The loop shall be 1.8 m circular unless otherwise shown. The loop shall consist of 4 turns of No. 16, or larger, wire with Type THWN or TFFN insulation.

The loop wires shall be encased in Size 10, minimum, Schedule 40 or Schedule 80 PVC or polypropylene conduit. The conduit shall be sealed to prevent the entrance of water and the movement of wires within the conduit.

The loop wires from the preformed loop to the adjacent pull box shall be twisted together into a pair (at least 7 turns per meter) and encased in Schedule 40 or Schedule 80 PVC or polypropylene conduit between the preformed loop and the adjacent pull box. The lead-in conduit shall be sealed to prevent the entrance of water at the pull box end.

The preformed loops shall be secured to the top of the uppermost layer of reinforcing steel within the reinforced concrete structure deck slabs, using nylon wire ties. The loop shall be held parallel to the structure deck by using PVC or polypropylene spacers where necessary. Conduit for lead-in conductors shall be placed between the uppermost 2 layers of reinforcing steel. Lead-in conductors shall be coiled securely within the temporary enclosures with adequate slack as shown on the plans. After slabs are in place, temporary enclosures will be removed, conduit shall be installed, and the loop wire

shall be routed through conduit to the preformed loop pull box. Conductors are to be terminated in the pull box and labeled as shown on the plans.

MICROWAVE VEHICLE DETECTION SENSOR SYSTEM

The Contractor shall install the following microwave vehicle detection sensor (MVDS) equipment at each location as described in these special provisions and as shown on the plans:

1. Microwave detector units, connectors, cables, conduit, pull box, mounting equipment, software, firmware, power supply units and all other support equipment.
2. One State-furnished Model 334 controller cabinet (described elsewhere in these special provisions).
3. One fiber optic data modem (described elsewhere in these special provisions).

Functional Requirements

The MVDS signal shall emulate the response of an inductive loop detector. The MVDS units shall be tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. Each MVDS unit shall operate independently and not interfere with other MVDS units.

The microwave sensor unit shall operate in the frequency band of 10.525 GHz ± 25 MHz. The transmitter power shall be a maximum of 10 mW.

The MVDS field of view shall be covered by a maximum detection range defined as follows:

Elevation beam-width	45 degrees
Azimuth beam-width	15 degrees
Range	3 to 60 meters

Each MVDS unit shall have the capability of providing a minimum of 8 detection zones within each beam footprint. The size of each zone shall be user definable with a maximum range resolution of 2 meters. The minimum footprint shall be greater than or equal to 1.8 meters.

The time of events shall be measured in a maximum of 10 ms resolution.

Measurement accuracy shall be better than 95 percent certainty for vehicle presence.

Each MVDS unit shall be supplied with a connectorized MVDS cable harness with appropriate cable length for each installation. The MVDS cable shall consist of 15 unshielded twisted pairs of No. 20 conductors with an overall shield. Each conductor shall have a minimum of 19 tinned copper strands with a minimum of 1.60 mm PVC insulation rated for 300 V at 105˚C. The outer jacket shall be chrome PVC with minimum thickness of 1.60 mm. The outside diameter of the cable shall not exceed 19.2 mm. A minimum of 4 meter slack of MVDS cable is required in each controller cabinet.

The connector shall be in conformance with Military Part Numbering System Designation: MS3476W18-32S or equivalent. This connector shall include contacts for powering the sensor unit, RS-232 serial data communications and contact pairs for each detection zone. The connector pinout is as follows:

No.	Pin No.	Designation	Signal	Remark
1	A	Contact Closure	Opto 1	
2	B	Contact Closure	Opto 1 Return	
3	C	Contact Closure	Opto 2	
4	D	Contact Closure	Opto 2 Return	
5	E	Contact Closure	Opto 3	
6	F	Contact Closure	Opto 3 Return	
7	G	Contact Closure	Opto 4	
8	H	Contact Closure	Opto 4 Return	
9	J	Contact Closure	Opto 5	
10	K	Contact Closure	Opto 5 Return	
11	L	Contact Closure	Opto 6	
12	M	Contact Closure	Opto 6 Return	
13	N	Contact Closure	Opto 7	
14	P	Contact Closure	Opto 7 Return	
15	R	Contact Closure	Opto 8	
16	S	Contact Closure	Opto 8 Return	
17	d	Contact Closure	Opto 9	
18	e	Contact Closure	Opto 9 Return	
19	f	DC Power	12-24 VDC +	
20	g	DC Power	12-24 VDC -	
21	h	AC Power	115 VAC +	Not Used
22	j	AC Power	115 VAC -	Not Used
23	V	RS-232 p2	Tx	
24	T	RS-232 p3	Rx	
25	U, W	RS-232 p5	Signal Ground	
26	b	Auxiliary	+5VDC Out	Not Used
27	c	Auxiliary	+5VDC Out Return	Not Used
28-32				Spares

The Contractor shall wire the MVDS cable harness and power conductors to the 10-position Type DIN rail mounted terminal blocks in the controller cabinet as directed by the Engineer. The RS-232 serial data communication output conductors shall be terminated at the service panel terminal block, TB-0. The contact pair output conductors shall be terminated at the input panel terminal block, TB-2. The ends of all unused and spare conductors shall be taped to prevent accidental contact to other circuits.

All software for testing and set-up procedures shall be supplied with the MVDS unit. The software shall test the MVDS unit performance and provide diagnostic information.

Operational Requirements

The Contractor shall provide a certification from the manufacturer that the MVDS unit will interface and operate with a Model 170 controller. In addition, the MVDS unit shall meet the following requirements:

A. Electrical

The unit shall operate with 12-24 VDC at 0.5 A power source. The unit shall have a feature of automatic recovery after a power failure.

B. Physical

The unit shall be encased in a weatherproof NEMA-3R enclosure. The unit shall not exceed 160 mm x 240 mm x 250 mm in size and shall not weigh more than 4.5 kg. The unit shall operate over a temperature range from -37˚C to +74˚C, up to 95 percent relative humidity.

C. Pull Box

A pull box shall be installed inside the base of the light pole with conduit connections as shown on the plans.

D. Installation and Testing

Prior to installing any MVDS units, the Contractor shall perform functional tests to verify that all MVDS units comply with these specifications. The MVDS units shall be installed as shown on the plans and in accordance with the manufacturer's recommended installation procedures. The Contractor shall confirm equipment placement with the Engineer before installing any equipment. The Contractor shall test the MVDS units for the following functions:

1. Speed, volume and occupancy for all roadway monitoring locations.
2. Correct speed and count readings of roadway traffic with a portable detection equipment.

FIBER OPTIC DATA MODEM

The fiber optic data modem (FODM) shall be RS-232 compatible fiber optic modem with dual optics for drop and insert capability which can be configured as master or local (slave) in either daisy chain or fault tolerant dual redundant (counter rotating) ring network architecture. These four modes of operations shall be selectable via an external Mode DIP-switch. All signals received via an optical port and retransmitted via fiber or via an expansion port shall be retimed to 0.01 percent pulse width accuracy by a crystal controlled timebase, eliminating pulse width distortion and eliminating virtually unlimited repeating. The FODMs shall have anti-streaming circuitry for both the optical fiber and the electrical (RS-232) sides. On RS-232 side, when enabled, the anti-streaming shall limit the amount of time an external device is allowed to transmit data onto the network for each Request to Send (poll). On the fiber side, the anti-streaming shall disable an optical receiver in the event that the receiver output stays high longer than maximum allowable time thus preventing the who fiber network from being disabled by a continuous "on" failure by receiver or optical emitter. External (TIME-OUT) DIP-switch shall allow user to disable or select the timeouts for both the optical side anti-streaming feature and the RS-232 side anti-streaming feature as well as to enable or disable the "Fiber Activity CTS Disable" feature. LED indicators to display power "on", anti-streaming "Fault" time-out and RS-232 fiber optic activity (selectable via dual function switch).

The FODMs at the field element shall be stand-alone type and shall be securely fastened on a EIA-310 rack-mount shelf. At the hub location, the FODMs shall be react-mount type installed in card cage assembly. The card cage assembly shall be EIA-310 rack mount type with at least 14 slots and with two power supplies for redundancy.

The FODM shall meet the following requirements:

Electrical Signaling:	EIA RS-232 with full handshake control signals
Electrical Power:	115 VAC, 60 Hz
Operating Temperature	-40 to 70°C
Operating Mode:	1. Daisy chain Master mode 2. Daisy chain Local mode 3. Fault tolerant Master mode 4. Fault tolerant Local mode
Emitter type:	Laser
Wavelength	1310 nm
Minimum coupled transit power into: 9/125 μm at 25°C (75°C)	-11 (-9.5) dBm
Output Variation	-0.015 dB/°C
Minimum receiver input power for 10^{-9} BER	-40 dBm
Maximum receiver input	-11 dBm
Optical port type	ST
RS-232 connector type	DB25S
Data Rates (auto)	1200 baud to 57.6 kbaud
Bit Error Rate (BER):	10^{-9}
Link Budget (Range) via singlemode 1310 nm	31 dB for (56 km)

FODMs shall be tested as follows:

a. Each optic modem shall be functionally tested by looping back optical transmit connector to the optical receive connector using a variable optical attenuator with measured optical loss at 31 dB at 1310 nm. A test set shall be connected to the modem and set for RS-232 communication testing. Fifteen minutes bit error rate (BER) test burn-in test shall be error free.

b. After performing the 15 minutes BER test, at least two modems shall be tested for receiver dynamic range. The following procedure shall be followed: First, the optical attenuation shall be increased to the point at which the data test just begins to register bit errors. The optical receive power into the modem shall be measured and recorded.

The optical attenuation shall be then decreased until data test once again register errors. At no time shall the optical power into the receiver exceed the manufacturer's specified saturation level. The optical receive levels shall once again be measured and recorded. These minimum and maximum receiver power levels define modem receiver's dynamic range and shall meet or exceed the manufacturer's specification.

c. One pair of modem shall be interconnected using optical patchcords and attenuators with a loss of 31 dB in each direction. The RS-232 interface shall be looped back onto one modem and a test set connected to the RS-232 interface of the other modem. A bit error rate of less than 10^{-9} shall be demonstrated.

STATE-FURNISHED CONTROLLER ASSEMBLIES

The Model 170 controller assemblies, including controller unit, completely wired controller cabinet and inductive loop detector sensor units, but without anchor bolts, will be State-furnished as provided under "Materials" of these special provisions.

The Contractor shall install the controller cabinet on each service platform, including furnishing and installing anchor bolts, and shall make field wiring connections to the terminal blocks in the controller cabinet.

A listing of field conductor terminations, in each State-furnished controller cabinet, will be furnished free of charge to the Contractor at the site of the work.

State forces will maintain controller assemblies. The Contractor's responsibility for controller assemblies shall be limited to conforming to the provisions in Section 6-1.02, "State-Furnished Materials," of the Standard Specifications.

Controller Assemblies Power Strip (Contractor-furnished)

The Contractor shall furnish and install one rack-mount surge power strip with a switch in each State-furnished Model 334 controller cabinet. The power strip shall be plugged into the non-GFCI duplex outlet normally labeled with "Controller Unit Recp." in the back of the power distribution assembly (PDA) unit. The power strip shall be mounted at the top of the standard EIA-310 rack cage and across the two vertical back rails with four stainless steel EIA mounting screws, two on each side. The power strip shall not hinder the accessibility to the back of all existing electrical equipment. All power cords for permanently field installed electrical equipment shall be plugged into the power strip.

The power strip, at a minimum, shall meet the following requirements:

1. Maximum rating of 15 A, 120 VAC, 60 Hz.
2. The power strip shall have a surge protection with UL 1449 Clamping Level of 400 V, an IEEE Let-Through Voltage rating of less than 336 V, a single-pulse energy rating of 210 J and EMI/RFI noise protection rating of 40 dB.
3. The power strip shall be 46 mm (H) x 483 mm (W) x 70 mm (D) maximum and shall not weigh more than 2.0 kg.
4. The front plate of the power strip shall have four cut-off EIA mounting screw holes, two on each side.
5. The power strip shall have six rear outlets with 38 mm minimum apart center to center. The power cord shall enter from the rear with a length of 2 meters minimum. The clearance between the power cord entrance and the nearest outlet shall be 90-mm minimum.
6. It shall have a 15 A circuit breaker and an internally illuminated switch to cut off power to all outlets. Both the circuit breaker and the switch shall be front mounted.

SERVICE MANUAL REQUIREMENTS

The Contractor shall provide to the Engineer a minimum of ten copies of service manuals for the camera unit, pan and tilt unit, camera control unit, video transmitter duplex data unit elsewhere in these special provisions. Each manual shall contain the following sections and sub-sections.

1. General Information Section

   a. A list of applicable subassemblies that comprise the specified equipment.
   b. Overall description of the equipment design features (including all enhance features if applicable), performance, and applications.
   c. Equipment specifications summary.
   d. Equipment installation instructions.

2. Theory of Operations Section

   a. Theory of operation of the standard equipment, with unique or unusual circuitry described in detail.
   b. Theory of operation reflecting any modifications to the standard equipment.

3. Maintenance Section

   a. Recommended test equipment and fixtures, or minimum operational and performance requirements for appropriate test equipment.
   b. Trouble shooting information and charts.
   c. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper sequencing of steps may result in component damage.

4. Replacement Parts Section

   a. Each manual shall contain an equipment replacement parts list including electrical parts, mechanical parts and assemblies.
   b. All semiconductors shall be identified by the supplier's numbers and by JEDEC numbers if applicable.

5. Diagram Section

   a. Schematic diagrams(s) identifying all circuit components and showing normal test voltages and levels.
   b. An overall functional block diagram.
   c. Detailed interconnecting diagram(s) showing wiring between modules, circuit boards and major components.
   d. Pictorial circuit board layout diagram(s) showing both component placement and printed wiring detail.
   e. Diagram(s) showing location of circuit boards and other subassemblies.
   f. Exploded view diagram(s) of complex mechanical assemblies.

6. Physical Requirements

   a. All pages, including latest revisions, shall be securely fastened together between protective covers (loose-leaf ring binding is acceptable).
   b. No page shall be subject to fading from exposure to any normal source of ambient lighting (diazo reproduced pages are not acceptable).

10-3.12 LIGHTING

ROADWAY LIGHTING ASSEMBLY

The roadway lighting assembly shall include the base plate, anchor bolts, pole, luminaries, and, for poles over 12 m in height, a luminaire lowering device system, all as shown on the plans and in conformance with these special provisions.

GENERAL

For roadway lighting poles that incorporate a luminaire lowering device, the installation of the lowering device on each pole shall be made under the supervision of a trained representative of the lowering device manufacturer. Prior to acceptance of the contract, a trained representative of the lowering device manufacturer shall demonstrate that each roadway lighting assembly operates properly. The demonstration shall consist of a minimum of 3 complete cycles of raising and lowering the luminaire carriage (complete with luminaires) the full length of the carriage travel, as designed, within one working day, prior to acceptance of the project.

All portions of the roadway lighting assembly shall have a minimum design wind velocity rating of 130 km/h.

The lowering device system shall be submitted for inspection and testing. Inspection and testing shall be performed at a site in California approved by the Engineer. The lowering device system shall be demonstrated at the Contractor's expense. Notification shall be given to the Engineer at least 7 days prior to demonstration.

After the roadway lighting system is in operation, an instructional video tape (VHS), complete written instructions and a demonstration to State Maintenance personnel on the maintenance of the roadway lighting assembly, including the procedures for the safe raising and lowering of the luminaire carriage, shall be provided.

Spare parts, part lists and the operating, maintenance and service instructions, packaged with or accompanying the equipment installed on the project, shall be delivered to the Engineer prior to acceptance of the project.

SUBMITTALS

Submittals for the roadway lighting assembly shall conform to the provisions in Section 86-1.04, "Equipment List and Drawings," of the Standard Specifications and these special provisions. Submittals shall be delivered to the Engineer at least

45 days prior to erection of the roadway lighting assembly. The Engineer shall be allowed 45 days for the review of submittals. Review areas will include structural, welding, electrical and other areas as determined by the Engineer.

A. Descriptive data, design working drawings, erection working drawings (including aiming directions for each luminaire), isolux diagram for each type of luminaire, calculations, and a list of the material used for the roadway lighting assembly shall be submitted to the Engineer. The material list shall be complete with the name of manufacturer, catalog number, size, capacity, finish, pertinent ratings and identification symbols used on the plans or in the special provisions for each unit.
B. Each submittal shall consist of 5 copies.
C. Plans and detailed drawings shall be not larger than 559 mm x 864 mm.
D. Each separate item submitted shall bear a descriptive title and the State contract number.

Two copies of the submittals shall be forwarded to the Office of Structure Design. The Engineer shall be given a copy of the cover letter or other notification, and date, that the copies were sent to the Office of Structure Design.

INSPECTION

The roadway light poles will be inspected at the fabrication site. The Engineer shall be notified when materials have been delivered to the fabrication site. After delivery, the Engineer shall be given at least 10 days notice before fabrication of the light poles commences.

If all or a portion of the roadway poles are fabricated more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impracticable and extremely difficult to ascertain and determine the actual increase in such expenses, it is agreed that payment to the Contractor for furnishing said Roadway Light Poles will be reduced by $2500 for each fabrication site located more than 480 air line kilometers from both Sacramento and Los Angeles and an additional $2500 ($5000 total) for each fabrication site located more than 4800 air line kilometers from both Sacramento and Los Angeles.

CORROSION RESISTANCE

Corrosion resistance shall be provided. Methods shall include the following:

A. Avoidance of contact between stainless steel and carbon steel, between different types of stainless steel (including welding material), and between aluminum and ferrous materials.
B. Utilizing continuous welding to eliminate crevices which retain moisture.
C. Minimizing welding of stainless steel.
D. Use of adequate sections and suitable materials to limit stress related corrosion.

POLE

The pole shall be constructed, finished and installed in conformance with the provisions for pentagon poles in "Sign Structures" of these special provisions.

The pole shall include shaft, access hole, access hole cover, support plate and anchor base.

The pole shall be hot-dip galvanized after fabrication in conformance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications, and painted in conformance with the provisions in Section 59, "Painting," of the Standard Specifications.

The pole shall have a reinforced access hole, for poles with lowering devices, this access hole shall allow adequate clearance for maintaining and servicing the lowering device. Other hardware inside the pole shall accommodate the lowering device.

The access door shall be hinged to the pole, open horizontally 180 degrees, and when in the open position shall not interfere with access to the interior of the pole.

The pole shall be erected plumb. The vertical axis of the erected pole shall be within 75 mm of the theoretical vertical axis when measured without the action of sunlight or wind.

An embossed aluminum plate shall be attached with rivets to the outside of each pole approximately 50 mm above the access hole. The nameplate shall indicate the name of the pole manufacturer and the height of the pole.

A plastic laminated data sheet shall be secured on the inside of the access hole door. The data sheet shall include the names, addresses and telephone numbers of the manufacturers of the pole, luminaire lowering device and luminaires, and the design parameters, including wind velocity, luminaires (number, wattage, model number, mass, projected area and coefficient of drag), and the mass, projected area and coefficient of drag for the pole top lowering mechanism.

LUMINAIRE LOWERING DEVICE

The lowering device, along with lighting fixtures and poles shall be manufactured and tested as an integrated system and be provided and warranted by one manufacturer. A prototype system shall be constructed by the manufacturer, for testing of

the device with the fixture and track assembly shown on the plans. The manufacturer shall submit prototype test analysis and certified test data demonstrating proper performance of the system lowering device, track, fixture and pole assembly for acceptance, prior to fabrication of equipment to be supplied. The lowering device shall consist of three main subassemblies: headframe, lowering channel and track, and the clevis and winch assembly. The lowering device system shall be in conformance with the following requirements:

Headframe

The headframes shall be hot rolled steel conforming to the requirements in ASTM Designation: A 36. The headframes shall be hot-dipped galvanized in conformance with the provisions, in Section 75-1.05, "Galvanizing," of the Standard Specifications. The headframes shall consist of a hoisting cable sheave, power cable roller assembly, latch barrel and protective support cover. The hoist cable sheave shall be corrosion resistant with hardened surface to prevent cable imprint under load and shall have sintered bronze bushings and a cable keeper. The sheave shall be machined to match the cable diameter. The sheave shall be zinc electroplated and yellow chromate dipped. The hoisting cable shall be stainless steel aircraft cord, manufactured in conformance with the requirements in Military Specification MIL-8320B.

Power cable roller assemblies shall consist of multiple rollers providing a smooth even bending radius for the cable at each end. The design shall prevent the cables from riding up the sides of the rollers and have keeper bars at each end.

Latch barrel assemblies shall be cast of gall resistant aluminum. The latch shall support the entire weight of the fixture channel and fixtures on its own. It will support the fixture/channel assembly and unload the cables, clevis and winch when the lowering device is not in operation.

Luminaire lowering channel assembly shall consist of a latch pin, system status flag, fixture mounting plate, wiring junction box with power cord connection fitting and a stainless steel track system.

Latch pins shall be fabricated of stainless steel. Latching shall be accomplished by the alternate raising and lowering of the luminaire carriage by the winch and hoisting assembly. When the luminaire carriage is raised to the top of the pole, the carriage shall automatically latch and be secure in a locked position. During the unlatching sequence it shall transfer the load to the winch cable while the operator is away from the base of the pole. The latching and unlatching sequence shall be indicated by reflecting flags visible from the ground. During latching no more than one G of force shall be imparted to the lamps in any direction.

Winch and Clevis

Clevis assemblies shall attach the winch cable to the hoisting cable and the main electrical power cord. The clevis shall not allow either the winch cable or the hoist cables to independently rotate and shall have an ultimate breaking strength of at least 408 kg.

The winch shall have an ultimate strength of five times the lifted load. The winch shall have a 30 to 1 worm gear reduction and shall include an integral drag brake on the worm shaft to prevent free spooling of the winch drum. The drum shall be supported on both ends and shall include a Type 316 stainless steel cable keeper. The winch shall be factory pre-wound with Type 316 stainless steel aircraft cable manufactured in conformance with Military Specification MIL-8320B.

Drive Motor

Portable drive motors shall weigh less than 20 kg. Motors shall be one horsepower, heavy duty, reversing type with a stalled torque at least twice that required to operate the device. The motors shall drive the winch through a torque limiter coupling to limit the driving force on the cable. The torque limiter shall be factory pre-set. There shall be a back-up shear pin designed to shear at a torque level between 50 percent and 100 percent over the torque limiter setting. Motors shall be equipped with a remote control unit and a 6 m operating cord.

Terminal Block

A prewired 600-V (ac) terminal block in a NEMA Type 3R enclosure and a weatherproof power receptacle shall be mounted on the luminaire carriage raceway. When the luminaire carriage is in the lowered position, the receptacle shall enable the luminaires to be energized and tested.

Power Cables

An electrical cable of sufficient length to power the luminaire carriage, and with appropriate electrical connections, shall be provided to test the luminaires while in the lowered position. A circuit breaker of the rating shown on the plans and an outlet box shall be provided in the pole base.

Electrical cords shall be attached to a weathertight wiring chamber through weathertight cable connections. The main power cord shall support its full weight when installed. A positive connection between cord segments shall be provided across cord joints to prevent stress on the joints.

Power cable shall be Type SO, rated for 600 V (ac) with the number and size of conductors as required. Luminaire carriage distribution cord shall be Type ST with insulation suitable for 105°C. Twist-lock receptacles (male and female) shall be provided and shall be rated at a minimum of 30 A, 480-V (ac).

ROADWAY LUMINAIRES TYPE SSR

Pole mounted roadway luminaires shall be metal halide floodlight with a mounting suitable for the location shown on the plans. Fixtures shall be fully assembled, with die-cast aluminum socket housing, reflector housing, lens retainer and hood. Fixtures shall be furnished with metal halide lamp, tempered glass lens, Type 316 stainless steel fixture yoke, Type 316 stainless steel adjustable pivot bracket and mounting plate, with an attached die cast aluminum ballast box with ballast, and shall be in conformance with the following requirements:

Housing

Housings shall be die-cast aluminum. The socket housing shall be removable for lamp replacement, without altering the fixture mounting or aiming assembly. The socket housing shall be held captive by three Type 316 stainless steel latches and a Type 316 stainless steel safety cable attached to the pivot bracket. All exterior hardware shall be Type 316 stainless steel. The reflector housing shall be equipped with a die cast aluminum lens retainer, sealed with a sponge silicone "O"ring lens gasket.

Reflector

Reflector shall be 1.6 mm thick spun aluminum, Type 3002-0 with a polished brite dipped and clear anodized finish. NEMA beam spread shall be shown on the plans.

Lens

Lens shall be 4.8-mm thick clear tempered glass.

Lamp

Lamps shall be metal halide of the wattage shown on the plans.

Lamp Socket

Lamp sockets shall be mogul base, 4 kV pulse rated, vibration resistant porcelain.

Ballast

Ballasts shall be high power factor, constant wattage auto-transformer type of the voltage shown on the plans. The ballast shall be supplied with the lighting fixture, internally mounted in a corrosion resistant, cast aluminum, finned box with a weather-resistant sponge silicone "O"ring gasket.

Mounting

Fixtures shall be equipped with a fully adjustable Type 316 stainless steel mounting yoke and Type 316 stainless steel adjustable pivot bracket aiming system. Fixture and ballast shall be suitable for pole mounting. Mounting hardware shall be Type 316 stainless steel.

Listings

Fixtures shall be UL listed for use in wet locations.

POLE MOUNTED MARKER LIGHTS TYPE SAM

Pole mounted marker light fixtures shall be a 200-mm diameter decorative lantern for use with twelve high flux LED lighting strips, each containing twelve high flux LED lamps. These fixtures shall be shipped fully assembled, furnished with lamps, power converter, transformer, single piece acrylic lens and gasketed base and fixture cap, and shall comply with the following requirements:

Housing

Housings shall consist of a gasketed bronze baseplate with an acrylic cylinder/lens and a removable gasketed bronze cap secured to the fixture with a threaded cap anchor.

Lens

Lens shall be a 200-mm diameter, single piece injection molded acrylic cylinder, held in place by a gasketed fixture base plate and cap assembly.

Lamp

Lamps shall have a 100,000 hour ±minimum rating, white high flux LED with 120 degree beam spread, installed within 25 mm x 25 mm x 280 mm LED mounting strips. Each strip shall contain LED lamps.

Converter

Power converter shall be integral with the fixture and shall convert 480 V, 1 phase, AC power to the required DC voltage for the LED lamps.

Gaskets

Housings shall have weatherproof "O" ring gaskets.

Mounting

Fixtures shall be equipped with a cast mounting base, suitable for surface mounting to the Roadway Lighting Pole top. Mounting hardware shall be Type 316 stainless steel.

Listings

Fixtures shall be UL listed for use in wet locations.

BIKE PATH LIGHTS TYPE SSB

Bike path lighting fixtures shall be a railing mounted, tubular shaped, compact fluorescent pathway fixture, with a mounting suitable for the locations shown on the plans. Fixtures shall be furnished complete with lamp, ballast, ballast enclosure and fixture support bracket, high impact lens, internal wiring, and shall be in conformance with the following requirements:

Housing

Housings shall be a complete assembly in conformance with the requirements in ASTM Designation: A 36 . Housing shall be furnished to the railing fabricator to be incorporated into the railing structure. The housing shall consist of 89-mm diameter (3" Schedule 40) steel pipe with welded end plates and a welded attached ballast compartment and support bracket. The painted finish shall be applied by the railing fabricator, after the fixture is welded into place.

Reflector

Reflectors shall be 0.81 mm thick specular aluminum sheet.

Lens

Lens shall be extruded high-impact acrylic with prisms on the internal surface and shall be retained by two or more Type 316 stainless steel tamper-proof screws.

Lamp

Lamps shall be twin-tube compact fluorescent type of the wattage shown on the plans.

Ballast

Ballasts shall be high power factor type of the voltage shown on the plans. The ballast shall be integral with the lighting fixture and internally mounted in the fixture support bracket. The fixture support bracket shall be equipped with a removable gasketed cover for ballast access.

Listings

Fixtures shall be UL listed for use in wet locations.

LIGHT PIPES TYPE SAL

Future light pipe fixtures will be surface mounted, linear lighting system, with two hollow prismatic light guides and a central luminaire housing for use with a 400 watt metal halide lamp. Fixtures will be fully assembled, furnished with lamp, mounting brackets, light guides and remote ballast and will be provided in a separate project.

Cast-in-place light pipe mounting fixtures shall be as shown on the plans. Mounting fixtures shall be installed as a part of this project.

BELVEDERE LIGHTS TYPE SSV

Belvedere light fixtures shall be suitable for pole mounting, compact, floodlight fixtures for use with compact metal halide PAR 20 lamps. Fixtures shall be fully assembled, furnished with lamp and ballast and shall be in conformance with the following requirements:

Housing

Housings shall be machined corrosion-resistant silicone aluminum alloy. Finish shall be a chromate conversion undercoating with a thermoplastic polyester powder coat, color will be selected by the architect. Housing shall be equipped with a lens bezel and glare shield.

Lens

Lens shall be tempered glass, housed within the fixture lens bezel, secured in place with a high temperature adhesive.

Lamp

Lamps shall be PAR 20 compact metal halide of the wattage shown on the plans.

Lamp Socket

Lamp sockets shall be ceramic with attached high temperature teflon coated lead wires.

Ballast

Ballasts shall be high power factor, core and coil, voltage shown on the plans. Ballast shall be integral with the lighting fixture, internally mounted in corrosion resistant silicone aluminum alloy box.

Gasketing

Housing and lens bezel shall be gasketed with high temperature "O" ring gaskets.

Mounting

Fixtures shall be equipped with a fully adjustable mounting stem with locking clutch mechanism for control of vertical adjustment. Fixture and ballast shall be suitable for surface and pole mounted applications. Mounting hardware shall be Type 316 stainless steel.

Poles

Poles for mounting Belvedere lights shall be in conformance with the provisions in Section 86-2.04, "Standards Steel Pedestals and Posts," of the Standard Specifications and as shown on the plans. Poles shall be galvanized and painted.

Listings

Fixtures shall be UL listed for use in wet locations. Fixtures shall be C-UL certified.

NAVIGATION LIGHTING

The bridge navigation lights shall be marine signal lanterns conforming to the requirements of Coast Guard Standards 33CFR 118.60, 33CFR84.13 and 33CFR 84.15. The lanterns shall be constructed of painted, anodized, polycarbonate base or fiberglass base, components with a precision-molded, color impregnated, glass, 200 mm Fresnel lens. The lantern shall be hinged for easy access to the lamps and internal assembly. The lantern shall have a bird spike incorporated into the lantern to reduce fouling where post mounted. Lanterns mounted upside down on the bridge structure shall be provided without a bird spike. Closure of the lantern shall be by captive toggle bolts and a watertight gasket. The lantern shall be capable of meeting IP-55 standards. The lantern top shall remain physically connected to the lantern base when opened for servicing. The lantern shall accommodate a 4-place lampchanger with four each S-11 marine signal lamps. Internal shock and vibration isolators are required to extend filament life.

The lantern shall have lens tie rods (astragal) constructed of stainless steel. The tie rods shall be placed at an angle of approximately 27 degrees to allow the light beam to be uniform within 25 percent at all viewing angles. Vertical lens tie rods will not be allowed due to shadowing of the lens, which significantly reduces lantern output. The lantern base shall incorporate a bottom cable entry and four attachment studs on a 120.65 mm bolt circle. Closure bolts and attachment hardware shall be constructed of stainless steel.

In order to operate the lampchanger and marine signal lamps, a transformer shall be fitted within the lantern to accept the supply voltage of 120 VAC and provide 10.0 V to 10.5 V to the lampchanger. Four 3.05 A, 12 V, marine signal lamps shall mount in the automatic lampchanger, which holds the operating lamps at the lens focal point and replaces the operating lamp upon failure. Only the operating lamp shall extend through the focal plane of the optic. Total lamp life for the optic shall exceed 25,000 hours.

TYPE E2 EXIT LIGHTS

The exit lights shall be single-face with red letters on gray background and shall be in conformance with the following requirements:

Housing

a. Fast Snap-In connection
b. UL 94V-0 Hi-Impact Thermoplastic
c. Universal top, side, or back mounting
d. Stencil face easily removable
e. Field selectable chevrons

Battery

a. Maintenance free sealed nickel cadmium
b. Rated life of 12 year
c. Operating range from 0°C to 95°C
d. Ideal for high ambient temperature areas

Illumination

a. Long-lasting Light Emitting Diodes (LEDs)
b. Internal light chamber eliminates hot spots
c. Rated life of 25 years for LED's and electronics

Electronics

a. Rated input voltage of 120 V(ac)
b. Surge protection
c. Battery backup
d. Low-voltage disconnect
e. AC lockout and brownout protection
f. Constant current charger

Compliance

a. UL 924 Listed, NFPA 70 and NFPA 101
b. NEC and OSHA Illumination Standards

10-3.13 FIXTURES

TYPE A1

Round satin opal cased drum light and be suitable for bathrooms.

Manufacturer:	Prescolite 9464-60 or equal with the same photometrics
Lamp:	A19 60 watt incandescent

TYPE F1

The fixture shall conform to UL 1570 and be suitable for damp locations. The body shall be made of die formed code-gage steel. Plated quarter turn latches shall secure the Reflector. The fixture shall be five-stage, iron-phosphate pretreated with painted parts finished with high-gloss baked white enamel.

Manufacturer:	Lithonia AF10 2 40 120 GEB or equal with the same photometrics
Lamp:	(2) F40T12
Ballast:	Electronic ballast with 20% THD, thermally protected, resetting class P. conforms to UL 935.

TYPE F2

The fixture shall conform to UL 1570 and be suitable for damp locations. The body shall be made of die formed code-gauge steel. Plated quarter turn latches shall secure the reflector. The fixture shall be five-stage, iron-phosphate pretreated with painted parts finished with high-gloss baked white enamel.

Manufacturer:	Lithonia DM/DMW 2 40 120 GEB or equal with the same photometrics
Lamp:	(2) F40T12
Ballast:	Electronic ballast with 20% THD, thermally protected, resetting Class P. conforms to UL 935.

TYPE F3 AND F4

The fixture shall be UL listed for wet location. The fixture shall meet the following standards:

1. UL Standard 844 for Hazardous Location - Class I, Division 2 (with heat-treated glass globe and guard).
2. UL Standard 595 for Marine Outside Type (Saltwater).
3. UL Standard 1570/1571 for Wet Location.
4. United States Coast Guard (U.S.C.G.) approved.

The housing shall be a gray glass reinforced thermoplastic. The fixture shall have brass screws and inserts. The fixture shall have long life silicone vaportight seal gaskets. The fixture shall have an integral metal grounding frame. The globe must be clear heat-treated glass. The fixture shall have an integral high power factor ballast.

Manufacturer:	Phoenix VP 00-2-8-1-1-0 or approved equal with the same photometrics
Lamp:	CFM32W/GX24q/835
Ballast:	High Power Factor

The F3 is stanchion mounted, Type F4 is wall mounted.

TYPE E1

Self-contained incandescent emergency lighting units. The battery shall be 12 volt, nickel-cadmium type, with 1.5-hour capacity. The battery charger shall be a dual-rated type, with sufficient capacity to recharge a discharged battery to full charge within twelve hours. The lamps shall be two 25 watt minimum, sealed beam type. The housing shall be a fiberglass-reinforced gray polyester enclosure. The Type E1 shall have indicator lamps to indicate AC ON and RECHARGING and a voltmeter to indicate the battery voltage. The TEST switch shall transfer unit from external power supply to integral battery supply. The input voltage shall be 120 V(ac). The electrical connection shall be a conduit connection.

TYPE H1

The fixture shall meet the following standards:

1. UL Standard 1572 for Marine Outside Type (Saltwater).
2. UL Standard 1570/1571 for Wet Location.
3. U.S.C.G. approved.

The fixture shall have brass screws and inserts. The fixture shall be enclosed and gasketed. The fixture shall have an integral metal grounding frame. The globe must be clear heat-treated glass. The fixture shall have an integral high power factor ballast.

Manufacturer:	GE Powr-Gard H9-1-10M-5S-JJ or equal with the same photometrics
Lamp:	MXR 100-U-MED
Ballast:	High Power Factor

TYPE H2

The fixture shall meet the following standards:

1. UL Standard 1572 for Marine Outside Type (Saltwater).
2. UL Standard 1570/1571 for Wet Location.
3. U.S.C.G. approved.

The fixture shall have brass screws and inserts. The fixture shall be enclosed and gasketed. The fixture shall have an integral metal grounding frame. The globe must be clear heat-treated glass. The fixture shall have an integral high power factor ballast.

Manufacturer:	GE Powr-Gard H9-1-10M-4T -JJ or equal with the same photometrics
Lamp:	MXR 100-U-MED
Ballast:	High Power Factor

10-3.14 SUPERVISORY CONTROL AND DATA ACQUISTION REMOTE TERMINAL UNIT SYSTEM

GENERAL

The Contractor's attention is directed to "Order of Work" of these special provisions for the timely identification of the supplier of the remote terminal units and products to be used by the Contractor.

The Engineer will arrange for the procurement and installation of a new SCADA Master Programmable Logic Controller (PLC) including workstations. The equipment will be installed in the Administration Building. The communications protocol between all field devices, RTUs and the SCADA PLC will be MODBUS.

The Contractor shall coordinate the procurement of the SCADA remote terminal units (RTUs) with the Engineer prior to procurement to assure compatibility between the SCADA RTUs and the new SCADA Master PLC.

The Contractor shall arrange for the RTU supplier to generate complete wiring diagrams, based on shop drawings, of each RTU, showing all incoming cable and wire terminations to be terminated by the Contractors. The wire, cable and circuit numbers shall match and be coordinated with the RTU requirement plans (elementary and wiring diagrams), furnished for the SCADA RTU system. This information shall be available for the Engineer to review upon request prior to installing any of the RTUs.

1. Manufacturer's Standards

The manufacturer shall have shown high commitment to product, manufacturing and design process quality. The manufacturer shall have attained ISO9000 registration.

2. Design and Manufacture

The I/O and control system, and all of the corresponding components within the family of controller products, shall be offered by a company who regularly manufactures and services this type of equipment.

All products shall be designed, manufactured, and tested in accordance with recognized UL, C-UL, CE Mark, IEC and JIS industrial standards. The system shall be operational during and after testing.

3. Vibration

Modules are to perform well where vibration is a factor. Designs are to be shock and vibration tested to meet the following specifications when installed on a panel-mounted Type DIN rail-using clamp supplied, and panel-mounted feet secured:

Vibration: IEC68-2-6: 10 to 57 Hz 0.012 in displacement (peak to peak) 57 to 500 Hz at 2 G.
Shock: IEC68-2-27, Shock: 15 G, 11 ms, half sine wave.

4. Noise

Modules are to be resistant to noise levels found in most industrial applications when installed according to accepted practices, including proper separation of wiring by voltage and power levels, and mounting on a conductive (unpainted) Type DIN rail. Filtering and transient protection shall be coordinated with equipment, such as the unit substation feeder management relays, communicating with the RTU. The Type DIN rail is an integral part of the grounding system. Modules are to be tested to the following noise specification:

Emissions	FCC Part 15, Section J, Class A, Computing Devices CISPR11
Susceptibility	IEC 801 - 2,3,4,5,6, ANSI/IEEE C37.90 (Relay and relay system associated with Electrical Power Apparatus)

5. Temperature

Modules shall operate reliability in ambient air temperatures from 0°C up to 55°C.

Storage temperatures are to be -40°C to +85°C.

6. Humidity

5 percent to 95 percent, non-condensing.

7. Quality Assurance

The manufacturer shall have a fully operational quality assurance and quality control program in place.

Complete documentation describing the quality assurance and quality control plan shall be available.

Complete product documentation describing installation and simple field maintenance shall be available.

The product shall be designed and manufactured in the USA.

8. Support

The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance. A toll-free (800) number hot-line shall be available for emergency support.

An electronic Bulletin Board Service (BBS) shall be available to users for application support.

Product shall have a warranty period of at least 1-year from the date of purchase.

9. Product Hardware

The RTUs shall consist of rugged components designed specifically for industrial environments. A complete RTU shall be modular in design. There shall be three classes of modules that combine to form a RTU and each class shall contain various subclasses or interchangeable types. Class 1 shall be a bus interface unit; Class 2 shall be an I/O module; and Class 3 shall be an I/O terminal base designed to mount up to two I/O modules. The I/O terminal base shall be designed for DIN rail or panel mount in any orientation. Each RTU shall include a minimum of one bus interface unit, one to four I/O terminal bases and one to eight I/O modules. I/O terminal bases are to be connected to each other and to the bus interface unit via a short backplane extension cable.

10. Packaging

All components shall be housed in structurally secure non-ventilated stainless steel enclosures.

The bus interface unit shall be a high-speed bus.

The I/O modules shall be modular. Each module shall be fully enclosed within a durable shroud. When mounted on the I/O terminal base, each I/O module shall not occupy more than one available slot (except as necessary for some specialty modules).

There shall be at least three types of I/O terminal bases available. Each shall contain mounting space for up to two I/O modules. One type of I/O terminal base shall utilize a box type terminal, another a barrier type terminal; and another a high-density connector. There shall be others as needed by the application.

The I/O terminal bases shall be connected together via a flexible cable using pin and socket connectors. This cable shall provide vibration resistance as well as mounting variations. This cable shall be available in various lengths up to 53.3 mm.

I/O modules shall be retained in the slot by metal screws on the upper and lower edges. Removing the module shall require only a screwdriver.

I/O modules shall be installed in any available slot in one of the minimum of four I/O terminal bases.

I/O modules shall connect electrically to the I/O terminal base via a pin and socket connector.

I/O modules shall be fully enclosed in a covering to protect the electronic circuitry from exposure.

11. Durability

All components within the I/O and control system family, including switches and operator-controlled devices shall be of the size and durability for the intended use for industrial applications in Seismic Zone 4.

All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

12. Parts Interchange

In order to minimize spare parts stocking requirements, the I/O and control system family shall have interchange capability. The I/O terminal bases and auxiliary terminals should, as much as possible, all operate equally well regardless of the I/O module being used.

The system shall incorporate a modular design using plug-in assemblies with pin and socket connectors.

All assemblies and sub-assemblies performing similar functions shall be interchangeable.

The system design shall accommodate the replacement of I/O modules without having to disconnect field wiring.

All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number, product manufacturing date code, CE, UL and C-UL certifications.

13. Environmental Conditions

All components of the I/O and control system shall meet the following environmental specifications:

Storage temperature	-40°C o 85°C
Operating temperature	0°C to 55°C
Humidity	5 to 95 percent relative humidity, non-condensing

Bus Interface Unit

The fieldbus interface module shall contain the local power supply, the central processing unit, and the communications link.

14. Power Supply

The power supply shall be a low voltage DC supply. It shall operate from a nominal 24 VDC voltage source with a voltage range of 18 VDC to 30 VDC. The maximum input power at nominal voltage shall be 16.8 W.

With a supply voltage of 18 VDC the power supply shall provide 6.5 VDC at up to 1000 mA to the I/O modules. With a supply voltage of 21 to 30 VDC the power supply shall provide 6.5 VDC at up to 1400 mA to the I/O modules.

15. Central Processing Unit (CPU)

At least one type of CPU shall be offered, and the CPU shall be embedded in fieldbus interface module. Each CPU shall possess the capability interface to the selected I/O communication bus and interface to the I/O system.

The bus interface unit shall maintain the I/O station configuration data in its mounting base in EEPROM. This shall allow replacement of the fieldbus interface module without loss of any configuration data or program.

16. Communications Link

The high speed bus shall be a reliable, high speed, peer-to-peer serial link. Communications speed shall not be less than 153.6 kbaud. Communications protocol shall be MODBUS.

Cyclic redundancy check (CRC) type error checking shall be used for all data communicated on this link. Communications errors (bus errors) shall not prevent the I/O system from continuing its operation. If bus errors are encountered the incorrect data shall be rejected and the bus errors reported to the controlling computer.

Isolation shall be provided between all devices connected to the communications bus. This isolation shall allow continued operation with up to 50 volts ground potential between devices. Also the communications bus shall be able to withstand 1500-volt transients between itself and the I/O circuits in each I/O station.

There shall be no active components in the serial cable path for the purpose of receiving, transmitting or amplifying the communications signal. This is required so that internal failures of any device on the communications bus do not affect communications with other devices on the same bus.

One individual communications bus shall be capable of handling at least 32 devices although the bus shall also operate with as few as two devices. The devices may be I/O stations, call boxes, hand held monitors or interfaces to host computers.

The length of the communications bus shall be extendible up to 2300 meters. The physical configuration of the cables between devices shall be a daisy chain.

The communications bus shall provide a message service capable of up to 128 byte data packs. These messages shall be capable of being either broadcast to all stations or directed to a specific station.

The communications bus shall be capable of being extended over a fiber optic cable through connection of a modem. The fiber network shall offer greater distances in communications, greater immunity to electrical noise interference and full redundancy.

17. Redundancy

The field control station shall support at least two forms of redundancy: dual host computers and dual communications busses.

Using a hand held monitor, I/O stations shall be configurable for "hot standby", "duplex", or no redundancy.

A station configured for "hot standby" shall be able to determine which host shall control its output points.

A station configured for "duplex" redundancy shall compare the output states commanded by two controlling host computers attached to the bus. While the commanded states are the same, the physical corresponding output shall assume the commanded state. If the commanded states are different, the corresponding output shall assume a pre-configured default state. The default state shall be set by configuration.

Dual communications busses shall be supported at the controlling host computers by having one bus interface device per bus per host computer. Dual busses at the field control station shall be supported by a built-in switching device that redirects the bus signals to the station.

SYSTEM DIAGNOSTICS

1. Visual Diagnostics

There shall be at least two green LEDs on the bus interface unit labeled PWR, and OK. The PWR LED shall indicate that +5 VDC power is available for logic operation. The OK LED shall indicate the bus interface unit has passed its powerup diagnostics. The OK LED shall blink to indicate that an I/O circuit fault has been detected. The OK LED shall blink to indicate there is a forced circuit.

The diagnostic status of the fuses, for those discrete I/O modules containing fuses, shall be indicated by the green PWR LED mounted on the top of the module turning off.

2. I/O Module Modularity

Interface between the CPU and user supplied input and output field devices shall be provided by I/O modules and I/O terminal bases.

3. Configuration

An expandable I/O system shall be supported by the CPU in the bus interface unit, and shall accommodate up to four I/O terminal bases with a maximum of eight I/O modules. There shall be provision for a 533 mm cable to join any two I/O terminal bases to allow more flexibility in panel layout.

4. I/O Addressing

I/O reference addressing for each I/O module shall be assigned through the use of the PC compatible configuration and programming software or the hand held programmer. There shall be no jumpers or DIP switch settings required to address modules.

The circuit on/off status of each I/O point on a module shall be indicated by a green LED mounted at the top of the module. The circuit faults on a module shall be indicated by a yellow LED mounted at the top of the module. These LED's must be visible through a clear plastic lens.

Addressing of all references including I/O must be represented as a Decimal Based number.

The Contractor shall coordinate I/O addressing and RTU logic with the Engineer prior to procurement of the RTUs.

5. Construction

The I/O modules shall be easily removable from the I/O terminal bases, to allow for convenient pre-wiring of field devices. There shall be a selection of at least three I/O terminal bases to accommodate the requirements of various field devices and enough field terminal positions for all field termination plus 25 percent spare capacity.

The I/O module side label shall have the module field device connection description, and catalog number, and the top label shall have a user legend space to record circuit identification information and a window to allow viewing of the status LEDs.

The top label shall have color coding for quick identification of the module as high voltage (red), low voltage (blue), or signal level (gray) type.

6. Electrical Specifications

I/O modules shall be designed for 1500-volt isolation between the field wiring and the system backplane.

7. Input Specifications

The 120 VAC input module shall accommodate an input voltage range from 0 to 132 volts.

The 24-Volt DC positive and negative logic input modules shall accommodate an input voltage range from -30 to +30 VDC.

8. Availability of Input Modules

Availability of input modules shall be as shown on the plans. As a minimum, the following discrete input modules shall be available:

Description	Points/Module
Input Simulator	8
120 VAC Input	16
240 VAC Input	16
24 VDC, Positive/Negative Logic Input	16
24 VDC, Positive/Negative Logic Fast Input	16
5/12 VDC, Positive/Negative Logic Input	16
48 VDC Positive/Negative Logic Input	16
125 VDC Positive/Negative Logic Input	16

9. Output Specifications

Discrete AC output modules shall have separate and independent commons allowing each group to be used on different phases of AC supply.

Each discrete AC output shall be provided with a RC snubber to protect against transient electrical noise on the power line.

Discrete AC outputs shall be suitable for controlling a wide range of inductive and incandescent loads by providing a high degree of inrush current (10x the rated current).

Discrete DC output modules shall be available with positive and negative logic characteristics in compliance with the IEC industry standard.

A discrete 24 VDC, 2 A resistive maximum load per output module with electronic short circuit protection shall be available.

Discrete DC output modules shall be compatible with a wide range of user-supplied load devices, such as: motor starters, solenoids, and indicators.

A 2 A relay output module shall be capable of supplying 2 A resistive maximum load per output and 4 A resistive maximum load per group of 4 outputs. The 2 A relay output module shall have six form A contacts and in addition shall have two form C contacts.

10. Availability of Output Modules

As a minimum, the following discrete output modules shall be available:

Description Point/Module	Fuse	# Fuses/Rating	Point/Mod
12 to 120 VAC, 0.5 A	3 A	2	12/16

ANALOG INPUT AND OUTPUT

1. General Specifications

When analog to digital and digital to analog conversion is required by an application, the following shall be available:

2. Module

As a minimum, the following analog modules shall be available:

Description	Channels/Module
Current Analog Input, 12 bit resolution	8
Current Analog Input, 16 bit resolution	16
Thermocouple Input, Isolated	8
RTD Input, Isolated	4
Current/Voltage Analog Output	4

3. Current Analog Input

The two analog current input module shall be capable of converting 8 and 16 channels of inputs in the range from 4 to 20 mA or from 0 to 20 mA.

Resolution of the converted analog current input signal shall be 12 bits binary or 1 part in 4096 and 16 bits binary or 1 part in 65,536.

All four of the channels of converted analog current input signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format.

The 16 channel analog input module shall have 10 and 20 ms user selectable input filter times for each channel.

4. Thermocouple Input

The thermocouple input module shall be capable of converting 8 channels of at least Type J, K, T, E, B, N, G, C, D, Platinel II, S, and R thermocouples.

Resolution of the converted signal shall be 16 bits or 1 part in 65,536.

The conversion speed per input shall be 70 ms at 50 Hz and 60 ms at 60 Hz per input channel.

The thermocouple input module shall support per channel voltage spans ±19.5 mV, ±30 mV, ±78.125 mV, ±156.25 mV, ±312.5 mV, and ±625 mV.

5. Resistance Temperature Detector analog input

The resistance temperature detector (RTD) input module shall be capable of converting 4 channels of 3 wire RTD input of at least type 10 ohm Cu, 10 ohm Pt, 25 ohm Pt, 50 ohm Cu, 100 ohm Cu, 100 ohm Pt, 100 ohm Ni, 120 ohm Ni, 604 ohm Ni, 1 K ohm Ni, and 1 K ohm Pt.

Resolution of the converted input signal shall be 16 bits binary or 1 part in 65,536.

All four of the channels of converted RTD input signals shall be updated each scan into a dedicated area of data registers.

The conversion speed per input shall be 230 ms at 50 Hz and 210 ms at 60 Hz per input channel.

6. Current and Voltage Analog Output

The analog current output module shall be capable of converting four channels of digital data to analog outputs in the range from 4 to 20 mA or from 0 to 20 mA selectable by jumper. The module shall also provide simultaneous voltage outputs in the range from 0 to 10 V or from 0 to 12.5 V selected by the same jumper.

Resolution of the converted output signal shall be 12 bits or 1 part in 4096.

All four channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format.

The analog current outputs shall default to 0 volt in the event of a CPU failure.

7. I/O Terminal Base

The I/O terminal bases shall be generic wiring points for the I/O stations. The I/O terminal bases shall provide mounting for up to two I/O modules, backplane communications, and terminals for user connections.

Up to two I/O modules shall be installed on each I/O terminal base. I/O modules shall screw onto the terminal base for vibration resistance.

Removing the I/O module from the I/O terminal base without disturbing the field wiring shall be possible.

Each I/O terminal base shall contain:

1. Two separate sets of module terminals forming an I/O 'slot'.
2. A grounding screw for connecting a ground wire.
3. Two backplane cable connectors.
4. Two spare fuse holders.
5. Provision for Type DIN rail and direct panel mounting.
6. Type DIN rail latches.
7. Two sets of keying slots with 10 slots in each set.
8. Provision for accepting two auxiliary terminal blocks.

I/O terminal bases shall be with barrier-type terminals, for user connections. The barrier-type shall have 37 terminals. Each terminal shall accommodate one or two wires up to No. 14 AWG (average 2.1 mm cross section).

Auxiliary terminal blocks shall be attached to the I/O terminal base when additional tie points are needed for analog and high-density discrete I/O modules. The barrier-type terminal block shall contain 9 terminals. All terminals in each auxiliary terminal block shall be internally tied together and isolated from the power and point terminals. There shall be provision to separate the terminals into groups if desired. An immediate I/O update function shall be provided for the update of all or a portion of the inputs or outputs for one scan while the program is running, or to update I/O during the program in addition to the normal I/O scan.

INSTALLATION REQUIREMENTS

One Remote Terminal Unit (RTU) for the bridge Supervisory Control and Data Acquisition (SCADA) System shall be installed by Contractor. The RTU is to be installed and wired as shown on the plans.

The Contractor will be responsible for making a complete, operational loop check of each circuit installed by the Contractor and connected to the input and output terminals of the RTU. Loop checks will be performed by simulating a contact closure as necessary to prove the operation of each circuit.

10-3.15 SUBSTATION ELECTRICAL

SMOKE DETECTORS

The Contractor shall install, where shown on the plans, photoelectric smoke detectors. A normally closed contact in each unit shall be used to supply a status signal to the SCADA Remote Terminal Unit System. It shall be possible to perform a functional test of the sensor without the need of generating smoke for a period sufficient to test the internal circuitry.

The detectors shall be assembled and engineered for surface ceiling mount with a standard outlet box. The detector shall respond to visible smoke particles with a minimum diameter of 3.3 microns.

Smoke sensors shall be Hochiki model ALG-V, Radionics D262, Esl Sentrol 440/445 series or equal.

ELECTRICAL ROOM SECURITY DOOR SWITCHES

The electrical room security door switches shall be industrial grade and rated 120 V, 100 mA. The switch contact shall be normally open and shall be closed when the switch contact pair is separated. The switch contact shall be enclosed in temperature and impact resistant plastic.

UNIT SUBSTATION

The Contractor shall install two 12.47 kV/480 V unit substations, each consisting of medium voltage switchgear, a step down transformer, low voltage switchgear and related equipment in the quantity as shown on the plans, completely assembled, equipped, wired, and factory tested. The Contractor shall provide materials, field installation, field start-up assistance, field testing, training, plans, data, descriptive information in detail, operations and maintenance manuals as required elsewhere in these special provisions.

The Contractor’s attention is directed to "Order of Work" of these special provisions for the timely identification of the supplier of the unit substation and products to be used by the Contractor.

The Contractor shall verify that the unit substation components can be raised through the hatch prior to procurement. The hatch opening being provided for installation of the equipment is limited in size. The exact size is shown on the plans. The unit substation components shall be designed to fit through the hatch openings.

The equipment shall be designed, fabricated, assembled and tested in accordance with applicable codes and standards of the following organizations:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronic Engineers
4. ISA - Instrument Society of America
5. NEC - National Electrical Code
6. NEMA - National Electrical Manufacturers Association
7. NFPA - National Fire Protection Association
8. OSHA - Occupational Safety and Health Administration
9. UL - Underwriters Laboratories

If there is a conflict between the above referenced standards, the more stringent standard shall be used. The equipment shall consist of individual vertical sections housing medium voltage circuit breaker units, draw out fuses and potential transformers, control switches, relays, wiring, interlocks and accessories assembled to form a rigid, self-supporting, completely metal enclosed structure. The equipment shall also include 12.47 kV/480 V step down transformer equipment and consist of individual vertical section housing the base structure, cores, coils, insulation, control cabinet and accessories. The low voltage switchgear section shall consist of vertical sections, circuit breakers, current transformers, potential transformers, control switches, wiring, interlocks and accessories. A breaker transport dolly shall be furnished for each substation.

Submittals (For Review and Approval)

The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram
7. Nameplate schedule

8. Component list
9. Conduit entry and exit locations
10. Assembly ratings including:

    a. Short-circuit rating
    b. Voltage
    c. Continuous current
    d. Basic impulse level for equipment over 600 volts
    e. kVA rating

11. Major component ratings including:

    a. Voltage
    b. Continuous current
    c. Interrupting ratings

12. Cable terminal sizes
13. Transformer impedance.

Where applicable, 10 copies of the key interlock schematic plans and sequence of operations shall be submitted to the Engineer:

Submittals (For Information)
When requested by the Engineer the following product information shall be submitted:

1. Descriptive bulletins
2. Product data sheets.

Submittals (For Final Acceptance)
Ten copies of the following information shall be submitted for record purposes prior to final payment:

1. Final as-built plans and information for secondary unit substation
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification and equipment anchorage details.

Operation and Maintenance Manuals
Ten copies of the equipment operation and maintenance manuals shall be provided prior to shipment of the equipment. Operation and maintenance manuals shall include the following information:

1. Instruction books or leaflets
2. Recommended renewal parts list

Qualifications
For the primary and secondary equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified. The manufacturer of this equipment shall have produced similar electrical equipment. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided.

The finish of the switchgear shall consist of a coat of thick exterior finish spray of air drying and high-gloss gray enamel and a coat of ANSI-16, cathodic epoxy paint applied by electro-deposition process to the pre-cleaned and phosphatized steel surfaces.

The Contractor shall provide labor and equipment for unloading and installing unit substation, foundations, anchor bolts, connections to all external power and control wiring, field testing and energizing. For mid-span substations, eastbound and westbound, equipment leveling shims shall be providerd. The substation floor may be at a 2.5-degree slope in two directions.

Inspection and Testing
Equipment furnished will be subject to expediting and shop inspection. Units shall be completely assembled, within shipping limitations, all dimensions shall be verified, and circuits shall be checked and tested prior to shipping.

The Engineer shall have the option to inspect fabrication and witness the testing of the equipment. The Contractor shall notify the Engineer a minimum of three weeks in advance of the date of scheduled tests. The manufacturer shall include the cost of transportation and lodging for up to three Department's representatives. The cost of meals and incidental expenses shall be the Department's responsibility. An authorized representative of the Engineer shall have free entry during fabrication and testing of the equipment.

UNIT SUBSTATION COMPONENTS

Unit Substation Medium Voltage Switchgear

The metal-clad switchgear is a part of the secondary unit substation and shall meet the applicable parts of that specification in these special provisions.

1. Switchgear Enclosure

The metal-clad switchgear shall be dead-front, free-standing, rigid, bolted steel frames, completely enclosed by metal sheets. Each unit, or auxiliary unit, shall have adequate facilities for removal of gases. The switchgear assembly shall be so constructed that it is easily extendible and so all components are easily accessible for installation and maintenance. All indicating instruments, protective relays, push buttons, indicating lights and control switches shall be mounted on the front side of cubicles.

2. Busses

The main bus shall be insulated by flame retardant epoxy that withstands dielectric tests specified in ANSI-C37.20. The bus supports shall be flame-retardant track resistant glass polyester, which have strength suitable to withstand the forces caused by a peak short circuit asymmetrical current. Three-phase, insulated copper bus bars shall be provided with the same continuous current ratings as the main power circuit breaker. All joints shall be electrolytically silver-plated. Bus insulation shall be slip on flame retardant and tracking resistant Noryl bus sleeves. Splice, "L" bow, and boots shall be insulated with vinyl insulation. Spare boots are to be included. Power bus, connections and supports shall be of standard design and suitably spaced for the continuous current and short circuit current capacities of the main circuit breaker. Interconnecting bus segments with suitable material for insulating bus joints, including structure-connecting hardware shall be provided with each shipping section. The standard phasing within equipment housings for power circuits shall be A, B, and C from left to right, top to bottom, and front to back when facing front of the equipment.

Continuous copper grounding bus bars shall run through the assembled switchgear with all non-current-carrying metal parts effectively connected to the grouding bus bars. The ground bus bar shall be not less than 50 mm x 6 mm in size. Connections shall be made by bolted type fittings. Mechanical lugs for conductor sizes from No. 2/0 AWG to 250 kcmil stranded bare copper wire, bolted to ground bus, shall be provided in each incoming supply cubicle and in each feeder cubicle for connection of ground wire to ground bus bar. Copper bus bar splices between shipping sections shall be provided within bolted connections having silver-plated contact surfaces and means for adequate clamping.

3. Medium Voltage Circuit Breakers

The circuit breakers shall be vacuum-break type, draw out construction, three-pole, single-throw. Minimum breaker ratings shall conform to the ratings as shown on single-line diagrams.

Each breaker shall be suitable for “local” electrical control in both operating and test positions. Provision shall also be made for “remote” electrical control. Circuit breakers shall have stored-energy closing mechanism of the motor-charged spring-wound type, which are normally electrically charged and released to close the breakers. With the breaker in closed or tripped position it shall be possible to recharge the stored-energy mechanism by hand.

An emergency mechanism trip lever shall be supplied to trip the breaker manually in the event of loss of tripping voltage. Local manual operation shall be possible from the front of the breaker by direct mechanical linkages, without use of auxiliary voltage or other auxiliary medium. The closing mechanism shall be "trip-free." The closed and open position of each breaker shall be clearly indicated by a mechanical position indicator visible from the front of the cubicles. Colors shall be RED for CLOSED and GREEN for OPEN positions of the circuit breaker. Position and connection to all main and auxiliary contacts and plugs shall be identical in each circuit breaker so that circuit breakers of equal rating shall be interchangeable. A minimum of 2 NO/2 NC breaker and 4 NO/4 NC mechanism operated control (MOC) spare electrically separate auxiliary contacts, with draw out finger connections to stationary mounted terminals, shall be furnished for each breaker in addition to those required for internal control. Breakers shall be adjustable for either normally-open (NO) or normally-closed (NC) contacts and shall be operated by the breaker in both operating and test positions. Breakers shall be truck-mounted and withdraw in the horizontal direction. Any attempt to withdraw a breaker in a closed position shall cause it to trip automatically. When the breaker is withdrawn, shutters shall automatically close off all access to live fixed contacts. There shall be a "test" position for each breaker in which, while still in the compartment with the door closed and with the power contacts disconnected, all its auxiliary wiring remains in an operating condition, permitting tests of all control functions associated with the circuit breaker. There shall be provision for padlocking the circuit breaker in the test position to

prevent plug-in of the breaker. The electrical and mechanical operating mechanism shall be designed so that it is impossible to close or trip the circuit breakers unless it is in either the racked-in (operating) or the test positions.

Each circuit breaker shall contain three vacuum interrupters separately mounted as a self-contained, self-aligning pole unit which can be removed easily. The vacuum interrupter pole units shall be mounted on glass polyester supports. An integral contact wear gap indicator for each vacuum interrupter shall be easily visible. The breaker front panel shall be removable when the breaker is withdrawn for inspection and maintenance.

The switchgear shall consist of a line-up of standard factory-assembled, metal-clad draw out power circuit breaker cubicles. The switchgear assemblies, including circuit breakers and components, shall be designed and fabricated to withstand, without distortion and damage, all stresses incidental to shipping, installation and operation, including system short-circuits and earthquakes.

4. 15 kV Circuit Breaker Ratings

The 15 kV circuit breakers shall meet or exceed the following ratings:

Continuous Current, A	1200
Nominal Voltage Class, kV	15
Nominal 3-Phase MVA Class, MVA	500
Rated Maximum Voltage, kV rms.	15
Rated Voltage Range Factor, K	1.30
Low Frequency Withstand Voltage, kV rms.	36
Basic Impulse Level, kV rms. Crest (based on a 1.2 x 50 microsecond wave)	95
Rated Short Circuit Current, kA rms. symmetrical (at rated maximum voltage)	18
Maximum Interrupting Capability, kA rms. symmetrical	23
Closing and Latching Capability, kA rms. symmetrical	37
Interrupting Time, Cycles (Max.)	5

5. Current Transformers

The current transformers shall have ratios as shown on the plans and shall be furnished with shorting terminal blocks on their secondaries. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their ANSI metering accuracy class shall be 0.3, B0.1 through B1.8 and their ANSI relaying accuracy class shall be T200. The line to line voltage shall not exceed the transformer insulation class voltage.

Current transformers shall be designed for the proper voltage operations as required and shall conform to requirements of ANSI Standard C57.13. Current transformers shall be dry or compound-insulated type, with a suitable means for mounting and for grounding the frame. Current transformer ratios, unless otherwise specified, shall be as indicated on the Single Line Diagram drawings and shall be multi-ratio.

6. Potential Transformers

The potential transformers shall be indoor, dry or compound-filled type with minimum insulation class and full-wave basic impulse level as specified elsewhere in these special provisions. The potential transformers shall have high and low voltage fuses and shall be trunnion-mounted in separate compartments. Shutters shall isolate primary bus stabs when drawers are withdrawn. High voltage fuses shall be current-limiting type. Accuracy shall be ANSI metering accuracy (60 Hz) of 0.3 W, X, M, Y, Z and 0.6 ZZ burdens at 120 VAC. The thermal rating for a 55°C rise shall not be less than 400 VA for potential transformers. The line-to-line voltage shall not exceed the transformer insulation class voltage.

7. Protective Relays

The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays as shown on the plans and described hereafter in this special provision.

8. Microprocessor Three-Phase Protective Relay

Relays for phase time over-current, instantaneous over-current and ground fault protection, ANSI 50/51, 50/51G, or 50/51N, shall be incorporated into a single device. The relay shall be solid-state microprocessor-based multi-functional type that operates from the 5-ampere secondary output of the current transformers. The relay shall provide ANSI 50/51 protective functions for each of the three phases, and ANSI 50/51G or 50/51N ground fault protection functions. The relay shall be true RMS sensing of each phase and ground. Ground element shall be capable of being utilized in residual, zero sequence, or ground source connection schemes, or deactivated.

The primary current transformer rating being used for phase and ground protection feeding the device shall be programmable for current transformers with primary current ratings from 5 through 1,200 amperes. Both the phase and ground protection curves shall be independently field selectable and programmable with or without load. The relay shall have a built-in alphanumeric display capable of displaying the following information:

A. Individual phase currents
B. Ground current
C. Cause of trip
D. Magnitude and phase of current causing trip
E. Peak current demand for each phase and ground since last reset
F. Current transformer primary rating
G. Programmed phase and ground set points.

Relay shall have the following features:

A. Integral manual testing capability for both phase and ground
B. Continuous self-testing of internal circuitry
C. Programmable set-points for device curve selection
D. Programmable inputs, such as current transformer ratios

Relays shall have provisions for future communication capability via local area network compatible with MODBUS protocol. Relays shall be capable of transmitting all information contained in the relay such as currents, set-points, cause of trip, magnitude of trip current, and open-close trip status via the communication network. The relay shall have the ability to close and open the associated breaker with proper access code from remote location over the communication network when the relay is configured in remote close/open mode.

Relay alarm or trip contacts shall not change state if power is lost or an under-voltage occurs. These contacts shall only cause a trip upon detection of an over-current or fault condition based upon programmed settings.

9. Undervoltage Relays (Device 27)

The time undervoltage relays shall monitor three phase ac voltages and shall not require additional supply voltage. The relay shall be adjustable from 100 percent to 80 percent of nominal voltage. Response time shall be less than 250 ms.

10. Directional Overcurrent Relay (Device 67)

The directional overcurrent relays shall monitor all three phases and shall consist of three units. The directional units shall have both instantaneous and time overcurrent units.

A. **Control Power -** Control power, at 125 V (DC) supplied from station batteries, shall be used to power the protective relays, auxiliary relays and control (to close and trip) the circuit breakers. The 125 V (DC) supply shall be distributed to each cubicle through dead front pull-out fuse blocks. Fuses shall independently protect breaker tripping and closing circuits for each of the cubicles. An alarm relay shall also be included in each tripping circuit to initiate remote alarm upon loss of DC tripping power. The total 125 V (DC) power requirements for each switchgear, plus close and trip currents for each breaker shall be furnished to the Engineer for review and approval.

B. **Control Accessories -** Red and green indicating lights shall be provided on the front door of each cubicle-red light to indicate breaker closed and green light to indicate breaker open. White and blue indicating lights shall also be provided on the front doors of each cubicle, white light to indicate circuit breaker control in local and blue light to indicate circuit breaker control in the remote. Indicating lights shall be LED type with "push to test" feature.

C. **Power Monitoring -** The switchgear manufacturer shall provide the power monitoring instrumentation as described in these special provisions and the appropriate voltage and current transformers required to provide sensing signals for the monitoring system. The switchgear manufacturer shall install the monitoring instruments, and wire all electrical circuits to the instrumentation package including wiring to a dedicated terminal strip for the relay outputs, digital status inputs and analog output ports. The switchgear manufacturer shall provide shorting switches or test blocks for all meter current transformer inputs.

D. **Space Heaters -** Space heaters shall be provided with the unit substation to prevent moisture condensation on the inside of each compartment. The space heaters shall be sized to the latest standards and controlled by a thermostat. A terminal block shall be provided adjacent to the thermostat for power source connection. The heaters shall be protected by perforated metal guards to prevent inadvertent contact with the heater elements.

Unit Substation Transformer

The transformer is a part of a secondary unit substation and shall conform to the provisions in these special provisions. The unit substation transformer shall be a dry-type transformer with the following requirements:

1. References

The unit substation transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and ANSI.

2. Delivery, Storage and Handling

Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

3. Field Measurements

Primary and secondary voltages shall be measured with appropriate tap adjustments.

4. Operation and Maintenance Manuals

Ten copies of the equipment operation and maintenance manuals shall be provided prior to shipment of the equipment. Operation and maintenance manuals shall include the following information:

A. Instruction books or leaflets
B. Recommended renewal parts list
C. Drawings and information required

5. Ratings

The ratings of the transformer shall be as follows or as shown on the plans:

KVA rating	750 kVA @ AA/80°C, 885 kVA @ AA/115°C, (future) 1180 kVA @ FA/115°C
Impedance	5.75%
HV	12.47 kV Delta
HV BIL	95 kV
HV Taps	Two 2% above & Two 2% below
LV	480/277 V Solidly Grounded Wye
LV BIL	30 kV

6. Construction

Transformer shall be cooled by natural air convection (AA) with provisions for future forced air. The electrical insulation system shall utilize Class H material in a fully rated 220°C system. Transformer design temperature rise shall be based on a 30°C average ambient over a 24-hour period with a maximum of 40°C. Solid insulation in the transformer shall consist of inorganic materials such as porcelain, glass fiber, electrical grade glass polyester, or Nomex. All insulating materials must be rated for continuous 220°C duty. The insulation between the high-and-low-voltage coils shall be more than sufficient for the voltage stress without the need of a varnish.

The transformer shall be designed for a temperature rise from AA/80°C to AA/115°C –future FA/115°C at 750 kVA, 885 kVA and 1180 kVA. The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR1. The transformer shall be UL labeled. The transformer shall be of explosion-resistant, fire-resistant, air-insulated, dry-type construction, and cooled by the natural circulation of air through the windings. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by Insuldur paper or equal.

The high-voltage and low-voltage coil assembly shall be vacuum pressure impregnated (VPI) polyester. The high-voltage and low-voltage coil assembly shall be preheated to evaporate any moisture, then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn out of the insulating materials. The resin shall be introduced to a level that submerges all parts while the vacuum is maintained for approximately one hour. Then the vacuum shall be released and pressure applied for approximately 1/2 hour, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.

The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of heavy gage sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate ventilating grills.

7. Finish

Each transformer shall be painted utilizing an initial phosphatizing cleaning treatment, followed by manufacturer's standard paint process baked on to a total of 0.1 mm average thickness. Units shall be painted ANSI 61 for indoor service and shall match the primary and secondary equipment.

8. Accessories

Transformer shall include:

A. Diagram instruction plate
B. Provisions for lifting and jacking
C. Removable case panel for access to high-voltage strap-type connector taps for de-energized tap changing
D. Two ground pads

9. Terminal Compartments

The transformer unit supplied shall include high voltage terminal compartment and low voltage terminal compartment. Connections between the primary device and transformer shall be cable and between the transformer and secondary shall be flexible bus braid.

10. Factory Testing

The standard factory tests shall be performed on all equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards as follows:

A. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project
B. Ratio tests on the rated voltage connection and on all tap connections
C. Polarity and phase-relation tests on the rated voltage connections
D. No-load loss at rated voltage on the rated voltage connection
E. Exciting current at rated voltage on the rated voltage connection
F. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on this project
G. Applied potential test
H. Induced potential test

The manufacturer shall provide three certified copies of factory test reports.

The special factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest revision of ANSI and NEMA standards as follows:

A. Temperature test(s) shall be made on one unit only of a project covering one or more units of a given KVA rating.
B. The Department's representative shall witness factory tests as outlined above.

    1. The manufacturer shall notify the Engineer two weeks prior to the date the tests are to be performed.
    2. The manufacturer shall include the cost of transportation and lodging for up to three Department's representatives. The cost of meals and incidental expenses shall be the Department's responsibility.

11. Field Quality Control

The Contractor shall arrange for the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 10 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

The Contractor shall provide three copies of the manufacturer's field start-up report.

Primary and secondary voltages shall be measured for proper tap settings. The Contractor shall use a magnetometer for proper insulation resistance of the primary and secondary windings.

Adjust taps to deliver appropriate secondary voltage. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. The Contractor shall provide three copies of the certification by the representative of the manufacturer.

The Contractor shall provide a training session for up to twelve Department's representatives for three normal workdays at a job site location determined by the Engineer. A qualified manufacturer's representative shall conduct the training session. The training program shall include instructions on the transformer, auxiliary devices and other major components.

Unit Substation Low Voltage Switchgear

The low voltage switchgear is a part of a unit substation and shall conform to the provisions in these special provisions. The low voltage switchgear shall consist of standard fabricated vertical sections bolted together to form a complete unit. The enclosures shall be NEMA Type 1.

Each low voltage switchgear shall be single-ended 480 V and consist of one main and feeder breakers as shown on the single-line diagrams. Each of the switchgear sections shall consist of a line-up of standard fabricated metal-enclosed vertical units equipped with electrically operated air circuit breakers.

Each steel unit forming part of the stationary assembly shall be a self-contained housing having one or more individual breaker or instrument compartments and a rear compartment for the busses, and outgoing cable connections. All digital metering devices and electronic data monitoring and communication devices for electrical power management system shall be mounted on the front door of compartments. Each circuit breaker compartment shall be equipped with primary and secondary contacts, rails, stationary levering mechanism parts, and required instrument current transformers. A blank formed steel door equipped with ventilation openings in the lower flange and supported on concealed hinges shall be provided for each circuit breaker compartment. The top of the unit shall be enclosed with removable steel sheets, which include necessary ventilation openings. Each compartment shall include the necessary 3-phase bus and connections between the bus and one set of circuit breaker studs. Solderless type terminals on silver plated copper extensions for the outgoing cables shall be provided on the other set of circuit breaker studs. The main copper busses shall have the same continuous current ratings as the frame size rating of the switchgear main circuit breakers and shall be braced to withstand magnetic stresses developed by current equal to the momentary and interrupting current ratings of the main circuit breakers.

The switchgear busses shall be the isolated type. Shipping breaks and provisions for future bus extensions shall have silver-plated bolted connections. A copper equipment ground bus, 50 mm by 6 mm minimum extending the length of the switchgear and electrically connected to the enclosure in each section, shall be provided. The bus shall have clamp type terminals at each end for connection to external copper ground conductors.

1. Circuit Breakers

Circuit breakers shall be electrically operated, three-pole, air break, metal-enclosed (iron frame) draw out type, mechanically trip free.

The electrically operated breakers shall have stored energy operating mechanisms.

The electrically operated breakers stored energy closing mechanism shall be motor operated. Electrical closing and tripping shall be initiated by means of a release solenoid and shunt trip coils. Control voltage shall be 125 VDC. Provision shall be made for charging the electrically operated breakers manually, on loss of control power. Each breaker shall be equipped with adjustable type solid-state trip device as follows:

A. Current setting
B. Long time delay
C. Instantaneous pick-up unit as per single-line diagram
D. Short time pick-up
E. Short time delay
F. Ground fault pick-up
G. Ground fault delay

The solid-state trip devices shall have indicators to show which element has operated, and shall have digital metering device functions of at least three individual phase current readouts. Operating, test and withdrawn positions shall be provided for each circuit breaker. The main contacts shall be disconnected in the test position, but auxiliary circuit contacts shall be maintained in this position for breaker and circuit testing operations. All contacts shall be disconnected in the withdrawn position. An auxiliary switch with a minimum of one normally-open and one normally-closed contact shall be provided with each feeder breaker. The switch shall be operable with the breaker in the test position. Each breaker shall have a mechanical flag indicator showing tripped or closed positions of breaker. Breakers shall have provisions for manual tripping. All circuit breakers of similar rating shall be electrically and mechanically interchangeable, so that any removable element can be inserted into, and function correctly, in any such draw out cavity. Mechanical interlocks shall prevent the breaker from being inserted or withdrawn from the operating position when the circuit breaker is in the closed position. The breaker control device shall have the ability to close and open the breaker with proper access code from a remote location over the communication network when the device is configured in remote close/open mode.

2. Current Transformers

Current transformers (CT) shall be mounted in breaker compartments and shall be easily accessible for inspection and maintenance. Current transformers shall conform to ANSI standard C57-13. They shall be of the dry compound insulated type. CT ratios are indicated on the single-line diagrams.

3. Potential Transformers

Potential transformers shall be mounted in an auxiliary unit. Current limiting fuses as required shall be provided on the primary and secondary side in dead-front fuse holders.

4. Digital Metering Devices

Digital metering devices shall be supplied, factory-wired, installed on the front panel and shall be flush mounted. Digital metering devices shall have the provisions for communication capability via local area network compatible with MODBUS protocol. Digital metering devices shall be capable of transmitting all information contained in the metering and solid-state trip unit.

Digital metering device, for monitoring main breakers, shall be multi-function solid-state type with digital display and shall have at least the following functions and features:

A. Metering functions:

1. Three - Line-to-line voltages
2. Three - Phase currents
3. One - Wattmeter
4. One - Var meter
5. One - Watt-hour meter
6. One - Peak demand meter
7. One - Power factor meter
8. One - Frequency meter

B. Communications:

1. One - RS-232 port
2. Non-volatile set points
3. Fault diagnosis
4. Push buttons for information retrieval and alarm/trip reset
5. Digital LED display window
6. Pre-trip data storage
7. Statistical data storage
8. Menu LED's
9. Alarm and trip LED's

5. Control Switches and Push Buttons

For electrically operated breakers, a two-position pistol-grip handle control switch shall be provided. The closed and open position of the breaker shall be clearly indicated by a indicating light visible from the front of the breakers. Indicating lamps shall be resistor type for DC and shall be "push to test" type. Colors shall be red for closed and green for open positions of the circuit breaker. For mechanically operated breakers, closing or opening shall be accomplished by a mechanical close or trip button located on the breaker escutcheon.

6. Wiring and Terminals

Secondary wiring in the individual switchgear units and interconnecting wires between various units shall be provided and shall consist of 600 V insulated wire. No. 14 AWG stranded copper for auxiliary wiring and No. 10 AWG stranded copper for current transformer circuits. The insulated wires shall be Type MTW, or SIS as listed in the National Electrical Code. All wiring shall be brought to terminal strips with clamp type, molded plastic terminals, preferably rail-mounted. One additional 8 terminal strip shall be supplied in each unit, for the connection of external auxiliary circuits. Terminal strips shall be preferably mounted vertically. Closed-end, crimp-type terminal lugs shall be used for all wiring connections to instruments, relays and other devices which are not provided with a clamp-type terminal. Instrument transformer secondary circuits shall be grounded at the switchgear. All leads from each individual instrument transformer shall be brought out to terminal blocks. Short circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Each end of wire shall be provided with Brady sleeve heat-shrink type vinyl marker, fixed permanently to the wire, and imprinted with the wire number and identification letter or symbol corresponding to the Vendor's elementary diagrams. Suitable clamp type terminals shall be provided for all outgoing power feeder cables. All power cable terminals shall be located for both top and bottom entry and connection, and space shall be provided for cable terminations throughout. Number and size of copper conductors are shown on the plans.

7. Finish

The unit substation enclosures shall be cleaned of rust and excess weld, and given a minimum of two coats of phosphatizing or rust prevention treatment. Finish coats shall be ANSI Light Gray No. 61.

8. Nameplates

Each major assembly unit, each circuit breaker and each control unit shall be supplied with a nameplate engraved with legend. Nameplates shall be 2 mm thick plastic and shall have a white facing with black characters, and shall be affixed to the equipment.

Nameplates for each switchgear assembly shall be 150 mm long by 50 mm high. Nameplates for each circuit breaker and each control unit shall be a minimum of 100 m x 30 mm. Nameplate schedule shall be submitted to the Engineer for approval before engraving.

9. Accessories

Accessories shall consist of, but not necessarily be limited to, the following items:

A. A manual lifting device, extension rails and crank handle to remove breaker units from compartments.
B. One portable static test set for solid-state trip devices.

10. Inspection and Testing

Equipment furnished will be subject to expediting and shop inspection. Units shall be completely assembled, within shipping limitations, all dimensions shall be verified, and circuits shall be checked and tested prior to shipping.

The Engineer shall have the option to inspect fabrication and witness testing of the equipment. The Contractor shall notify the Engineer a minimum of three weeks in advance of the date of scheduled tests. The manufacturer shall include the cost of transportation and lodging for up to three Department's representatives. The cost of meals and incidental expenses shall be the Department's responsibility. An authorized representative of the Engineer shall have free entry during testing and fabrication of the equipment.

Low Voltage Control Center

The low voltage control center (LVCC) shall be a full-voltage non-reversing motor control center. The power circuit compartment of the LVCC shall be a motor starter unit which shall consist of a line starter which shall be a lighting contactor as specified, and a disconnect device which shall be a circuit breaker Type D as specified elsewhere in these special provisions. Also the power circuit compartment shall consist of circuit breakers Type C only as specified elsewhere in these special provisions. Details of the layout of the LVCC shall be as shown on the plans.

1. General

The Contractor shall furnish and install the LVCCs as specified herein and as shown on the plans. The LVCCs and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL 845.

The LVCCs shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the manufacturer and be based upon testing of representative equipment.

Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment. Installing Contractor to verify equipment proposed shall fit into the available space. Installation shall be coordinated with other trades, and the approval authorities shall be notified of any interference or conflicts in the LVCC system power and control wiring.

2. Submittals (For Review and Approval)

The following information shall be submitted to the Engineer:

A. Master drawing index
B. Front view elevation
C. Floor plan
D. Top view
E. Single line
F. Unit wiring diagrams depicting remote devices
G. Nameplate schedule
H. Starter and component schedule
I. Conduit entry/exit locations
J. Assembly ratings including:

1. Short-circuit rating
2. Voltage
3. Continuous current

K. Major component ratings including:

1. Voltage
2. Continuous current
3. Interrupting ratings

L. Cable terminal sizes.

Where applicable the following information shall be submitted to the Engineer:

1. Connection details between close-coupled assemblies
2. Composite floor plan of close-coupled assemblies
3. Key interlock schematic drawing and sequence of operations.

Submit ten copies of the above information.
When requested by the Engineer, the following product information shall be submitted:

1. Descriptive bulletins
2. Product sheets.

3. Submittals (For Close Out)
Ten copies of the following information shall be submitted to the Engineer for record purposes:

A. Final as built plans.
B. Unit wiring diagrams.
C. Certified production test reports.
D. Installation information.
E. Seismic certification and equipment anchorage details.

4. Qualifications
The manufacturer of the assembly shall be the manufacturer of the major components within the assembly. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

5. Operation and Maintenance Manuals
Ten copies of the equipment operation and maintenance manuals shall be provided. Operation and maintenance manuals shall include the following information:

A. Instruction books or leaflets.
B. Recommended renewal parts list.
C. Drawings.

6. Ratings
The LVCCs shall be UL listed or recognized and meet NEMA and ANSI relevant standards for a Motor Control Center. The LVCCs shall be 600-V class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number of wires shall be as indicated on the drawings.

7. Construction
Structures shall be totally enclosed, deadfront, freestanding assemblies. The structures shall be 2,300 mm high and 540 mm deep for front-mounted units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

Compartments for mounting control units shall be incrementally arranged such that not more than six size 1 starters can be mounted within each vertical structure. Guide rails shall be provided. A vertical wireway with minimum of 0.025 m^2 of

cross sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.

All full voltage starter units through NEMA Size 5 shall be of the draw out type. Draw out provisions shall include positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. Draw out units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated for 600 V. Knockouts shall be provided for the addition of future terminal blocks. In addition, a master terminal block, when Type C wiring is specified, shall be draw out and shall be located in the bottom wireway, readily accessible through a hinged cover. All control wire to be 14-gage minimum.

All draw out units shall be secured by a spring-loaded quarter turn indicating type fastening device located at the top front of the unit. Each unit compartment shall be provided with an individual front door.

An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or re-insertion of the unit while in the ON position. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with one to three padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

8. Bus

Each structure shall contain a main horizontal silver-plated copper bus, with minimum of 800 A or as shown on the plans. The horizontal bus shall be rated at 50°C temperature rise over a 40°C ambient in compliance with UL standards. Vertical busses feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. All joints shall be front accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300 A for front mounted units.

The vertical bus shall be completely isolated and insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical busses to prevent any fault generated gases to pass from one phase to another. The vertical bus shall include a shutter mechanism to provide complete isolation of the vertical bus when a unit is removed.

Busses shall be braced for 65,000 A rms symmetrical.

9. Wiring and Terminations

Wiring shall be NEMA Class II, Type C.

10. Time Delay Relays

The time delay relays shall have a variable time delay unit with ON delay and knob adjustable timing range with maximum setting between 180 and 240 seconds and minimum setting of less than one second.

11. Miniature Relays

The miniature relays shall have contact with a minimum current rating of 10 A at 120 V(ac).

12. Combination Motor Starter

Combination motor starter units shall be full-voltage non-reversing, unless otherwise shown.

Each combination unit shall be rated 42,000 amperes interruting current (AIC) symmetrical at 480 V. The motor starter shall provide adjustable magnetic protection and be provided with pin insert to stop magnetic adjustment at 1300 percent motor nameplate full load current to comply with NEC requirements. All combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button. The motor circuit protectors shall include transient override feature for motor inrush current.

Motor starters shall be electrically operated, electrically held, three-pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. Motor starters shall have provisions for a total of eight NO or eight NC auxiliary contacts. The overload relay assembly shall be of the thermal bimetallic ambient compensated type. Overload relays shall be reset from outside the enclosure by means of an insulated button. The overload relay shall have a built-in push-to-test button, electrically isolated NO-NC contacts and single phase sensitivity.

Each starter shall be equipped with a fused control power transformer, two indicating lights, HOA selector switch, and two NO contacts, unless otherwise scheduled on the plans. Device panel shall have space to accommodate six oil-tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.

13. Lighting Contactors

Electrically held lighting contactor shall be used for lighting loads from 10 to 300 A. The lighting contactors shall be UL listed or recognized and shall comply with applicable NEMA standards and shall be rated greater than or equal to the

rating of its circuit breaker. The contactors shall be designed to withstand large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contacts welding. Contactors shall be capable of accepting up to eight auxiliary contacts - top or side mounted up to 60 A and side mounted only up to 100 A. Contactors shall be capable of being operated by AC or DC control.

14. Incoming Feeder Terminations and Device

Incoming cable shall terminate within the control center on a main lug termination point. Main lug terminations shall have adequate dedicated space for the type and size of cable used and the lugs shall be standard mechanical screw with anti-turn feature.

15. Space Heaters

Space heaters shall be provided with the LVCC to prevent moisture condensation on the inside of each compartment. The space heaters shall be sized to the latest standards and controlled by a thermostat. A terminal block shall be provided adjacent to the thermostat for power source connection. The heaters shall be protected by perforated metal guards to prevent inadvertent contact with the heater elements.

16. Enclosures

The type of enclosure shall be in accordance with NEMA standards Type 1A with gasketed doors. All enclosing sheet steel, wireways and unit doors shall be gasketed.

17. Nameplates

Each unit will have 26 x 70-mm hot stamped nameplate. The lettering shall be black 4.75 mm high, on a white background.

18. Finish

The LVCC shall be given a phosphatizing pretreatment. The paint finish shall be an anionic, thermoset acrylic. Manufacturer's standard color shall be used. The control center finish shall pass 600 hours of corrosion resistance testing in conformance with the requirements in ASTM Designation: B 117.

19. Examination

The Contractor shall fully inspect shipments for damage. Damage shall be reported to the manufacturer, and a claim shall be filed upon the shipper, if necessary. The Contractor shall verify NEC clearances as dictated on the plans prior to installation. UL labeling of the assembly shall be verified prior to installation.

20. Factory Testing

The Contractor shall have the motor control centers tested in a high-power laboratory to prove adequate mechanical and electrical capabilities. All factory tests required by the latest ANSI, NEMA and UL standards shall be performed. The Contractor shall provide three certified copies of factory test reports.

The Department’s representative shall witness the factory tests as outlined above. The manufacturer shall notify the Engineer three weeks prior to the date the tests are to be performed. The manufacturer shall include the cost of transportation and lodging for up to three Department's representatives. The cost of meals and incidental expenses shall be the Department's responsibility.

21. Installation

The Contractor shall supply the Engineer three copies of the installation instructions and follow the installation instructions supplied by the manufacturer. Control wiring shall be as shown on the plans except as modified by the approval and submittal process. All local and remote devices shall be interfaced into the control wiring and operational systems for each load.

22. Field Testing

The requirements as stipulated in the NETA testing procedure for this type of motor control center assembly shall be followed. Generate a field report on tests performed, test values experienced, and make available to Engineer upon request. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports. The Contractor shall provide three copies of the manufacturer's representative's certification.

23. Training

The Contractor shall provide a training session for up to ten State personnel for three work days at the job site or other office location chosen by the Engineer. The Contractor shall arrange for a qualified manufacturer's representative to conduct the training session. The training program shall consist of the following:

A. Review of the MCC one-line drawings and schedules.
B. Review of the factory record shop drawings and placement of the various cells.
C. Review of each type of starter cell, components within, control, and power wiring
D. Review contactor coil replacement and contact replacement procedures.
E. Discuss the maintenance time table and procedures to be followed in an on going maintenance program.
F. Provide three-ring binders to participants complete with copies of drawings and other course material covered.

Utility and Lighting Panels

The utility and lighting panels shall conform to the following requirements and as shown on the plans:

a. The bus shall be copper.
b. Boxes shall be made from code gage galvanized steel.
c. The trim shall be made form code gage steel and painted ANSI 61 gray.
d. Doors 1200 mm or less shall have a single point lock. Doors over 1200 mm shall have a three point catch and lock.
e. The ground bar shall be standard, bolted in box.
f. The enclosure shall be NEMA Type 12. The top and bottom gutters shall be minimum 139 mm and the side gutters shall be 152 mm.

The Contractor shall install single-phase and three-phase general purpose individually mounted panels, self-cooled, as specified herein and as shown on the plans. The panels and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI and NEMA.

1. Submittals

The following information shall be submitted to the Engineer:

A. Dimension drawing and mass
B. Technical certification sheet
C. Transformer ratings
D. Component ratings

2. Qualifications

For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified. The manufacturer of this equipment shall have produced similar electrical equipment. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided.

3. Ratings

Voltage ratings shall be as shown on the plans. Units shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96. Where applicable, transformer sound levels shall not exceed 45 dB for a 10 to 30 kVA rated self-cooled transformer as defined by ANSI and NEMA.

4. Construction

Each single-phase panel shall include a main primary breaker. Main primary and feeder breakers shall be enclosed with a padlock lockable hinged door.

Each three-phase to single-phase panel shall include a main breaker, step-down transformer breaker. Main primary, secondary and feeder breakers shall be enclosed with a padlock lockable hinged door.

5. Transformer

Transformers for the three-phase panels shall be insulated with a 185°C-insulation system. Required performance shall be obtained without exceeding the above-indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours. All insulation materials shall be flame-retardant and shall not support combustion in conformance with the requirements in ASTM Designation: D 635.

Transformer core shall be constructed with high-grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the

saturation point. The transformer core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level. The core of the transformer shall be grounded to the enclosure. The transformer shall include two 5 percent taps below nominal voltage.

6. Enclosure

The enclosure shall be made of heavy-gage steel and the maximum temperature of the enclosure shall not exceed 90°C. The enclosure shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes. Panels shall be mounted in additional fiberglass enclosures as shown on the plans. Each panel to be mounted outside on the platforms shall be installed in a NEMA 4X fiberglass or stainless steel enclosure.

Circuit Breaker Type B

The circuit breaker Type B shall be a molded case circuit breaker providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics and shall be designed, manufactured, assembled and tested in accordance with UL 489 and NEMA AB-1 Standards. The frame rating and settings shall be as specified on the plans.

The molded case circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the toggle handle so that the contacts cannot be held closed against short circuits and abnormal currents. All poles shall be so constructed that contacts open, close and trip simultaneously in the either ON or OFF position. All breaker covers shall have molded-in "ON" and "OFF" position.

The circuit breaker frames shall employ high strength, molded-polyester, glass-reinforced cases and covers. The breaker frame shall have legible, tamper-proof nameplates containing maximum frame ampere ratings, maximum voltage ratings and interrupting ratings in accordance with UL standards. All breaker frames sizes shall have external means for manually tripping the breaker and exercising the mechanism and trip latch member.

The molded case circuit breakers shall have inverse time and instantaneous tripping characteristics. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.

The circuit breaker rating shall be as specified on the plans and as required by the load and coordination studies.

Ground fault protection shall be provided where indicated. Shunt trips, bell alarms and auxiliary switches shall be provided.

Circuit Breaker Type C

The circuit breaker Type C shall be the same as Type B except circuit breaker Type C shall have an auxiliary switch for SCADA.

Circuit Breaker Type D

The circuit breaker Type D shall be the same as Type C except circuit breaker Type D shall have a minimum interrupting capacity of 100 kilo-amperes interrupting current (kAIC) at 600 V and have an auxiliary switch for SCADA.

DC Panel

The DC panel shall conform to the following requirements and as shown on the plans:

a. The bus shall be copper.
b. Boxes shall be made from code gage galvanized steel.
c. The trim shall be made form code gage steel and painted ANSI 61 gray.
d. Doors 1200 mm or less shall have a single point lock. Doors over 1200 mm shall have a three point catch and lock.
e. The ground bar shall be standard, bolted in box.
f. The enclosure shall be NEMA Type 12. The top and bottom gutters shall be minimum 139 mm and the side gutters shall be 152 mm.
g. The panel shall be rated at 125 VDC with a 2 pole main breaker rated for 100 A.
h. The panel shall have a total number of 24 branch circuit poles (space for twelve 2 pole breakers).

Circuit breakers shall be 2 pole, 20 A, 10 kAIC interrupting capacity.

Dry Type Transformer

The Contractor shall install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-winding type, self-cooled as specified herein, and as shown on the contract plans. The transformers and all

components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI and NEMA.

1. Submittals

The following information shall be submitted to the Engineer for review and approval:

A. Dimension drawing and mass.
B. Technical certification sheet.
C. Conduit entry and exit locations.
D. Transformer ratings.

2. Qualifications

For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified. The manufacturer of this equipment shall have produced similar electrical equipment. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided. The transformers shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) for Zone 4 application.

3. Ratings

The transformer's kVA and voltage ratings shall be as shown on the plans. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

A. Up to 9 kVA less than 40 dB.
B. 10 to 50 kVA less than 45 dB.

4. Construction

Transformers shall be insulated as follows:

A. 2 kVA and below: 150°C insulation system based upon 80°C rise.
B. 3 to 15 kVA: 185°C insulation system based upon 115°C rise.
C. 15 kVA and above: 220°C insulation system based upon 150°C rise.

All insulation materials shall be flame-retardant and shall not support combustion in conformance with the requiremens in ASTM Designation: D 635. Transformer core shall be constructed with high-grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction. On units rated 15 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level. The transformer shall include two 5 percent taps below nominal voltage.

5. Enclosure

The enclosure shall be made of heavy-gage steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90°C. The core of the transformer shall be grounded to the enclosure.

On encapsulated units rated 15 kVA and below and below the enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes. Enclosures shall be finished with ANSI 61 color weather-resistant enamel.

6. Safety Switch

The safety switch shall be a heavy-duty low-voltage safety switch with the following requirements:

a. Rated for 600 VAC.
b. Terminals be copper-aluminum.
c. The enclosure shall be NEMA Type 12 dust-tight and oil-tight enclosure.
d. A metal nameplate shall be mounted on the front cover that contains switch information (type, catalog number, electrical ratings V, A, and horsepower rating)
e. Handle whose position is easily recognizable and padlockable in the "Off" position.
f. Visible blades.

g. Reinforced fuse clips.
h. Nonteasible, positive, quick-make quick-break mechanisms.
i. Switch assembly plus operating handle as an integral part of the enclosure.
j. Switch shall be UL listed, horsepower rated, meet Federal Specification WS-885c, and NEMA Specifications KSI-1975.
k. Switch shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.
l. Switch shall have line terminal shields.

7. Battery System

The stationary battery system shall include ten 12 V batteries and a safety switch. Each battery shall be comprised of six 2 V cells. The battery system shall have a minimum capacity of 105 A-hr based on the 8-hour discharge rate, at a temperature of 25°C, to a final voltage of 1.75 volts per cell. The electrolyte in each cell shall have a specific gravity of 1.3 at 25°C.

The cell jar shall be made of standard flame retardant polypropylene. The cells shall be designed to be individually removed or installed. Internally each cell shall not have any free electrolyte, but be of an absorbed recombinant design utilizing lead-calcium plates without any cadmium (Cd) component. The pressure relief valve shall be constructed to prevent acid leakage and oxidation. The cell's material must also be thermally stable to withstand cell temperature excursions if battery is exposed to adverse temperature or charging conditions. The pressure rating release of the valve shall be limited to a maximum of 31 kPa to minimize forcing of acid between post seal and cover. The cell post shall be designed with dual seal. The first seal shall be of an 0-ring design allowing the entire seal structure freedom of movement due to changes in internal cell pressure, temperature, aging, shipment and seismic events. Neither seal shall use heat for adhesion.

The modular battery system shall be designed with steel modules with separate cell compartments. A polarized bracket shall be provided to automatically align the individual modules in the proper polarity orientation to each other in horizontal stacking and side by side configuration. A cooling air channel shall be incorporated into the module system design to provide free convection airflow between stacks. The battery system modules shall be bolted to the substation foundation to meet the seismic requirements of these special provisions.

A safety shield shall be designed of a non-conductive material and sized to cover the front of each module. Each safety shield shall be individually removable with a quick connect lift-off.

A drip pan shall be installed under the battery system to catch any leaks from the batteries.

The batteries shall have an expected life of twenty years.

The battery safety switch shall be a heavy-duty low-voltage safety switch and meet the following requirements:

a. Rated for 125 VDC.
b. Terminals shall be copper-aluminum.
c. The enclosure shall be NEMA Type 12 dust-tight and oil-tight for industrial applications.
d. A metal nameplate shall be mounted on the front cover that contains switch information (type, catalog number, electrical ratings V, A, and horsepower rating)
e. Handle whose position is easily recognizable and padlockable in the "Off" position.
f. Visible blades.
g. Reinforced fuse clips.
h. Nonteasible, positive, quick-make quick-break mechanisms.
i. Switch assembly plus operating handle as an integral part of the enclosure.
j. Switch shall be UL listed, horsepower rated, meet Federal Specification WS-885c, and NEMA Specifications KSI-1975.
k. Switch shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.
l. Switch shall have line terminal shields.

8. Battery Charger and Rectifier

The battery charger and rectifier shall provide under normal conditions, full rated output for continuous load and tripping of one of the circuit breakers of the switchgear or charging of the 120 VDC on line battery system described elsewhere in these special provisions.

The charger and rectifier shall meet the following requirements:

a. Input Power: Single phase, 120 V(ac), 60 Hz.
b. Output Power: 120 VDC, 6 A.
c. DC Voltage Regulation: ± 0.5 percent under all conditions of line, load, frequency and temperature variations.
d. DC Output Ripple: 2 percent with battery.

e. Automatic current limiting.
f. Overcurrent Protection: AC fuse, DC fuse.
g. Isolation: DC charging circuit isolated from the AC input circuit.
h. Metering: Separate DC voltmeter and DC ammeter, 88 mm rectangular pivot and jewel meters with ± 2 percent full scale accuracy
i. Modes of operation: Switch controlled float and equalize modes.
j. Enclosure: NEMA Type 1 steel case with baked on ANSI 61 gray enamel finish.

10-3.16 STRONG MOTION DETECTION SYSTEM

The Contractor shall install the strong motion detection system in accordance with the details shown on the plans, and the provisions in "Concrete Structures," "Steel Structures," "Miscellaneous Metal" and "Clean and Paint Structural Steel" elsewhere in these special provisions.

GENERAL

Attention is directed to "Cooperation" and "Order of Work" of these special provisions.

Upon completion of installation at each seismic sensor enclosures and seismic recorder locations on the bridge and on pile caps, the California Division of Mines and Geology (CDMG) will install, test, and adjust the sensors and recorders of the seismic monitoring system.

System layouts shown on the plans are generally diagrammatic and location of equipment is approximate. Exact routing of conduits and other facilities and location of equipment is to be governed by structural conditions and other obstructions, and shall be coordinated with the work of other trades. Equipment requiring maintenance and inspection shall be located where it is readily accessible for the performance of such maintenance and inspection.

At each seismic sensor and recorder location, the sequence of work shall be as follows:

A. Install the seismic monitoring casings and downholes.
B. Construct the free field.
C. Mount the seismic sensor enclosures, seismic sensor cable junction boxes and the complete conduit system.
D. Pull all seismic cables (without any splices) from each seismic sensor enclosure to the respective seismic recorder location as shown on the plans.
E. Pull all interconnect cables (without any splices) from each seismic recorder location to the next seismic recorder locations as shown on the plans.
F. Ensure that electrical power and telephone service is present at each of the recorder locations.
G. Notify the Engineer 20 working days in advance when California Division of Mines and Geology (CDMG) is to install and test their equipment as specified elsewhere in these special provisions.

COORDINATION WITH CALIFORNIA DIVISION OF MINES AND GEOLOGY

1. Pile-Type Downhole Installations

With two weeks advance notice, CDMG will be on-site to supervise the installation of the steel downhole casings. CDMG will provide the steel downhole casings along with the specially formed sealed cap assemblies (Bishops Hat) for the bottom of the casings. CDMG will require assistance in transferring the "Bishops Hat" orientation marks to the top (exposed end) of each of the casings after the casings are assembled and joints are tack/spot-welded. Each of the steel casings will need to be secured into the rebar cage of the caisson. This means that the rebar cage will need to extend the full length of the pile in order for the deepest casing to be near the pile tip depth. Installation of the downhole casings shall not be performed without the presence of CDMG.

2. Access and Contractor Assistance

The Contractor shall provide CDMG personnel means and equipment to safely access and perform work at all recorder, sensor and antenna locations after all Contractor-installed equipment, conduit and cabling is completed. The Contractor's assistance shall include transportation of equipment on the job site, traffic control, and movement of stored materials or parked vehicles where necessary.

3. California Division of Mines Geology's Requirements

a. At recorder locations:

1. CDMG will require convenient access to the recorder housings prior to their installation for the purpose of preparing to mount the recorders into the housings.
2. CDMG will require approximately three days access per recorder location to install and wire the recorders.

3. CDMG will also require access to each recorder location during the installation and testing of the sensors wired to that recorder.
4. CDMG will require approximately three days access per recorder location during the final system testing and any necessary troubleshooting and repairs.

b. At normal sensor locations: CDMG will require approximately 30 minutes work time, excluding transit time, at each sensor location on a minimum of two occasions (installation and operational testing) to accomplish their work.
c. At pile-type downhole locations: CDMG will require approximately 14 day access for each pile cap downhole package. In addition, access may be required to the pile cap downhole locations, during the two days required for wiring and testing the recorder.

MATERIAL

1. State-furnished Material
The following materials will be State-furnished as provided under "Materials" of these special provisions:

a. Force Balance Accelerometer (FBA) pigtails
b. Seismic sensor mounting plates
c. Steel downhole casings
d. Sealed caps assemblies

2. State-furnished and Installed Material
The following materials will be furnished and installed by State forces:

a. Down-hole seismic sensors and cable to surface
b. Seismic sensors on bridge
c. Seismic recorders

3. Cables and Conductors

a. **Seismic Sensor Cable**: Seismic sensor cable, SSC, shall be four twisted pairs stranded tinned copper conductors, AWG No. 22 (7 x 30 strands), insulation 0.18 mm thick, individually shielded pairs with an aluminum polyester shield and AWG No. 22 stranded tinned copper drain wire for each pair, overall nominal outside diameter of 7.6 mm or less and outer jacket of 0.23 mm thick. Cable shall be instrument cable, NEC rated CLP2 plenum cable rated for 150°C. Cable shall be similar to Beldon plenum cable, Catalog No. 87778 except with only four pairs and having a color code as specified below:

1st Pair	red, black
2nd Pair	white, brown
3rd Pair	blue, violet
4th Pair	yellow, orange

Seismic sensor cable shall be United Wire and Cable Co., Inc., Consolidated Wire and Cable, or equal. Cable spools shall be of sufficient length to allow cables to be installed without splices from the sensor enclosures to the recorder cabinets as shown on the plans.

b. **Telephone Cable**: Telephone cable shall be waterproof filled-sheath, ISDN rated cable with four twisted pairs, individually shielded stranded conductor, minimum AWG No. 22 tinned copper, polyethylene insulated, with a foil aluminum-polyester shield, and chrome PVC jacket rated for 300 V. Cable spools shall be of sufficient length to allow the cables to be installed without splices from telephone service point to the seismic recorders.

c. **Interconnect Cable**: Interconnect cable, IC, shall be EIA RS-485 applications cable, Plenum type, NEC rated CL2P for temperature of 150°C. Cable shall be similar to Belden cable No. 9844 but plenum rated. The cable shall have eight tinned-copper, insulated conductors (4 twisted pairs). Overall aluminum-polyester shield and 24 AWG stranded tinned copper drain wire. Overall tinned copper braid shield (90 percent coverage). Overall nominal O.D. of 8.9 mm or less, with outer jacket of 0.23 mm thick. Color code should be as specified below:

1st Pair	White/Blue Stripe, Blue/White Stripe
2nd Pair	White/Orange Stripe, Orange/White Stripe
3rd Pair	White/Green Stripe, Green/White Stripe
4th Pair	White/Brown Stripe, Brown/White Stripe

Interconnect cable shall be United Wire and Cable Co., Inc., Consolidated Wire and Cable, or equal.

d. **Conductors**: Conductors shall conform to "Conductors and Wiring" specified elsewhere in these special provisions.

4. Electrical Boxes

a. **Seismic Sensor Enclosure and Cast Iron Box, Submersible (Enclosure Type No. 1)**: The enclosure and cover shall be cast iron, with the word "SEISMIC" cast into the cover. The enclosure shall withstand submersion in water to two-meter in depth for extended periods (6 hours) without any leakage. Cast mounting lugs shall be attached on two opposing sides, with a minimum of two lugs on each side. The enclosure shall have one each bossed, drilled and tapped (NPT) hole to accept a conduit connector centered between mounting lugs on one side only. The enclosure shall have one each mounting button drilled and tapped for 6.35 mm x 508 mm located in the center (±3.175 mm) of the inside bottom of the box. The enclosure finish shall be hot-dip galvanized.
The enclosure must be equivalent to one of the following:

1. O-Z Gedney P/N YF-121206-SUB, with raised cast lettering "SEISMIC" in cover. One each mounting button P/N 1MBT installed in the center inside the bottom of the box. Mounting lugs P/N 4ML1816 attached. One each P/N BDT100 installed centered between mounting lugs on one side only.
2. Crouse Hinds P/N WCB121208-1-000G with mounting straps and raised cast lettering "SEISMIC" in cover. One each mounting pad, blind tapped for 6.35 mm x 508 mm installed in the center inside box. One each drilled and tapped (NPT) hole centered between mounting straps on one side only.

b. **Seismic Sensor Enclosure Hot Dip Galvanized Box with Hinged Cover (Enclosure Types 2-5)**: Enclosure to be NEMA Type 4 . Box to have padlock hasp installed of same material as enclosure. The backside of the enclosure must be a flush and smooth surface. Ground stud (6.35 mm x 508 mm) to be installed on inside lower right corner of door when viewed with door open and hinge on left side of box. Finish to be hot-dip galvanized.
The enclosure must be equivalent to the following:

Circle AW P/N 14126-4CHC or Hoffman P/N A-1412CHNF, without upper and lower mounting flanges, with #10-32 ground stud installed on inside lower right corner of the door (when viewed with door open and hinge on left side of box) and with padlock hasp similar to P/N A-PLKJIC installed. Finish to be hot-dip galvanized.

c. **Downhole Junction Box Cast Iron Box, Submersible**: Enclosure and cover to be cast iron. Box to withstand submersion in water up to six-foot depth for extended periods. Cast mounting lugs attached on the two shorter opposing sides, minimum of two lugs each side. One each bossed, drilled and tapped (NPT) hole to accept a conduit connector centered between mounting lugs on one side only. Each downhole cable requires a bossed, drilled, and tapped (NPT) hole to accept a watertight connector. These holes to be centered between lid and bottom along the longer side of box. Finish to be hot-dip galvanized.
The enclosure must be equivalent to one of the following:

1. O-Z Gedney P/N YF-140806-SUB, with mounting lugs P/N 4ML1816 attached to the shorter sides of the box. One each P/N BDT200 installed centered between mounting lugs on one side only. Appropriate number of P/N BDT100 installed centered between lid and bottom of the longer side.

2. Crouse Hinds P/N WCB120806-3-000G0(****)00 with mounting straps. Two each mounting straps on each shorter side of box. One each bossed, drilled and tapped (NPT) hole to accept a conduit connector centered between mounting pads on one side only. Each downhole cable requires a bossed, drilled, and tapped (NPT) hole to accept a Crouse Hinds, or equivalent, watertight connector. These holes to be centered between the lid and bottom along the longer side of box.

The watertight connectors shall be equivalent to Crouse Hinds P/N CGB397.

d. **Seismic Sensor Cable Junction Box**: Seismic sensor cable junction boxes shall be NEMA Type 4, 14-gage steel enclosure with lift-off cover of the size as shown on the plans. Finish shall be hot-dip galvanized. A nameplate with the inscription "Seismic Junction Box" shall be installed on the cover of each junction box.

No unused openings shall be left in any box. Two-piece knockout seals shall be installed as required to close openings.

Junction boxes shall be installed at the locations and elevations shown on the plans or specified herein. Adjustments to locations may be made as required by structural conditions and to suit coordination requirements of other trades.

TELEPHONE SERVICE

The Contractor shall make all arrangements and obtain all permits and licenses required for the connection of the Integrated System Digital Network (ISDN) telephone service applicable to this project, shall furnish all labor and materials necessary for such extensions which are not performed or provided by the utility, and shall furnish and install any intermediate equipment required by the serving utilities.

Upon written request by the Contractor, the State will pay all utility permits, licenses, and connection changes directly to the utility. Such request shall be submitted not less than 15 days before service connections are required.

TESTING

After all the seismic sensors and recorders have been installed and connected by the CDMG, the seismic monitoring system shall be tested by the CDMG to insure that the system functions properly. The Contractor shall make necessary repairs and replacements at the Contractor's expense if the source of the problem is determined to be part of the Contractor's scope of work.

After the seismic monitoring system installation work has been completed, the seismic monitoring system shall be tested in the presence of the Engineer to demonstrate that the seismic monitoring system functions properly. The Contractor shall make necessary repairs, replacements, adjustments and re-tests at the Contractor's expense.

SUBMITTALS

A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval. The Engineer will require 3 weeks to review the submittal after a complete set has been received, as determined by the Engineer.

Manufacturer’s descriptive data shall be submitted for the following:

a. Conduit – list by size and installation method
b. Pull boxes – each type
c. Seismic cable
d. Interconnect cable
e. Telephone cable
f. Cable support
g. Seismic sensor enclosures – each type
h. Seismic sensor cable junction boxes – each type
i. Downhole junction box
j. Downhole protective box

Attention is directed to the provisions in Section 5-1.01, "Authority of the Engineer," of the Standard Specifications. The Engineer may request submittals for materials or products where submittals have not been specified in these special provisions, or may request that additional information be included in the specified submittals, as necessary to determine the quality or acceptability of such materials or products.

The submittals shall be delivered to the Office of Structure Design, Documents Unit, Fourth Floor, 1801 – 30th Street, Sacramento, California 94274-0001.

Each submission of drawings, materials lists, and descriptive data shall consist of at least five copies. Two copies will be returned to the Contractor either approved for use or returned for correction and re-submittal.

Each separate item submitted shall bear a descriptive title, the name of the project, district, county, and contract number. Plans and detailed drawings shall not be larger than 559 mm x 915 mm.

The material list shall be complete as to name of manufacturer, catalog number, size, capacity, finish, all pertinent ratings, and identification symbols used on the plans and in the special provisions for each unit.

Unapproved samples and samples not incorporated in the work shall be removed from State Right of Way, when directed by the Engineer.

CLOSEOUT SUBMITTALS

Project record drawings shall be submitted in accordance with the requirements listed below.

One set of the project plans shall be kept on file by the Contractor for the sole purpose of recording as-built information and shall be so marked. Data to be recorded shall include, but not be limited to, all clarification and change orders, location of underground utilities, and changes in size, manufacture or location of features shown on the plans. In addition, the locations of significant items such as main filters, controls, isolating valves and similar items shall be highlighted on this set of as-built plans.

All corrections shall be made in red ink or red pencil. Superseded material shall be neatly lined out. Original figures shall not be eradicated nor written over. Each sheet shall be clearly marked as having "As-Built Changes" or "No As-Built Changes" as appropriate. The Contractor shall sign and date each sheet of the plans certifying that all information shown is correct.

Additional plans shall be submitted when as-built information cannot be clearly shown on existing plans. Supplemental plans for as-built information shall be not less than 279 mm x 432 mm in size and shall have the contract number on each plan.

Final location of all underground work shall be recorded by depth from finished grade and by offset distance from permanent surface structures, for example: buildings, curbs and walks. Equipment within the building and all concealed conduits shall be recorded by offset distances from building walls.

The Contractor shall periodically review the set of record drawings with the Engineer during the progress of the work to assure that all changes and other required information are being recorded.

Before completion of the work, the Contractor shall request a review of the as-built plans to determine completeness and adequacy. If the as-built plans are unacceptable, the Contractor shall inspect, measure and survey the project and record the required additional information.

The as-built plans shall be delivered to the Engineer prior to acceptance of the contract.

10-3.17 FIELD TESTING

Field testing shall be performed in the presence of the Engineer. The Contractor shall notify the Engineer five days prior to conducting tests. The Contractor shall furnish all materials, instruments, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests recommended by the manufacturer unless specifically waived by the Engineer. The Contractor shall perform acceptance tests of all installed electrical equipment in accordance with latest applicable ICEA, NETA and IEEE standards.

The tests shall include, but not be limited to, testing of equipment, field wiring, and circuit to circuit and system to system, to ensure the satisfactory operation of each system complete. Initiate moving parts and doors, including locks and latches. All units and components shall operate within the efficiency, repeatability, and accuracy limitations approved and shall in all respects conform to the plans, special provisions and approved submittals.

The Contractor shall maintain a written record of all tests performed which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test report shall be signed and dated by the Contractor.

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper procedures or handling.

10-3.18 PILE CORROSION MONITORING SYSTEM

Pile corrosion monitoring system and the connection for the future pile corrosion protection system shall conform to these special provisions.

STANDARDS

The Contractor shall install each system component in conformance with the latest edition of the following standards:

1. STDS State of California Standard Specifications
2. NEMA National Electrical Manufacturers Association
3. ASTM American Society for Testing and Materials
4. IEEE Institute of Electrical and Electronic Engineers
5. ANSI American National Standard Institute
6. ICEA Insulated Cable Engineers Association
7. OSHA Occupational Safety and Health Administration
8. NACE National Association of Corrosion Engineers
9. UL Underwriters Laboratories

SUBMITTALS

The following manufacturer's data shall be submitted by the Contractor to the Engineer:

1. Catalog cuts, bulletins, brochures or data sheets for all equipment.
2. Certification that the equipment and materials proposed meet the requirements of this special provision.

Corrosion Monitoring System Submittal

The Contractor's corrosion monitoring system working drawings shall include an installation schedule for the ultrasonic thickness probe system and for the electrical resistance probe system.

Prior to installing the ultrasonic thickness probes and electrical resistance probes the Contractor shall provide a corrosion monitoring system submittal for the attachment procedure in conformance with this special provision.

The corrosion system submittal shall be stamped and signed by an engineer who is registered as a Corrosion Engineer in the State of California. The Contractor shall allow the Engineer 30 working days to review the submittal after a complete set has been received, as determined by the Engineer, and prior to installation. Should the Engineer fail to complete his review within the time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in the driving system submittal review, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.07, "Liquidated Damages," in the Standard Specifications.

Ultrasonic Thickness Probe

The ultrasonic thickness transducers to be installed on the interior surface of the steel pile on Piers E3, E7 and E16 shall be an Accuscan, Immersion, Lemo Connector Type, Transducer Part Number A310-S-SM manufactured by RT transducers distributed by Panametrics, or equal. Cable shall be as supplied by manufacturer for the intended use. The probes are to be installed permanently inside the pile shell and set in epoxy after the reinforcing cage is installed and before the tremie concrete is placed. Wiring shall be set in epoxy on the shell wall, or installed in a small conduit and sealed in silicone gel.

This system is to be installed in one pile at each of three piers at the depths shown on the plans. Specific details of the probe, the required wiring and the associated terminal sockets shall be provided by the corrosion consultant. The length of cable shall be less than 30 meters.

Electrical Resistance Probe

The Probes shall be Model ER0500 Surface Strip Type or equal with cable supplied to the manufacturer's recommendations. The cable shall be terminated in a connector which allows for measurements to be made at the surface by connection to a junction box as shown on the plans.

Probes shall be designed for heavy duty service conditions such as underground and structural monitoring of pipelines, vessels, above and below ground storage tanks and structures whether cathodically protected or not. Probes shall provide good sealing of the reference element and the check element of the corrosion sensor. Probes shall be connected to the structure as shown on the plans. The lead shall be installed at the probe or connector end.

Probe Requirements:

	Surface Strip	Cylindrical
Probe Body	Epoxy Block	All Welded Element
Cable Connection	Heavy Duty Length	Heavy Duty Length with Bonded Heat Shrink Sleeving onto Element

Probe Configuration:

Wire Loop . . WIRE	Probe verification .. CHECK
Tube Loop . . TUBE	Others (Flush, Strip, Loop) . DUAL

The system design is based on Metal Samples Corrosion Monitoring Systems (a Division of Alabama Specialty Products, Inc.) Model MS0500, a battery-powered, portable corrosion meter capable of interpreting all electrical resistance type corrosion probes. The instrument shall be light weight (about 1.8 kilograms), easy to operate, and shall enable the operator to take readings from several different probe locations. The unit shall have a convenient weather-tight carrying case.

Corrosion rate measurements shall be made using the electrical resistance method. The unit shall measure the change in resistance of the probe element as metal loss occurs. The rate of change is directly proportional to the corrosion rate.

The unit shall have a permanently attached cable that the operator can simply connect to a probe and take the reading. A selector switch shall be provided on the unit’s display panel for indicating the probe element type to be read. All electrical resistance probe types shall be able to be used with this unit, including wire loop, tube loop, cylindrical, and flush mount probes.

Connection for Future Pile Corrosion Protection

The terminal located inside a hollow pier shall provide an electrical connection to the steel pile cap frame that is set inside the concrete pile cap. The steel frame is electrically connected to the steel pile shells by welded steel plates to permit the connection of an impressed current cathodic protection system in the future.

The Contractor's working drawings for the connection for future pile corrosion protection system shall include a listing of all materials to be used and a statement that meets the requirements of this special provision.

Prior to installing the connections at any given pier the Contractor shall provide a submittal for attaching the negative test lead, in conformance with this special provision.

Connection terminal boxes shall be installed at the approximate location shown on the plans. The Contractor shall field verify final location of the test stations. Wire identifiers shall be placed on all wire prior to installation of test boxes.

10-3.19 PAYMENT

The contract lump sum price paid for each of the following items, under electrical facilities (San Francisco-Oakland Bay Bridge), shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing electrical facilities (San Francisco-Oakland Bay Bridge), complete in place, including manuals, testing and training, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer:

1. Substation Westbound
2. Substation Eastbound
3. Roadway Level Westbound
4. Roadway Level Eastbound
5. Girder Level Westbound
6. Girder Level Eastbound
7. Navigation Lighting System
8. Supervisory Control and Data Acquisition Remote Terminal Unit System
9. Traffic Operations System
10. Strong Motion Detection System
11. Pile Corrosion Monitoring System

Quantities of camera with housing units, pan and tilt units, camera control units, video transmitter duplex data units, preformed loop detector stations, microwave vehicle detection sensor systems, fiber optic data modems and fiber optic splice closures to be paid for by the unit will be determined from actual count in place.

The contract unit price paid for each of the following items shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in the listed items below, complete in place, including manuals, testing and training, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer:

1. Camera with Housing
2. Pan and Tilt Unit
3. Camera Control Unit
4. Video Transmitter Duplex Data
5. Preformed Loop Detector Station
6. Microwave Vehicle Detection Sensor System
7. Fiber Optic Data Modem
8. Fiber Optic Splice Closure

Quantities of fiber optic cables to be paid for by the meter will be determined from the length designated by the Engineer. Fiber optic cables placed in excess of the lengths designated will not be paid for.

The contract prices paid per meter for fiber optic cable of various types shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in fiber optic cable of various types complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for electrical work and equipment associated with substation architectural westbound and substation architectural eastbound, as shown on the architectural electrical drawings, shall be considered as included in the contract lump sum prices paid for substation architectural westbound and substation architectural eastbound and no additional compensation will be allowed therefor.

SECTION 10-4. MECHANICAL

10-4.01 MECHANICAL WORK

Mechanical work shall consist of performing mechanical work in accordance with the details shown on the plans and these special provisions. Mechanical work shall include all such work for Substation EB, Substation WB, City and County of San Francisco (CCSF) water main and sewage force main, and domestic water piping and compressed air for Caltrans bridge maintenance.

Mechanical work shall include furnishing all labor, materials, equipment and services required for providing heating, ventilating, air conditioning, plumbing, piping and material handling systems.

Earthwork, foundations, sheet metal, painting, electrical, and such other work incidental and necessary to the proper installation and operation of the mechanical work shall be in accordance with the requirements specified for similar type work elsewhere in these special provisions.

System layouts are generally diagrammatic and location of equipment is approximate. Exact routing of pipes, ducts, etc., and location of equipment is to be governed by structural conditions and obstructions. Equipment requiring maintenance and inspection is to be readily accessible.

SUBMITTALS

A. Product data

A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions for plumbing fixtures, and component layout shall be included where applicable.

Manufacturer's descriptive data shall be submitted for the following:

1. All piping materials, components, and associated appurtenances
2. Electrical Unit Heaters
3. Cabinet Fans
4. Exhaust Fans
5. Air Filters
6. Thermostats
7. Dampers
8. Diffusers, Grills, and Registers
9. Electric Incinerating Toilets
10. Self-contained Eyewash Units
11. Monorail Hoist

B. Operation and maintenance manuals

Prior to the completion of the contract, 3 identified copies of the operation and maintenance instructions with parts lists for the equipment specified herein shall be delivered to the Engineer at the jobsite. The instructions and parts lists shall be indexed and bound in a manual form and shall be complete and adequate for the equipment installed. Inadequate or incomplete material shall be returned. The Contractor shall resubmit adequate and complete manuals at no expense to the State.

Operation and maintenance manuals shall be submitted for the following equipment:

1. Electrical Unit Heaters
2. Cabinet Fans
3. Exhaust Fans
4. Air Filters
5. Thermostats
6. Dampers
7. Diffusers, Grills, and Registers
8. Electric Incinerating Toilets
9. Self-contained Eyewash Units
10. Monorail Hoist

C. Working drawings

The Contractor shall submit complete working drawings.

Working drawings shall be submitted as described elsewhere in these specifications. The working drawings shall be supplemented by manufacturer's descriptive data, performance data, and installation instructions for the following:

1. Pipe
2. Valves
3. Air outlets
4. Hose and Fittings
5. Couplings
6. Supports
7. In-line Components
8. Substation Equipment

For initial review, 5 sets of drawings shall be submitted. After review, 6 sets shall be submitted to the said Office for final approval and use during construction.

D. Project record drawings

Project record drawings shall be submitted in accordance with the requirements of these special provisions.

As the work progresses, the Contractor shall maintain a record of all deviations in the work from that shown on the plans.

One set of the project plans shall be kept on file by the Contractor for the sole purpose of recording as-built information and shall be so marked. Data to be recorded shall include, but not limited to, all clarifications and change orders, location of underground utilities, and changes in size, manufacture or location of features shown on the plans. In addition, the locations of significant items shall be highlighted on this set of project record drawings.

All corrections shall be made in red ink or red pencil. Superseded material shall be neatly lined out. Original figures shall not be eradicated nor written over. Each sheet shall be clearly marked as having "As-Built Changes" or "No As-Built Changes," as appropriate. The Contractor shall sign and date each sheet of the plans certifying that all information shown is correct.

The Contractor shall periodically review the set of record drawings with the Engineer during the progress of the work to assure that all changes and other required information are being recorded.

Before completion of the work, the Contractor shall request a review of the record drawings to determine completeness and adequacy. If the record drawings are unacceptable, the Contractor shall inspect, measure and survey the project and record the required additional information.

The record set of plans shall be delivered to the Engineer prior to acceptance of the contract.

E. Codes and standards

Mechanical work, including equipment, materials and installation, shall conform to the California Building Standards Code, Title 24, and to the California Code of Regulations, Title 8, Chapter 4, Division of Industrial Safety (DIS).

F. Warranties and guarantees

Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

SYSTEM IDENTIFICATION

Piping, ducts, valves and equipment

Identification of piping, ducts, valves and equipment shall be as shown on the plans or these special provisions:

A. Above ground piping and ducts - Markers shall be provided on lines which are either exposed or concealed in accessible spaces. For piping systems, except drain and vent lines, indicate the fluid conveyed or its abbreviation; either by preprinted markers or stenciled markings, and include arrows to show the direction of flow. To assure secure attachment of adhesive type pipe markers, circumferential taping shall be applied to strap the pipe marker to the pipe, insulation, etc. Color of the strapping tape shall be the same as the pipe marker background color. Colors shall comply with ANSI/ASME Standard: A13.1. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through penetrations in floors, walls or ceilings or

otherwise pass into inaccessible spaces, and at 50-foot maximum intervals along exposed portions of the lines. Marking of short branches and repetitive branches for equipment connections is not required.

B. Valves - Valve tags shall be provided on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Provide brass or plastic laminate tags. Prepare and submit a tagged valve schedule, listing each valve by tag number, location and piping service. Valve schedule shall be mounted in a glazed frame at a location approved by the Engineer.

C. Equipment - All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (for example, AC-4). Provide 13 mm high lettering, white on black background. Nameplates shall be permanently secured to the unit.

10-4.02 MONORAIL HOIST

Monorail hoist consists of designing, constructing, furnishing and installing an electric powered monorail hoist on a motorized trolley, in accordance with the details shown on the plans, the requirements specified in these special provisions, and the recommendations and instructions of the hoist manufacturer.

The work shall also include the design, construction, furnishing and installation of the monorail for the trolley and hoist.

Monorail design requirements

The hoist rail shall be designed to support hoist loads, including the required safety factors, as recommended by the hoist manufacturer for the capacity specified, and as recommended by the Materials Handling Institute Standard No. 74, "Top Running and Underhung Single Girder Electric Overhead Traveling Cranes," and as required by Title 24 of the California Building Standards Code, and Title 8 of the California Code of Regulations.

The hoist rail shall be located as shown on the plans. The approximate spacing of support points is as shown on the plans. The minimum vertical clearance shall be as shown on the plans.

SUBMITTALS

Product data

Manufacturer's descriptive data, performance data, parts list and installation instructions for hoisting equipment shall be submitted for approval.

Working drawings

Working drawings and design calculations for the monorail shall be submitted for approval.

Working drawings shall include control panel schematic and wiring diagram, and a listing of electrical equipment and devices to be furnished.

Working drawings and design calculations for the monorail shall be stamped and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California.

Operation and Maintenance Manuals

Prior to the completion of the contract, 3 identified copies of the operation and maintenance instructions with parts lists for the equipment specified herein shall be delivered to the Engineer at the jobsite. The instructions and parts lists shall be indexed and bound in a manual form and shall be complete and adequate for the equipment installed. Inadequate or incomplete material will be returned. The Contractor shall resubmit adequate and complete manuals at no expense to the State.

Certificate of Compliance

Certificates of Compliance shall be furnished for the monorail in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Codes and standards

All welding shall be in accordance with the requirements in American Welding Society (AWS) D14.1, "Specifications for Welding Industrial and Mill Crane and Other Material Handling Equipment."

Acceptable manufacturers

Subject to project conditions, bridge crane shall be Yale, Demag, CraneVeyor Corp.; Detroit Hoist; Lift-Tech International, Inc.; or equal.

GENERAL

The electric monorail hoist shall include an electric powered hoist on a motorized trolley, power bar conductors, and pendant-type electrical controls.

The hoist and trolley shall be a close-headroom, wire rope type, mounted on a single-speed, electric motor driven trolley.

The hoist control system shall consist of a festooned conductor system, travel limit switches, fully solid-state softstart for the trolley motors, and a pendant station complete with strain relief hardware for full operation of hoist and trolley. Controls shall be actuated by the pendant station.

Hoist and trolley

The trolley shall be motorized and shall have not less than 6 hardened forged steel wheels with sealed, tapered roller bearings. The trolley frame shall be of rigid construction. The trolley operating speed shall be as shown on the plans. The trolley motor shall be continuous duty, reversible, with motor brake. Horsepower, voltage and phase shall be as shown on the plans.

The hoist shall be oil bath gear driven flanged drum with machined grooves, heavy duty ball bearings, have a high limit switch for the hook travel, and shall be equipped with a load limiting clutch to prevent damage from overloads. Hook shall be forged steel, with 360 degree swivel and spring latch. The hoist motor shall be reversible, with motor brake. Horsepower, voltage and phase shall be as shown on the plans. The hoist shall provide lift and head as shown in the plans.

Monorail

Shall be fabricated from structural steel conforming to ASTM Designation: A 36. The rails shall have a maximum deflection of 1/600 of the support span length under maximum loading conditions. The monorail shall be provided with travel stops.

Control panel

Control panel shall be UL or FM listed for crane operation and shall include main disconnect, mainline contactor, hoist motor disconnect, trolley motor disconnect, hoist motor reversing starter, trolley motor reversing starter, thermal overload relays, control transformer disconnect, control transformer, control relays, power terminal block and control terminal block. All contactors and starters shall be NEMA rated. Components shall be mounted on the interior mounting panel.

Control panel shall be a NEMA 12 enclosure, with interior mounting panel and hinged exterior dead front door. Control panel shall be factory prewired in conformance with Class-II Type 1C wiring. All wires entering or leaving the control panel shall terminate on terminal blocks. Control wires shall be 7 strand No. 14 Type MTW wires. Wiring shall be arranged such that any component may be removed without removing any wiring except that component's leads.

Control panel shall be a complete system furnished by the hoist manufacturer.

Power and control cable.-- Power and control cable shall be as recommended by the hoist manufacturer.

Festooned bridge conductor system

Festooned conductor system shall consist of multiconductor cable, cable grip, messenger chain, tag-line wire, take up brackets, and other necessary hardware. Conductor sizes shall be as recommended by the hoist and trolley manufacturer.

Shop finishing

Hoist shall be cleaned and receive 2 coats of the manufacturer's standard paint.

Identification

An information plate, with the following information, shall be attached to the monorail hoist and trolley:

1. Manufacturer's name and address
2. Model number
3. Serial number
4. Hoist capacity
5. Date of installation

INSTALLATION

The monorail hoist shall be installed in accordance with the manufacturer's instructions and the approved working drawings.

The hoist control panel shall be actuated from a pendant station suspended 1.2 meters above the floor. Main power and trolley power shall be by festooned conductor system.

Power and control cables shall be fastened at a spacing of not more than 0.9 meter on center.

Field painting

After installation, damaged and abraded areas of the shop paint shall be repainted using the same materials as applied in the shop.

TESTS

The hoist shall be tested in the presence of the Engineer. Any equipment failure or malfunction shall be corrected by the Contractor at the Contractor's expense.

Tests shall be as described herein:

No Load Test

The trolley and hoist shall be operated to throughout the full length of the monorail and the limits of hook travel. Travel limit switches shall be engaged.

Load Test

The minimum test load shall be 125 percent of the rated load capacity. The trolley shall be operated for the full length of the monorail under the test load. The test load shall be raised to the hook height limit and lowered until the cable is slack. After a 5-minute waiting period, the test load shall be raised 0.3-meter and held in that position, without slipping, for a minimum time period of ten minutes.

Loss of Power Test

The main power switch shall be opened while the test load is being lowered. The test load shall stop completely and immediately when the power switch is opened.

Manufacturer's field service

The Contractor shall arrange for the hoist manufacturer's representative to be present during testing.

MEASUREMENT AND PAYMENT

Full compensation for monorail hoist shall be considered as included in the contract lump sum prices paid for Substation Architectural Eastbound and Substation Architectural Westbound and no separate payment will be made therefor**.**

10-4.03 PIPE, FITTINGS AND VALVES

Pipe fittings, and valves shall consist of furnishing and installing pipes, fittings and valves in accordance with the details shown on the plans and these special provisions. Pipe, fittings and valves shall include such piping accessories and appurtenances, not mentioned, that are required for the proper installation and operation of the piping systems.

Pipe, fittings and valves for the following system shall be routed as indicated on the plans and specified in these special provisions:

Domestic Water and Compressed Air for Bridge Maintenance

The pipe sizes shown on the plans are nominal pipe size (NPS). No change in the pipe size shown on the plans shall be permitted without written permission from the Engineer.

The pipe and fitting classes and material descriptions shall be as specified herein. No change in class or description shall be permitted without written permission from the Engineer.

Codes and standards

Pipe, fittings and valves shall be installed in accordance with the requirements in the latest edition of the Uniform Plumbing Code, ANSI/ASME B31.3, the manufacturer's recommendations and the requirements specified herein.

PIPE AND FITTINGS

Class **Description**

B3.--

Black steel pipe conforming to ASTM Designation: A 53 grade B. NPS 2 and smaller shall be extra strong pipe with 20 700 kPa WOG socket welding fittings and couplings, ASTM Designation: A 105. NPS 2 1/2 and larger shall be standard weight pipe with standard weight butt welding fittings and couplings, ASTM Designation: A234 Gr WPB.

For full size branches use Tee; for reducing branches use sockolets unless indicated otherwise.

Grooved Mechanical Couplings

Mechanical pipe couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fittings in a positive, airtight couple. Couplings shall be capable of minimum 3 degree angular deflection from centerline.

Coupling housing clamps shall be fabricated in 2 or more parts of malleable iron castings conforming to the specifications in ASTM Designation: A47, Grade 32510. Housing clamps shall hold in place a molded synthetic rubber composition air sealing gasket designed so that internal pressure serves to increase the seal's air tightness. Couplings shall be coated with a rust inhibiting vinyl alkyd enamel coating.

The coupling assembly shall be securely held together by 2 or more trackhead, square or ovalneck, steel bolts. Bolts and nuts shall be heat treated carbon steel and shall be in accordance with the specifications in ASTM Designation: A 183. Couplings shall be rated for a working pressure of 6890 kPa. Couplings shall be Gruvlok Fig. 7001 or approved equal.

Hinged Flex Joint

Joints shall be hinged type, allowing angular movement of plus or minus 20 degrees in a single plane and operate by angulation of bellows. Bellows shall consist of multiple convolutions of type 304 stainless steel, be rated for pressure of 1034 Kpa and temperature of 93 degrees. Joints shall be flange by flange. Flanges and hinge mechanism shall be carbon steel. Hinged flex joints for compressed air service shall incorporate permanently attached internal liners of the same material as the bellows. Joints shall be U.S. Bellows, Metraflex, Flexatherm or approved equal.

Hose (for maintenance lines)

Hose shall be rated by manufacturer for severe service, minimum working pressure 2750 Kpa and temperature range of –29°C to 82°C. Inside diameter to match piping

Hose shall be constructed of a flame resistant Hypalon cover designed to withstand weather, abrasion and chemicals, two braids of wire reinforcement and a neoprene tube.

Ground Joint Hose Coupling

Coupling shall be malleable iron ground joint type suitable for compressed air service. The spud half of coupling shall feature a machined recess holding a beveled polymer insert and come complete with malleable iron wing nut cap and chain. Coupling shall be Dixon EZ Boss #GB28 or approved equal.

Twist Lock Hose Coupling

Coupling shall be brass, female NPT type with rubber washer and be rated to minimum pressure 758 KPa. Coupling shall be Dixon AB or approved equal.

Unions (for steel pipe)

Unions (for steel pipe) shall be 1730 kPa, threaded malleable iron, ground joint, brass to iron seat, galvanized or black to match piping.

VALVES

Gate valve (NPS 2 1/2 and smaller)

Gate valve (NPS 2 1/2 and smaller) shall be bronze body and trim, removable bonnet and non rising stem, Class 125 and same size as pipe in which installed. Gate valve shall be Crane, 438; Nibco Scott, T-113; Jenkins, 370; or equal.

Gate valve in nonferrous water piping systems may be solder joint type with bronze body and trim. Valve shall be Kitz, 59; Nibco Scott, S-113; Jenkins, 1240; or equal.

Gate valve (NPS 3 and larger, above ground)

Gate valve (NPS 3 and larger, above ground) shall be iron body with bronze trim, removable bonnet and non-rising stem, class 125 and same size as pipe in which installed. Gate valve shall be Crane, 461; Nibco Scott, F-619; Jenkins, 326; or equal.

Ball valve

Ball valve for water and air service shall be two piece, minimum 2760 kPa WOG, bronze body with hard chrome plated brass ball and reinforced teflon seat. Valve shall be Nibco Scott, T-580; Watts, B-6000; Kitz, 56; or equal.

Automatic Moisture Trap

Trap shall be inverted bucket type, screwed connection, ASTM-A 48 Class 30 Cast Iron body, suitable for working pressure to 1720 Kpa. Trap shall be Armstrong Model 811 or equal.

INSTALLATION OF PIPES AND FITTINGS

Pipe and fittings

Pipe and fittings shall be installed in accordance with the following designated uses:

Designated Use	Pipe and Fitting Class
Domestic water	B3
Compressed air	B3

Installing piping

Piping shall be installed generally level, free of traps and bends, and arranged to conform to the building requirements. Long radius elbows shall be used wherever possible.

Piping shall be installed parallel to walls. All obstructions shall be cleared, headroom preserved and openings and passageways kept clear whether shown or not. Piping shall not interfere with other work.

Where pipes pass through exterior walls, a clear space around pipe shall be provided. Space shall be caulked water tight with silicone caulk.

Compressed air piping shall be pitched to low point. Branches shall be taken off top of main, unless noted otherwise.

Welding Pipe

Welding for carbon steel pipe shall be in accordance with ANSI B31.3. Welding for structural steel pipe supports and accessories shall be in accordance with AWS D1.1. Quality control for all welding shall be in accordance with "Welding Quality Control" elsewhere in these special provisions.

Pipe sleeves

The Contractor shall provide sleeves, inserts and openings necessary for the installation of pipe, fittings and valves. Damage to surrounding surfaces shall be patched to match existing.

PVC pipe sleeves shall be provided where each pipe passes through concrete floors, footings, walls or ceilings. Inside diameter of sleeves shall be at least 20 mm larger than outside diameter of pipe. Sleeves shall be installed to provide at least 10 mm space all around pipe the full depth of concrete. Space between pipes and pipe sleeves shall be caulked watertight.

Inspection

Inspection and NDE shall be in accordance with "Welding Quality Control" elsewhere in these special provisions. Welds shall be visually inspected by the Contractor.

Cutting pipe

All pipe shall be cut straight and true and the ends shall be reamed to the full inside diameter of the pipe after cutting.

Damaged pipe

Pipe that is cracked, bent or otherwise damaged shall be removed from the work.

Pipe joints and connections

Joints in threaded steel pipe shall be made with teflon tape or a pipe joint compound that is nonhardening and noncorrosive, placed on the pipe and not in the fittings.

The use of thread cement or caulking on threaded joints will not be permitted. Threaded joints shall be made tight. Long screw or other packed joints will not be permitted. Any leaky joints shall be remade with new material.

Exposed polished or enameled connections to fixtures or equipment shall be made with special care, showing no tool marks or threads.

Cleaning and closing pipe

The interior of all pipe shall be cleaned before installation. All openings shall be capped or plugged as soon as the pipe is installed to prevent the entrance of any materials. The caps or plugs shall remain in place until their removal is necessary for completion of the installation.

Flushing

Flush all water piping systems clean of dirt and foreign material following completion of the hydrostatic and leakage test. Flushing shall consist of running clean fresh water through the piping system at a velocity sufficient to keep the pipe filled and remove materials from the line.

Such flow shall continue until in the opinion of the Engineer the line is discharging only clean water.

Provide all equipment, and supplies for performing the work, and waste the water at locations or by procedures approved by the Engineer.

Air Blowing

Air blow all compressed air piping systems clean of dirt and foreign materials following completion of leakage tests. Air used shall be from a source approved by the Engineer.

Lines shall be blown using clean, dry, oil free air at a sufficient velocity to loosen all foreign materials until, in the opinion of the Engineer, the discharge is free from foreign materials.

Painting

All exposed surfaces of carbon steel piping, components, supports and appurtenances shall be painted in accordance with requirements for structural steel bridge members. Color to match bridge color.

Hangers and supports

Locate pipe supports as indicated in the plans. Unless stated otherwise, use ASTM A36 for fabrication of pipe supports and ASTM A325 heavy hex head bolts with hardened washers and heavy hex nuts for bolted connections; use hot-dip galvanized nuts, bolts and washers for galvanized supports. Pipe supports shall be fabricated and installed according to MSS SP-58 and SP-69.

Dimensions and elevations for supports are the responsibility of the Contractor and should be confirmed in the field prior to fabrication and installation.

Hangers and supports for field routed piping shall be selected to withstand all conditions of loading to which the piping and associated equipment may be subjected and within the manufacturer's load ratings. Hangers and supports shall be spaced and distributed so as to avoid load concentrations and to minimize the loading effect on the building structure.

Hangers and supports shall be sized to fit the outside diameter of pipe or pipe insulation. Hangers shall be removable from around pipe and shall have provisions for vertical adjustment after erection. Turnbuckles may be used.

Materials for holding pipe in place shall be compatible with piping material.

Hanger rods shall be provided with locknuts at all threaded connections. Hanger rods shall be sized as follows:

NPS Designator	Minimum Hanger Rod Diameter
1/2 to 2	10 mm
2 1/2 to 3 1/2	13 mm
4 to 5	16 mm
6	19 mm

Testing

The Contractor shall test piping at completion of roughing in, before backfilling, and at other times as directed by the Engineer.

The system shall be tested as a single unit, or in sections as approved by the Engineer. The Contractor shall furnish necessary materials, test pumps, instruments and labor and notify the Engineer at least 3 working days in advance of testing. After testing, the Contractor shall repair all leaks and retest to determine that leaks have been stopped. Surplus water shall be disposed of after testing as directed by the Engineer.

The Contractor shall take precautions to prevent joints from drawing while pipes and appurtenances are being tested. The Contractor shall repair damage to pipes and appurtenances or to other structures resulting from or caused by tests.

General tests

All piping shall be tested after assembly and prior to backfill, pipe wrapping, connecting fixtures, wrapping joints and covering the pipe. Systems shall show no loss in pressure or visible leaks.

The Contractor shall test water piping systems according to the following test schedule and in accordance with Section 20-5.03H, "Pressure Testing," of the Standard Specifications:

Test Schedule		
Piping System	Test Pressure	Test Media
Water	1550 kPa	Water
Air	1035 kPa	Air

During testing of water systems, valves shall be closed and pipeline filled with water. Provisions shall be made for release of air.

The Contractor shall test compressed air piping according to the test schedule and according to the following procedure:

A. The section of piping to be tested shall be sealed and compressed air shall be slowly introduced into the system. Pressure shall be raised to preliminary test pressure not greater than 175 kPa to locate major leaks. After leaks detectable at this preliminary test pressure have been corrected, the pressure shall be slowly raised in steps, each not greater than 175 KPa until specified test pressure is attained. Pressure shall be held at each step for a minimum of 10 minutes to allow for detection of defects. After full specified pneumatic test pressure has been attained, each joint, valve packing, and other potential leak points shall be soap tested for air leaks, and such leaks shall be corrected.

MEASUREMENT AND PAYMENT

Domestic water pipe and compressed air pipe will be measured and paid for per meter in the same manner specified for galvanized steel pipe and plastic pipe in Section 20-5.04, "Measurement," and Section 20-5.05, "Payment," of the Standard Specifications.

Full compensation for furnishing and installing valves, drains, steel brackets, and other fittings, hose, hose couplings, dirt stops, pipe supports, testing and checking, pipe wrapping tape, epoxy adhesives, and seismic expansion assemblies, shall be considered as included in the contract prices paid per meter for the types of line involved and no additional compensation will be allowed therefor.

10-4.04 CCSF WATER MAIN AND SEWAGE FORCE MAIN

CCSF water main and sewage force main shall consist of furnishing and installing pipes, fittings, and valves in accordance with the details shown on the plans and these special provisions. Pipe, fittings, and valves shall include such piping accessories and appurtenances, not mentioned, that are required for the proper installation and operation of the piping systems.

Pipe, fittings and valves for the following systems shall be routed as indicated on the plans and specified in these special provisions:

CCSF Water Main
CCSF Sewer Force Main

MATERIALS

Pipe and fittings for line 4 NPS or greater

Pipes and fittings for piping 4 NPS or greater shall be ductile iron.

Ductile iron pipe shall be restrained, push-on joint pipe conforming to ANSI/AWWA C151/A21.51.

Ductile iron pipe shall be furnished in either 5.5 or 6.1-meter lengths.

Restrained push-on joints for ductile iron pipe shall conform to ANSI/AWWA C111/A21.11. The joints shall be boltless, non-compression, non-threaded with synthetic rubber gasket seals and have a positive-locking device to keep the connection from separating. The pipe joints shall be designed for a working pressure of 2,413 Kpa and be capable of deflecting after assembly. Fittings and flanges for ductile iron pipe shall conform to ANSI/AWWA C110/A21.10, except for the manufacturer's proprietary design dimensions for restrained push-on joint pipe.

Ductile iron pipe and fittings shall have cement mortar lining and seal coating conforming to ANSI/AWWA C104/A21.4. Pipe shall have a bituminous outside coating conforming to ANSI/AWWA C151/A21.51, and fittings shall have a bituminous outside coating conforming to ANSI/AWWA C110/A21.10.

Casing insulators for sewage lines 4 NPS or greater

Casing insulators for sewage lines of 4 NPS or greater shall be designed for the size of casing and primary lines shown on the plans and shall be load rated by manufacturer for the application. Casing insulators shall be 203-mm-wide units consisting of 14-gage steel band and a minimum of four 50-mm-wide glass reinforced runners. The casing insulators shall have a non-conductive inner liner. Insulators 150 mm in diameter or larger shall also be coated with 0.25-mm-thick coating of heat-fused polyvinyl chloride. Casing insulators shall be factory constructed to ensure the line is centered in the casing to avoid any pipe-to-pipe contact and shall have at least two runners seated along the bottom of the casing pipe.

End seals for line 4 NPS or greater

Casing pipe end seals shall be 3-mm-thick synthetic rubber, wrap-around type, secured with stainless steel bands and sealed with two pressure-sensitive butyl mastic strips. Steel bands shall be Type 304 stainless steel with 100% non-magnetic worm gear mechanism.

Sleeve-type expansion assembly for piping 4 NPS or greater

Sleeve-type expansion assembly for lines of 4 NPS or greater shall consist of a sleeve-type expansion joint and an integral ball joint at each end with insulated flange connections to piping. Expansion joint shall be manufactured of ductile iron and conform to the requirements of ANSI/AWWA C153/A21.53. Expansion joint for pipe sizes 24 NPS and smaller shall be pressure rated to a minimum of 2413 KPa, and expansion assembly for pipe sizes greater than 24 NPS shall be rated at a minimum of 1,723 KPa. Seismic expansion assembly shall be capable of deflecting and expanding simultaneously to an amount of not less than a 15 degree deflection at each end of the unit and a total of 200 mm axial movement.

Seal gasket for sleeve expansion shall be retained in the grooved outer casing with a leak-proof design for 2,413 KPa working pressure. The ball joints for the seismic expansion assembly shall be contained in flanged retainers with seal gaskets that shall conform to said specification.

Expansion joint shall be lined with a minimum of 15 mils of fusion-bonded epoxy conforming to the requirements of ANSI/AWWA C213, and shall be holiday tested with a 1,500-volt spark test conforming to the requirements of ANSI/AWWA C213.

Flexible Ball Joint

Flexible ball joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material properties of ANSI/AWWA C153/A21.53. Flexible joints shall consist of a ball and socket type joint capable of 20- degree minimum deflection. Each flexible ball joint shall be pressure tested against its own restraint to a minimum of 2,413 KPa. Joint shall be flange by flange.

All pressure-containing parts shall be lined with a minimum of 15 mils of fusion-bonded epoxy, conforming to the applicable requirements of ANSI/AWWA C213, and shall be tested with a 1,500-volt spark test conforming to said specification. All flexible ball joints shall be FLEX 900 as manufactured by EBAA IRON, Inc., or approved equal.

Manufactured Expansion Loop

Provide flexible expansion loops of size noted on drawings. Flexible loops shall be designed to impart no thrust loads on the anchors. The loop shall consist of two flexible sections of series 300 SS hose and braid, two 90 degree elbows, and a 180 degree return. Loops used for sewer service shall have an interlocked liner. Loops shall be installed in a neutral condition unless noted otherwise.

Loops installed hanging down shall have a drain plug. Loops installed straight up may be fitted with an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180 degree return supported. Install loop within four pipe diameters, both upstream and downstream, from a pipe guide or anchor. Loop shall be Metaflex, Metraloop or equal.

Casing pipe

Casing pipe shall be 6 mm thick welded steel pipe conforming to Section 70-1.02B, "Welded Steel Pipe," of the Standard Specifications, except that the pipe shall be treated in accordance with the following requirements, prior to shipping. Exterior surfaces of welded steel pipe shall be cleaned and coated in accordance with specifications of ANSI/AWWA C213 or, at the option of the Contractor, cleaned, primed, and coated in accordance with specifications of ANSI/AWWA C214.

Welding quality control shall be in accordance with "Welding Quality Control" elsewhere in these special provisions.

Pipe wrapping tape

Wrapping tapes for pipe shall be a pressure-sensitive polyvinyl chloride or polyethylene tape having thickness of 50 mils, minimum.

Pipe supports

All steel anchor bolts, nuts, pipe clamps, and other fittings shall be suitable for the type and size of the lines or casing, and shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Locate pipe supports as indicated on the plans. Unless stated otherwise, use ASTM A36 for fabrication of pipe supports and ASTM A325 heavy hex head bolts with hardened washers and heavy hex nuts for bolted connections. Pipe supports shall be fabricated and installed according to MSS SP-58 and SP-69.

Dimensions and elevations for supports are the responsibility of the contractor and should be confirmed in the field prior to fabrication and installation.

Mechanical Snubber

Snubber shall be a mechanical, velocity-limiting device designed to arrest shock forces and movements by becoming a load carrying member during seismic disturbances or other transient events. During normal operation the snubber shall telescope freely through its normal operating stroke allowing thermal expansion. Snubber shall be complete with front and rear bracket attachment assemblies. Snubber shall be Piping Technology and Products model MSA-35 or approved equal.

Wedge Action Mechanical Joint

Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, impart multiple wedging action against the pipe, increasing its resistance as the pressure increases while maintaining the flexibility of the joint. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be ductile iron heat treated to minimum hardness of 370 BHN. Twist of nuts shall be incorporated in the design of the wedge activation screws insuring proper torque. Joint shall be pressure rated to minimum 2413 KPa. And be EBAA Iron Inc; Megalug, Ford Meter Box Company; Uni-flange or approved equal.

INSTALLATION

Piping in bridge structures shall be supported as shown on the plans and in conformance with these special provisions.

If a block-out is provided in the bridge abutment wall for casing, the space between the casing and bridge abutment wall shall be filled with portland cement mortar conforming to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications, unless stated otherwise.

When the bridge superstructure is to be prestressed, the space around lines through abutments shall not be filled until the prestressing has been completed.

Openings for lines through bridge superstructure concrete shall either be formed or shall consist of pipe sleeves.

Ductile iron pipe for lines 4 NPS in diameter or greater shall be connected and fully extended (pulled out) at the joint before the next connection is made.

Expansion joint for lines 4 NPS in diameter or greater, or the type specified, shall be factory adjusted and set at half the expansion capacity and approved by the Engineer in advance.

Cleaning and closing of pipe

The interior of all pipe shall be cleaned before installation. All openings shall be capped or plugged as soon as the pipe is installed to prevent the entrance of any materials. The caps or plugs shall remain in place until their removal is necessary for completion of the installation.

TESTING

Piping of 4 NPS in diameter or greater shall be tested in accordance with the provisions in Section 20-5.03H(1), "Method A," of the Standard Specifications, except that the testing pressure shall be 1,380 KPa of water pressure and the testing period shall be four hours minimum with no leakage or pressure drop. The air relief valve shall not be subjected to water pressure due to testing.

The Contractor shall furnish pipe anchorages to resist thrust forces occurring during testing. All leaks shall be repaired, and all defective materials shall be replaced at the Contractor's expense.

All pressure testing and necessary repairing of lines shall be completed prior to backfilling, placing deck slabs over lines in box girder cells, or otherwise covering the lines.

Each end of line shall be capped prior to and after the testing

The line shall be tested as one unit. The limits of the unit shall be 1.5 meter beyond the casing at each end of the bridge.

MEASUREMENT AND PAYMENT

CCSF water main, CCSF sewer force main, CCSF sewer casing pipe, and CCSF water casing pipe will be measured and paid for per meter in the same manner specified for welded steel pipe in Section 70-1.04, "Measurement," and Section 70-1.05, "Payment," of the Standard Specifications.

Full compensation for furnishing and installing air release valves, drains, steel brackets, and other fittings, casing and casing insulators, dirt stops, pipe supports, testing and checking,, pipe wrapping tape, epoxy adhesives, and seismic expansion assemblies, shall be considered as included in the contract prices paid per meter for the various sizes of pipes involved and no additional compensation will be allowed therefor.

10-4.05 PLUMBING FIXTURES

Plumbing fixtures shall consist of furnishing and installing plumbing fixtures in accordance with the details shown on the plans and these special provisions.

PRODUCTS

Plumbing fixtures shall meet the following requirements:

Electric Incinerating Toilet

The incinerating toilet shall use electric heat to incinerate waste to a clean ash. Unit shall consist of a bowl assembly lined with disposable treated paper, separate incinerating chamber, foot pedal, heater unit, vent blower, start button and vibration resistant bolt down base plate.

Upon foot pedal operation, bowl assembly shall open to allow waste and liner to drop into incineration chamber. Upon release of foot pedal bowl assembly shall close to form a tight seal. Incineration shall be activated using separate start button.

Unit shall be available for use while incinerating a previous use. The average incinerating time shall be maximum 2 hours. Power requirements are as shown on the plans. Exhaust shall be vented to the outside using Sch. 40 PVC pipe as shown on the plans.

Provide 100 treated paper bowl liners.

Portable "Self-Contained" emergency eyewash

Self-contained emergency eyewash shall consist of pressurized tank with tire type fill valve, twin spray heads with balance control and dust caps, flow control devices, six foot heavy duty drench hose and pressure relief valve. Unit shall provide usable flow of 1.5 liters per minute for 15 minutes for either eyewash or drench hose.

Eyewash shall have anti-surge heads operated by chrome plated brass stay open type valve with stainless steel push handle. Drench valve shall be operated by chrome plated self closing squeeze handle.

Tank shall be 38 liter Type 304 stainless steel with 900 kPa ASME rating. Pressure relief valve shall have 830 kPa set point.

Provide one bottle of bacteriostatic additive to permit water storage for extended periods.

INSTALLATION

General

All finish for exposed metal on any fixture, including wall flanges, bolts, nuts and washer, shall be polished chrome plated or stainless steel.

Fixtures shall be sealed to wall or floor with silicone caulk bead.

All exposed metal surfaces on fixture supports shall be enameled to harmonize with fixtures.

Wall mounted fixtures shall be installed on concealed chair carriers designed to support weight of fixture from the floor, made for the specific fixture to be supported and for the particular installation conditions.

Unless otherwise noted, fixtures shall be mounted at the heights shown on the plans.

Self-contained emergency eyewash shall be installed with a rigid bracket located 1.2 m above the floor. Bracket shall be minimum 1.52 mm (16-gage) steel and shall be braced to the wall.

FIELD QUALITY CONTROL

Testing

The Contractor shall test piping in accordance with the requirements specified elsewhere in these special provisions.

All installed fixtures shall be tested for proper operation after all plumbing work has been completed.

MEASUREMENT AND PAYMENT

Full compensation for plumbing fixtures including eyewash and incinerating toilet shall be considered as included in the contract lump sum prices paid for Substation Architectural Eastbound and Substation Architectural Westbound and no separate payment will be made therefor.

10-4.06 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT AND SYSTEMS

GENERAL

Heating, ventilating and air conditioning equipment and systems shall consist of furnishing, installing and testing heating, ventilating and air conditioning (HVAC) equipment and systems in accordance with the details shown on the plans and these special provisions.

The performance rating and electric service of the HVAC equipment shall be as shown on the plans.

Temperature controls

Thermostats, relays, time switches, and other sensor type control devices required for this work shall be furnished and installed by the supplier of the heating, ventilating and air conditioning equipment. All temperature control wiring shall be furnished and installed in accordance with the requirements specified in Section 10-3, "Electrical Systems," of these special provisions.

Codes and standards

Equipment and systems shall conform to California State Energy Commission Regulations and, where applicable, shall be American Refrigeration Institute (ARI), American Gas Association (AGA), Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), and Air Movement and Control Association (AMCA) approved for performance ratings and application shown on the plans.

Any appliance for which there is a California standard established in the Appliance Efficiency Standards may be installed only if the manufacturer has certified to the Commission, as specified in those regulations, that the appliance complies with the applicable standards for that appliance. Space conditioning equipment may be installed only if the manufacturer has certified that the equipment meets or exceeds all applicable efficiency requirements listed in the Energy Efficiency Standards.

PRODUCTS

Electric Unit heater

Electric unit heater shall have enclosed spiral fins with electric fan. All components shall be factory assembled. Housing shall be of steel construction. Unit heater and fan shall have integral thermal overload protection. Unit shall be listed by a nationally recognized testing laboratory.

Cabinet Fans.--

Cabinet fans shall be belt-driven, double-width, double inlet (DWDI), backward inclined centrifugal blower type. Blower assembly shall be mounted on vibration isolators. Pulleys shall be machine cast iron and adjustable. Belts shall be non-static and oil resistant.

Blower housing shall be fabricated of galvanized steel. Side panels shall be completely removable for access to interior equipment. All bearings shall be permanently sealed and lubricated. Motor shall be mounted out of airstream.

Where shown on the plans, a filter module shall be provided consisting of slide-out unit with permanent or disposable filter elements.

Exhaust fan (wall mounted)

Exhaust fan shall be wall mounted, AMCA certified and shall be equipped with grille, metal housing, and centrifugal fan wheel. Fan motor and fan assembly shall be isolated from base with rubber vibration isolators. Fan shall be completely weatherproof and shall have a disconnect means under the hood and fan motor shall have integral thermal overload protection. Wall exhaust fan shall be Jenn-Air; Carnes; EWDA; Penn; or equal.

Unit heater thermostat

Unit heater thermostat shall be low voltage type, single set point range internally adjustable from 4°C to 27°C, and provided with a blank cover.

Time switch

Time switch shall be one-hour, spring-wound, "OFF" type time switch without a "HOLD" feature. Time switch shall be Intermatic, Type F60M; Tork, A500 Series; or equal.

AUXILIARY HVAC COMPONENTS

Unless specified herein, all components shall be sized and have the characteristics as shown on the plans.

Rigid ductwork

Rigid ductwork shall be galvanized steel sheet metal conforming to the latest edition of the SMACNA "Low Velocity Duct Construction Standards." Galvanized steel shall be cleaned by washing with mineral spirit solvent sufficient to remove any oil, grease or other materials foreign to the galvanized coating.

Spiral duct

Spiral duct shall be prefabricated type.

Duct supports

Duct supports shall be hot-dip galvanized steel.

Flexible ductwork

Flexible ductwork shall be UL 181, Class 1 air duct rated and shall meet the requirements of NFPA 90-A. Duct shall have steel helix wire, flexible insulation, minimum thermal resistance of R-0.7 (m^2*K/W), and flame resistant vapor barrier. Inner and outer surfaces shall be non-metallic. Outer surface shall be Copolymer or Mylar, factory applied.

Flexible connection

Flexible connection shall be prefabricated type and shall be commercial quality flexible glass fabric coated on both sides with neoprene or hypalon.

Volume damper

Volume damper shall be opposed blade type, operable from face with screw driver or Allen-head wrench, shall be same manufacturer as diffuser or may be furnished as part of the diffuser.

Backdraft Dampers

Backdraft dampers shall be of aluminum frame and blades with extruded vinyl edge seals. Bearings shall not require lubrication. Linkage shall be concealed in frame. Provide accessories, such as screens, as shown on the plans.

Duct Supply Registers

Duct supply registers shall be single deflecting type with horizontal face bars, galvanized steel, flanged frame with sponge or felt gasket.

Transfer Grilles

Transfer grilles shall be galvanized steel with perforated screen, flanged frame, and sponge or felt gasket.

Air filter (for HVAC units)

Air filter shall be permanent metal viscous impingement type, constructed of aluminum or galvanized steel, 50 mm minimum thickness and be approved for Class 2 use. Filter shall have a minimum efficiency rating of 50 percent as determined when tested in accordance with ASHRAE Test Standard 52. Filter shall be mounted in 1.52 mm (16-gage) galvanized steel holding frames. Two cans of recharging adhesive shall be provided with the filter and shall be nearly odorless, have a high flash point, rapid wetting characteristics, dye tracer and be water soluble. Filter shall be Airspan, Type AF, Eco-Air Products, Inc., Type HIA; Snyder General, Type AAF; or approved equal.

INSTALLATION

Heaters

Unit heaters shall be installed in such a manner as to insure adequate clearance and separation.

Ventilators

Exhaust ducts connected to exhaust fans shall be routed as shown on the plans and shall terminate in a weatherproof cap. Duct sizes shall be as shown on the plans or as recommended by the manufacturer, whichever is larger.

Mounting heights

Thermostats and time switches shall be installed as shown on the plans.

Temperature controls

Temperature control for each unit heater shall be provided by a thermostat and time switch. Thermostat shall be set for 21°C. The thermostat shall be wired in series with the time switch and shall de-energize the heater above the setpoint.

Each thermostat shall be insulated from the outside walls, and shall be provided with an aluminum radiation shield above the thermostat.

The time switch shall be installed beside the thermostat or where shown on the plans.

Air outlets

Volume dampers shall be furnished and installed for all diffusers. Blocking shall be provided on all sides of air outlets between ceiling or wall joists. Collars shall be supplied for all outlets and shall be taped and sealed in place.

Access door

Access doors shall be provided in rigid ducts and plenums for access to volume dampers, fire dampers and control devices located within such ductwork; and shall be provided at such other locations as shown on the plans.

Ducts and vents

Ductwork within the structure shall be installed to clear lighting fixtures, doors, windows and other obstructions. Ductwork shall preserve head room and shall keep openings and passageways clear whether shown on plans or not.

Ductwork shall be installed and braced according to the latest edition of the SMACNA "HVAC Duct Construction Standards."

Slopes in sides at transitions shall be approximately one to five. The ductwork system shall not contain abrupt changes or offsets of any kind unless otherwise shown on the plans.

Where ducts pass through walls, floors or ceilings, galvanized sheet metal or steel angle collars shall be installed around the ducts.

Duct sections shall be connected by beaded sleeve-type couplings using joint sealer as recommended by the duct manufacturer. Duct sections shall be mechanically fastened with pop rivets or sheet metal screws and sealed with mastic or insulated, reinforced silver tape.

Flexible connections shall be provided at both inlet and outlet of fan coil and ventilating units.

Sheet metal plenums shall be adequately braced and supported from the floor or structure with structural steel angles to prevent sagging, flexing and vibration.

All standing seams and transverse joints of supply, return and exhaust ducts and seams around plenums, fan and coil housings shall be sealed with sealant and taped.

Ductwork identification

Ductwork shall be identified as follows:

Duct Description	Identification Symbol
Supply duct	S
Return duct	R
Exhaust duct	EXH
Outside air duct	OA

Identification symbol letters shall be stenciled at locations visible from the access routes to be used by maintenance workers. Such letters shall be painted with black colored paint and shall be a minimum of 50 mm high.

FIELD QUALITY CONTROL

Pre-test requirements

Before starting or operating systems, equipment shall be cleaned and checked for proper installation, lubrication and servicing.

In each system, at least one air path, from fan to final outlet, shall have all balance dampers open. The final air quantities shall be achieved by adjusting the volume dampers or the fan RPM.

Final adjustments and balancing of the systems shall be performed in such a manner that the systems will operate as specified and as shown on the plans.

The Contractor shall replace or revise any equipment, systems or work found deficient during tests.

All automatic operating devices which are pertinent to the adjustment of the aforementioned air systems shall be set and adjusted to deliver the required quantities of air and at temperatures specified by the Engineer. All control work shall be done in collaboration with the control manufacturer's representative.

Project completion tests

The Engineer shall be notified at least 3 working days in advance of starting project completion tests.

Upon completion of mechanical work and pre-test requirements, or at such time prior to completion as determined by the Engineer, the Contractor shall operate and test installed mechanical systems for at least 3 consecutive 8-hour days to demonstrate satisfactory overall operation.

MEASUREMENT AND PAYMENT

Full compensation for heating, ventilating, and air conditioning equipment and systems, including electrical work for connection of mechanical items, shall be considered as included in the contract lump sum prices paid for Substation Architectural Eastbound and Substation Architectural Westbound and no separate payment will be made therefor.

SECTION 11. MODIFIED STANDARD SPECIFICATION SECTIONS

SECTION 11-1. (BLANK)

SECTION 11-2. PORTLAND CEMENT CONCRETE

11-2.01 GENERAL

Portland cement concrete shall conform to the provisions in this Section 11-2, "Portland Cement Concrete," and the section entitled "Portland Cement Concrete" in Section 8, "Materials," of these special provisions. Section 90, "Portland Cement Concrete," of the Standard Specifications is deleted. Section 90, "Portland Cement Concrete," of the Standard Specifications is amended to read as follows.

SECTION 90: PORTLAND CEMENT CONCRETE
90-1 GENERAL

90-1.01 DESCRIPTION

· Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.

· The Contractor shall determine the mix proportions for all concrete except pavement concrete. The Engineer will determine the mix proportions for pavement concrete. Concrete for which the mix proportions are determined either by the Contractor or the Engineer shall conform to the requirements of this Section 90.

· Unless otherwise specified, cementitious material shall be a combination of cement and mineral admixture. Cementitious material shall be either:

1. "Type IP (MS) Modified" cement; or
2. A combination of "Type II Modified" portland cement and mineral admixture; or
3. A combination of Type V portland cement and mineral admixture.

· Type III portland cement shall be used only as allowed in the special provisions or with the approval of the Engineer.

· Class 1 concrete shall contain not less than 400 kg of cementitious material per cubic meter.

· Class 2 concrete shall contain not less than 350 kg of cementitious material per cubic meter.

· Class 3 concrete shall contain not less than 300 kg of cementitious material per cubic meter.

· Class 4 concrete shall contain not less than 250 kg of cementitious material per cubic meter.

· Minor concrete shall contain not less than 325 kg of cementitious material per cubic meter unless otherwise specified in these specifications or the special provisions.

· Unless otherwise designated on the plans or specified in these specifications or the special provisions, the amount of cementitious material used per cubic meter of concrete in structures or portions of structures shall conform to the following:

Use	Cementitious Material Content (kg/m3)
Concrete designated by compressive strength:	
Deck slabs and slab spans of bridges	400 min., 475 max.
Roof sections of exposed top box culverts	400 min., 475 max.
Other portions of structures	350 min., 475 max.
Concrete not designated by compressive strength:	
Deck slabs and slab spans of bridges	400 min.
Roof sections of exposed top box culverts	400 min.
Prestressed members	400 min.
Seal courses	400 min.
Other portions of structures	350 min.
Concrete for precast members	350 min., 550 max.

· Whenever the 28-day compressive strength shown on the plans is greater than 25 MPa, the concrete shall be designated by compressive strength. If the plans show a 28-day compressive strength that is 28 MPa or greater, an additional 14 days will be allowed to obtain the specified strength. The 28-day compressive strengths shown on the plans that are 25 MPa or less are shown for design information only and are not a requirement for acceptance of the concrete.

· Concrete designated by compressive strength shall be proportioned such that the concrete will attain the strength shown on the plans or specified in the special provisions.

· Before using concrete for which the mix proportions have been determined by the Contractor, or in advance of revising those mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.

· Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, mineral admixture shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

· If any concrete has a cementitious material, portland cement, or mineral admixture content that is less than the minimum required, the concrete shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State $0.55 for each kilogram of cementitious

material, portland cement, or mineral admixture that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

· The requirements of the preceding paragraph shall not apply to minor concrete or commercial quality concrete.

90-2 MATERIALS

90-2.01 CEMENT

· Unless otherwise specified, cement shall be either "Type IP (MS) Modified" cement, "Type II Modified" portland cement or Type V portland cement.

· "Type IP (MS) Modified" cement shall conform to the requirements for Type IP (MS) cement in ASTM Designation: C 595, and shall be comprised of an intimate and uniform blend of Type II cement and not more than 35 percent by mass of mineral admixture. The type and minimum amount of mineral admixture used in the manufacture of "Type IP (MS) Modified" cement shall be in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures."

· "Type II Modified" portland cement shall conform to the requirements for Type II portland cement in ASTM Designation: C 150.

· In addition, "Type IP (MS) Modified" cement and "Type II Modified" portland cement shall conform to the following requirements:

A. The cement shall not contain more than 0.60 percent by mass of alkalies, calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O, when determined by either direct intensity flame photometry or by the atomic absorption method. The instrument and procedure used shall be qualified as to precision and accuracy in conformance with the requirements in ASTM Designation: C 114;
B. The autoclave expansion shall not exceed 0.50 percent; and
C. Mortar, containing the cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not expand in water more than 0.010 percent and shall not contract in air more than 0.048 percent, except that when cement is to be used for precast prestressed concrete piling, precast prestressed concrete members, or steam cured concrete products, the mortar shall not contract in air more than 0.053 percent.

· Type III and Type V portland cements shall conform to the requirements in ASTM Designation: C 150 and the additional requirements listed above for "Type II Modified" portland cement, except that when tested in conformance with California Test 527, mortar containing Type III portland cement shall not contract in air more than 0.075 percent.

· Cement used in the manufacture of cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same cement mill.

· Cement shall be protected from exposure to moisture until used. Sacked cement shall be piled to permit access for tally, inspection, and identification of each shipment.

· Adequate facilities shall be provided to assure that cement meeting the provisions specified in this Section 90-2.01 shall be kept separate from other cement in order to prevent any but the specified cement from entering the work. Safe and suitable facilities for sampling cement shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper, in conformance with California Test 125.

· If cement is used prior to sampling and testing as provided in Section 6-1.07, "Certificates of Compliance," and the cement is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the cement manufacturer or supplier of the cement. If the cement is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.

· Cement furnished without a Certificate of Compliance shall not be used in the work until the Engineer has had sufficient time to make appropriate tests and has approved the cement for use.

90-2.02 AGGREGATES

· Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

· Natural aggregates shall be thoroughly and uniformly washed before use.

· The Contractor, at the Contractor's expense, shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.

· Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."

· Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, D_f, of the fine aggregate is 60, or greater, when tested for durability in conformance with California Test 229.

· If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."

· If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $4.60 per cubic meter for paving concrete and $7.20 per cubic meter for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

· If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $4.60 per cubic meter for paving concrete and $7.20 per cubic meter for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

· The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs shall be in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

· No single Cleanness Value, Sand Equivalent or aggregate grading test shall represent more than 250 m^3 of concrete or one day's pour, whichever is smaller.

· Aggregates specified for freeze-thaw resistance shall pass the freezing and thawing test, California Test 528.

· The Contractor shall notify the Engineer of the proposed source of freeze-thaw resistant concrete aggregates at least 4 months before intended use. Should the Contractor later propose a different source of concrete aggregates, the Contractor shall again notify the Engineer at least 4 months before intended use. Blending of fine or coarse aggregates from untested sources with acceptable aggregates will not be permitted. Provisions for the time of submission of samples as provided in Section 40-1.015, "Cement Content," are superseded by the foregoing.

· Concurrently with notification of proposed sources of freeze-thaw resistant concrete aggregates, the Contractor shall furnish samples in the quantity ordered by the Engineer. The samples shall be secured under the direct supervision of the Engineer. Samples from existing stockpiles of processed aggregate shall be taken from washed materials and shall be visibly damp. Samples from materials in place in a material source shall be taken at depths from the existing surface that will ensure the presence of the full quantity of ground water. Excavations for the purpose of securing samples shall be made to the full depth of intended source operations. Samples shall be protected against loss of contained water until they are delivered to the Engineer.

· The Engineer will waive the above freeze-thaw test and the 4-month advance notice, required in this Section, provided aggregates are to be obtained from sources that have previously passed this test and test results are currently applicable.

· No extension of contract time will be allowed for the time required to perform the freezing and thawing test.

· When the source of an aggregate is changed, except for pavement concrete, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates. When the source of an aggregate is changed for pavement concrete, the Engineer shall be allowed sufficient time to adjust the mix, and the aggregates shall not be used until necessary adjustments are made.

90-2.02A Coarse Aggregate

· Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

· Coarse aggregate shall conform to the following quality requirements:

Tests	California Test	Requirements
Loss in Los Angeles Rattler (after 500 revolutions)	211	45% max.
Cleanness Value		
Operating Range	227	75 min.
Contract Compliance	227	71 min.

· In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

1. coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested by California Test 227; and
2. prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.02B Fine Aggregate

· Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.

· Fine aggregate shall conform to the following quality requirements:

Test	California Test	Requirements
Organic Impurities	213	Satisfactory[a]
Mortar Strengths Relative to Ottawa Sand	515	95%, min.
Sand Equivalent:		
Operating Range	217	75, min.
Contract Compliance	217	71, min.

a Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the Engineer, from mortar strength tests, that a darker color is acceptable.

· In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71 minimum and a Sand Equivalent "Contract Compliance" limit of 68 minimum will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

1. fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
2. prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.03 WATER

· In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with

the requirements in ASTM Designation: C 109, when compared to the results obtained with distilled water or deionized water, tested in conformance with the requirements in ASTM Designation: C 109.

· In non-reinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1500 parts per million of sulfates as SO_4, when tested in conformance with California Test 417.

· In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.

· Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (Na_2O + 0.658 K_2O) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

90-2.04 ADMIXTURE MATERIALS

· Admixture materials shall conform to the requirements in the following ASTM Designations:

A. Chemical Admixtures—ASTM Designation: C 494.
B. Air-entraining Admixtures—ASTM Designation: C 260.
C. Calcium Chloride—ASTM Designation: D 98.
D. Mineral Admixtures—Coal fly ash; raw or calcined natural pozzolan as specified in ASTM Designation: C618; silica fume conforming to the requirements in ASTM Designation: C1240, with reduction of mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.
E. Metakaolin conforming to requirements in ASTM Designation: C 618, Class N and to the following chemical and physical requirements.

Chemical Requirements	Percent
Silicon dioxide (Si02) + Aluminum Oxide (Al203)	94 (min.)
Sulfur Trioxide (S03)	1.0 (max.)
Loss on ignition	1.2 (max.)
Available Alkalies (as Na20) equivalent	1.0 (max.)
Physical Requirements	Percent
Retained +325 mesh	2.0 (max.)
Fineness variation	1.0 (min.)
Pozzolanic (strength) Activity Index with portland cement	100 (minimum % of control) at 7 days
Pozzolanic (strength) Activity Index with portland cement	100 (minimum % of control) at 28 days

· Unless otherwise specified in the special provisions, mineral admixtures shall be used in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures."

90-3 AGGREGATE GRADINGS

90-3.01 GENERAL

· Before beginning concrete work, the Contractor shall submit in writing to the Engineer the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

· The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

· Gradations proposed by the Contractor shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	Sieve Size	Limits of Proposed Gradation
37.5-mm x 19-mm	25-mm	19 - 41
25-mm x 4.75-mm	19-mm	52 - 85
25-mm x 4.75-mm	9.5-mm	15 - 38
12.5-mm x 4.75-mm	9.5-mm	49 - 78
9.5-mm x 2.36-mm	9.5-mm	50 - 85
Fine Aggregate	1.18-mm	55 - 75
Fine Aggregate	600-µm	34 - 46
Fine Aggregate	300-µm	16 - 29

· Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

90-3.02 COARSE AGGREGATE GRADING

· The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

	Percentage Passing Primary Aggregate Nominal Sizes							
	37.5-mm x 19-mm		25-mm x 4.75-mm		12.5-mm x 4.75-mm		9.5-mm x 2.36-mm	
Sieve Sizes	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance
50-mm	100	100	—	—	—	—	—	—
37.5-mm	88-100	85-100	100	100	—	—	—	—
25-mm	x ± 18	X ± 25	88-100	86-100	—	—	—	—
19-mm	0-17	0-20	X ± 15	X ± 22	100	100	—	—
12.5-mm	—	—	—	—	82-100	80-100	100	100
9.5-mm	0-7	0-9	X ± 15	X ± 22	X ± 15	X ± 22	X ± 15	X ± 20
4.75-mm	—	—	0-16	0-18	0-15	0-18	0-25	0-28
2.36-mm	—	—	0-6	0-7	0-6	0-7	0-6	0-7

· In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

· Coarse aggregate for the 37.5-mm, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

· When the 25-mm, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 25-mm x 4.75-mm primary aggregate nominal size.

90-3.03 FINE AGGREGATE GRADING

· Fine aggregate shall be graded within the following limits:

Sieve Sizes	Percentage Passing	
	Operating Range	Contract Compliance
9.5-mm	100	100
4.75-mm	95-100	93-100
2.36-mm	65-95	61-99
1.18-mm	X ± 10	X ± 13
600-µm	X ± 9	X ± 12
300-µm	X ± 6	X ± 9
150-µm	2-12	1-15
75-µm	0-8	0-10

· In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

· In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the 1.18-mm sieve and the total percentage passing the 600-µm sieve shall be between 10 and 40, and the difference between the percentage passing the 600-µm and 300-µm sieves shall be between 10 and 40.

· Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

90-3.04 COMBINED AGGREGATE GRADINGS

· Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein. Within these limitations, the relative proportions shall be as ordered by the Engineer, except as otherwise provided in Section 90-1.01, "Description."

· The combined aggregate grading used in portland cement concrete pavement shall be the 37.5-mm, maximum grading.

· The combined aggregate grading used in concrete for structures and other concrete items, except when specified otherwise in these specifications or the special provisions, shall be either the 37.5-mm, maximum grading, or the 25-mm, maximum grading, at the option of the Contractor.

Grading Limits of Combined Aggregates

Sieve Sizes	Percentage Passing			
	37.5-mm Max.	25-mm Max.	12.5-mm Max.	9.5-mm Max.
50-mm	100	—	—	—
37.5-mm	90-100	100	—	—
25-mm	50-86	90-100	—	—
19-mm	45-75	55-100	100	—
12.5-mm	—	—	90-100	100
9.5-mm	38-55	45-75	55-86	50 - 100
4.75-mm	30-45	35-60	45-63	45 - 63
2.36-mm	23-38	27-45	35-49	35 - 49
1.18-mm	17-33	20-35	25-37	25 - 37
600-µm	10-22	12-25	15-25	15 - 25
300-µm	4-10	5-15	5-15	5 - 15
150-µm	1-6	1-8	1-8	1 - 8
75-µm	0-3	0-4	0-4	0 - 4

· Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

90-4 ADMIXTURES

90-4.01 GENERAL

· Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the special provisions. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.

· Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by mass of admixture, as determined by California Test 415, shall not be used in prestressed or reinforced concrete.

· Calcium chloride shall not be used in concrete containing steel reinforcement or other embedded metals.

· Mineral admixture used in concrete for exposed surfaces of like elements of a structure shall be from the same source and of the same percentage.

· Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

· If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

90-4.02 MATERIALS

· Admixture materials shall conform to the provisions in Section 90–2.04, "Admixture Materials."

90-4.03 ADMIXTURE APPROVAL

· No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved.

· Admixture brands will be considered for addition to the approved list if the manufacturer of the admixture submits to the Transportation Laboratory a sample of the admixture accompanied by certified test results demonstrating that the admixture complies with the requirements in the appropriate ASTM Designation and these specifications. The sample shall be sufficient to permit performance of all required tests. Approval of admixture brands will be dependent upon a determination as to compliance with the requirements, based on the certified test results submitted, together with tests the Department may elect to perform.

· When the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

· If a mineral admixture is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the manufacturer or supplier of the mineral admixture. If the mineral admixture is used in ready-mix concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES AND CALCIUM CHLORIDE

· When the use of a chemical admixture or calcium chloride is specified or ordered by the Engineer, the admixture shall be used at the dosage specified or ordered, except that if no dosage is specified or ordered, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

· Calcium chloride shall be dispensed in liquid, flake, or pellet form. Calcium chloride dispensed in liquid form shall conform to the provisions for dispensing liquid admixtures in Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures."

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES

· The Contractor will be permitted to use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:

A. When a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by mass, except that the resultant cementitious material content shall be not less than 300 kilograms per cubic meter; and
B. When a reduction in cementitious material content is made, the dosage of admixture used shall be the dosage used in determining approval of the admixture.

· Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES

· When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.

90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES

· When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate as provided in Section 40-1.015, "Cement Content."

90-4.08 REQUIRED USE OF MINERAL ADMIXTURES

· Unless otherwise specified, mineral admixture shall be combined with cement to make cementitious material.

· The calcium oxide content of mineral admixtures shall not exceed 10 percent and the available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 618.

· The amounts of cement and mineral admixture used in cementitious material shall be sufficient to satisfy the minimum cementitious material content requirements specified in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and shall conform to the following:

A. The minimum amount of cement shall not be less than 75 percent by mass of the specified minimum cementitious material content;
B. The minimum amount of mineral admixture to be combined with cement shall be determined using one of the following criteria:

1. When the calcium oxide content of a mineral admixture is equal to or less than 2 percent by mass, the amount of mineral admixture shall not be less than 15 percent by mass of the total amount of cementitious material to be used in the mix;
2. When the calcium oxide content of a mineral admixture is greater than 2 percent, the amount of mineral admixture shall not be less than 25 percent by mass of the total amount of cementitious material to be used in the mix;

15. When a mineral admixture that conforms to the provisions for silica fume in Section 90-2.04, "Admixture Materials," is used, the amount of mineral admixture shall not be less than 10 percent by mass of the total amount of cementitious material to be used in the mix;
16. When a mineral admixture is used, which conforms to the provisions for metakaolin in Section 90-2.04, "Admixture Materials," is used, the amount of mineral admixture shall not be less than 10 percent by mass of the total amount of the cementitious material to be used in the mix;
17. When a mineral admixture, which conforms to the provisions for metakaolin in Section 90-2.04, "Admixture Materials," is used in combination with other mineral admixtures, which conforms to the requirements of ASTM Designation: C 618 and to the provisions in Section 90-2.04, the total amount of mineral admixture shall not be less than 20 percent of the total cementitious materials and the amount of metakaolin shall not be less than 5 percent of the total cementitious materials to be used in the mix.

C. The total amount of mineral admixture shall not exceed 35 percent by mass of the total amount of cementitious material to be used in the mix. Where Section 90-1.01, "Description," specifies a maximum cementitious content in kilograms per cubic meter, the total mass of cement and mineral admixture per cubic meter shall not exceed the specified maximum cementitious material content.

90-4.09 BLANK

90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES

· Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ±5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

· Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.

· If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix.

· When automatic proportioning devices are required for concrete pavement, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

· Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.

· Liquid admixtures requiring dosages greater than 2.5 L/m^3 shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

· Special admixtures, such as "high range" water reducers that may contribute to a high rate of slump loss, shall be measured and dispensed as recommended by the admixture manufacturer and as approved by the Engineer.

90-4.11 STORAGE, PROPORTIONING, AND DISPENSING OF MINERAL ADMIXTURES

· Mineral admixtures shall be protected from exposure to moisture until used. Sacked material shall be piled to permit access for tally, inspection and identification for each shipment.

· Adequate facilities shall be provided to assure that mineral admixtures meeting the specified requirements are kept separate from other mineral admixtures in order to prevent any but the specified mineral admixtures from entering the work. Safe and suitable facilities for sampling mineral admixtures shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper.

· Mineral admixtures shall be incorporated into concrete using equipment conforming to the requirements for cement weigh hoppers, and charging and discharging mechanisms in ASTM Designation: C 94, in Section 90-5.03, "Proportioning," and in this Section 90-4.11.

· When concrete is completely mixed in stationary paving mixers, the mineral admixture shall be weighed in a separate weigh hopper conforming to the provisions for cement weigh hoppers and charging and discharging mechanisms in Section 90-5.03A, "Proportioning for Pavement," and the mineral admixture and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the mineral admixture is not weighed in a separate weigh hopper, the Contractor shall provide certification that the stationary mixer is capable of mixing the cement, admixture, aggregates and water uniformly prior to discharge. Certification shall contain the following:

A. Test results for 2 compressive strength test cylinders of concrete taken within the first one-third and 2 compressive strength test cylinders of concrete taken within the last one-third of the concrete discharged from a single batch from the stationary paving mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength;"
B. Calculations demonstrating that the difference in the averages of 2 compressive strengths taken in the first one-third is no greater than 7.5 percent different than the averages of 2 compressive strengths taken in the last one-third of the concrete discharged from a single batch from the stationary paving mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength;" and
C. The mixer rotation speed and time of mixing prior to discharge that are required to produce a mix that meets the requirements above.

90-5 PROPORTIONING

90-5.01 STORAGE OF AGGREGATES

· Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and also that the various sizes shall not become intermixed before proportioning.

· Aggregates shall be stored or stockpiled and handled in a manner that shall prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:

A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

· In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

90-5.02 PROPORTIONING DEVICES

· Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Proportioning for Pavement." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and mineral admixture for one batch of concrete is a single operation of a switch or starter.

· Proportioning devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to ensure their accuracy.

· Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the mass of each batch of material shall not vary from the mass designated by the Engineer by more than the tolerances specified herein.

· Equipment for cumulative weighing of aggregate shall have a zero tolerance of ±0.5 percent of the designated total batch mass of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be ±0.5 percent of the individual batch mass designated for each size of aggregate. Equipment for cumulative weighing of cement and mineral admixtures shall have a zero tolerance of ±0.5 percent of the designated total batch mass of the cement and mineral admixture. Equipment for weighing cement or mineral admixture separately shall have a zero tolerance of ±0.5 percent of their designated individual batch masses. Equipment for measuring water shall have a zero tolerance of ±0.5 percent of its designated mass or volume.

· The mass indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch mass of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch masses; and
B. Cement shall be within 1.0 percent of its designated batch mass. When weighed individually, mineral admixture shall be within 1.0 percent of its designated batch mass. When mineral admixture and cement are permitted to be weighed cumulatively, cement shall be weighed first to within 1.0 percent of its designated batch mass, and the total for cement and mineral admixture shall be within 1.0 percent of the sum of their designated batch masses; and
C. Water shall be within 1.5 percent of its designated mass or volume.

· Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, mineral admixture, or cement plus mineral admixture and aggregates shall not exceed that of commercially available scales having single graduations indicating a mass not exceeding the maximum permissible mass variation above, except that no scale shall be required having a capacity of less than 500 kg, with 0.5-kg graduations.

90-5.03 PROPORTIONING

· Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cement, mineral admixture, and water as provided in these specifications. Aggregates shall be proportioned by mass.

· At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its saturated, surface-dry mass.

· Should separate supplies of aggregate material of the same size group, but of different moisture content or specific gravity or surface characteristics affecting workability, be available at the proportioning plant, withdrawals shall be made from one supply exclusively and the materials therein completely exhausted before starting upon another.

· Bulk "Type IP (MS) Modified" cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer.

· Bulk cement and mineral admixture may be weighed in separate, individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer. If the cement and mineral admixture are weighed cumulatively, the cement shall be weighed first.

· When cement and mineral admixtures are weighed in separate weigh hoppers**,** the weigh systems for the proportioning of the aggregate, the cement, and the mineral admixture shall be individual and distinct from all other weigh systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to constitute an individual and independent material weighing device. The cement and the mineral admixture shall be discharged into the mixer simultaneously with the aggregate.

· The scales and weigh hoppers for bulk weighing cement, mineral admixture, or cement plus mineral admixture shall be separate and distinct from the aggregate weighing equipment.

· For batches with a volume of one cubic meter or more, the batching equipment shall conform to one of the following combinations:

A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
B. Single box and scale indicator for all aggregates.
C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

· In order to check the accuracy of batch masses, the gross mass and tare mass of batch trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined when ordered by the Engineer. The equipment shall be weighed at the Contractor's expense on scales designated by the Engineer.

90-5.03A Proportioning for Pavement

· Aggregates and bulk cement, mineral admixture, and cement plus mineral admixture for use in pavement shall be proportioned by mass by means of automatic proportioning devices of approved type conforming to these specifications.

· The Contractor shall install and maintain in operating condition an electronically actuated moisture meter that will indicate, on a readily visible scale, changes in the moisture content of the fine aggregate as it is batched within a sensitivity of 0.5 percent by mass of the fine aggregate.

· The batching of cement, mineral admixture, or cement plus mineral admixture and aggregate shall be interlocked so that a new batch cannot be started until all weigh hoppers are empty, the proportioning devices are within zero tolerance, and the discharge gates are closed. The interlock shall permit no part of the batch to be discharged until all aggregate hoppers and the cement and mineral admixture hoppers or the cement plus mineral admixture hopper are charged with masses that are within the tolerances specified in Section 90-5.02, "Proportioning Devices."

· When interlocks are required for cement and mineral admixture charging mechanisms and cement and mineral admixtures are weighed cumulatively, their charging mechanisms shall be interlocked to prevent the introduction of mineral admixture until the mass of cement in the cement weigh hopper is within the tolerances specified in Section 90-5.02, "Proportioning Devices."

· The discharge gate on the cement and mineral admixture hoppers or the cement plus mineral admixture hopper shall be designed to permit regulating the flow of cement, mineral admixture, or cement plus mineral admixture into the aggregate as directed by the Engineer.

· When separate weigh boxes are used for each size of aggregate, the discharge gates shall permit regulating the flow of each size of aggregate as directed by the Engineer.

· Material discharged from the several bins shall be controlled by gates or by mechanical conveyors. The means of withdrawal from the several bins, and of discharge from the weigh box, shall be interlocked so that not more than one bin can discharge at a time, and so that the weigh box cannot be tripped until the required quantity from each of the several bins has been deposited therein. Should a separate weigh box be used for each size of aggregate, all may be operated and discharged simultaneously.

· When the discharge from the several bins is controlled by gates, each gate shall be actuated automatically so that the required mass is discharged into the weigh box, after which the gate shall automatically close and lock.

· The automatic weighing system shall be designed so that all proportions required may be set on the weighing controller at the same time.

90-6 MIXING AND TRANSPORTING

90-6.01 GENERAL

· Concrete shall be mixed in mechanically operated mixers, except that when permitted by the Engineer, batches not exceeding 0.25 m^3 may be mixed by hand methods in conformance with the provisions in Section 90-6.05, "Hand-Mixing."

· Equipment having components made of aluminum or magnesium alloys that would have contact with plastic concrete during mixing, transporting, or pumping of portland cement concrete shall not be used.

· Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or evidence of undispersed cement, mineral admixture, or cement plus mineral admixture.

· Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.

· When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 10 mm. When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below. Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 100 kg per cubic meter of concrete.

Average Slump	Maximum Permissible Difference
Less than 100-mm	25-mm
100-mm to 150-mm	38-mm
Greater than 150-mm to 225-mm	50-mm

· The Contractor, at the Contractor's expense, shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

90-6.02 MACHINE MIXING

· Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.

· The temperature of mixed concrete, immediately before placing, shall be not less than 10°C or more than 32°C. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 65°C. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

· The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one - fourth of the specified mixing time.

· Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.

· Paving and stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

· The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.

· The size of batch shall not exceed the manufacturer's guaranteed capacity.

· When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at jobsite batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.

· Concrete shall be mixed and delivered to the jobsite by means of one of the following combinations of operations:

A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in non-agitating hauling equipment (central-mixed concrete).
B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
C. Mixed completely in a truck mixer (transit-mixed concrete).
D. Mixed completely in a paving mixer.

· Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

· Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.

· When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed shall be allowed for partial mixing in a central plant.

90-6.03 TRANSPORTING MIXED CONCRETE

· Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."

· Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

· Bodies of non-agitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.

· Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 24°C.

· No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer. If the Engineer authorizes additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

· The rate of discharge of mixed concrete from truck mixer-agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

· When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C or above, the time allowed may be less than 1.5 hours.

· When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

· Each load of concrete delivered at the jobsite shall be accompanied by a weighmaster certificate showing the mix identification number, non-repeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale masses (kilograms) for the ingredients batched. Theoretical or target batch masses shall not be used as a substitute for actual scale masses.

· Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a 90 mm diskette with a capacity of at least 1.4 megabytes. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.

· The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch masses or measurements for a load of concrete provided that both certificates are imprinted with the same non-repeating load number that is unique to the contract and delivered to the jobsite with the load.

· Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

90-6.04 TIME OR AMOUNT OF MIXING

· Mixing of concrete in paving or stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.

· The required mixing time, in paving or stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes, except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

· The required mixing time, in paving or stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

· The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

90-6.05 HAND-MIXING

· Hand-mixed concrete shall be made in batches of not more than 0.25 m^3 and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than 0.3 meters in total depth. On this mixture shall be spread the dry cement and mineral admixture and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

90-6.06 AMOUNT OF WATER AND PENETRATION

· The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the "Nominal" values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. When Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 225 mm after the chemical admixtures are added.

Type of Work	Nominal		Maximum	
	Penetration (mm)	Slump (mm)	Penetration (mm)	Slump (mm)
Concrete Pavement	0-25	—	40	—
Non-reinforced concrete facilities	0-35	—	50	—
Reinforced concrete structures				
Sections over 300-mm thick	0-35	—	65	—
Sections 300-mm thick or less	0-50	—	75	—
Concrete placed under water	—	150-200	—	225
Cast-in-place concrete piles	65-90	130-180	100	200

· The amount of free water used in concrete shall not exceed 183 kg/m^3, plus 20 kg for each required 100 kg of cementitious material in excess of 325 kg/m^3.· The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.

· Where there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic meter of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 kg of water per added 100 kg of cementitious material per cubic meter. The cost of additional cementitious material and water added under these conditions shall be at the Contractor's expense and no additional compensation will be allowed therefor.

· The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

90-7 CURING CONCRETE

90-7.01 METHODS OF CURING

· Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the special provisions.

90-7.01A Water Method

· The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.

· When a curing medium consisting of cotton mats, rugs, carpets, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing mediums.

· When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified in the preceding paragraph, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

90-7.01B Curing Compound Method

· Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

· Curing compounds to be used shall be as follows:

1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.
2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
4. Non-pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
5. Non-pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
6. Non-pigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

· The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.

· The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.15-kg/m^2 in 24 hours or more than 0.45-kg/m^2 in 72 hours.

· The curing compound to be used will be specified elsewhere in these specifications or in the special provisions.

· When the use of curing compound is required or permitted elsewhere in these specifications or in the special provisions and no specific kind is specified, any of the curing compounds listed above may be used.

· Curing compound shall be applied at a nominal rate of 3.7 m^2/L, unless otherwise specified.

· At any point, the application rate shall be within ±1.2 m^2/L of the nominal rate specified, and the average application rate shall be within ±0.5 m^2/L of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

· Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

· The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

· At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

· Agitation shall not introduce air or other foreign substance into the curing compound.

· The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

· Curing compounds shall remain sprayable at temperatures above 4°C and shall not be diluted or altered after manufacture.

· The curing compound shall be packaged in clean 210-L barrels or round 19-L containers or shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 210-L barrels shall have removable lids and airtight fasteners. The 19-L containers shall be round and have standard full open head and bail. Lids with bungholes shall not be permitted. On-site storage tanks shall be kept clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.

· Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.

· Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State of California.

· Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State of California.

· When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

· Curing compound will be sampled by the Engineer at the source of supply or at the jobsite or at both locations.

· Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.

· Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

90-7.01C Waterproof Membrane Method

· The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

· Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.

· The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 100 mm.

· The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

· Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

· Sections of membrane that have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

90-7.01D Forms-In-Place Method

· Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 0.5-m in least dimension the forms shall remain in place for a minimum period of 5 days.

· Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

90-7.02 CURING PAVEMENT

· The entire exposed area of the pavement, including edges, shall be cured by the waterproof membrane method, or curing compound method using curing compound (1) or (2) as the Contractor may elect. Should the side forms be removed before the expiration of 72 hours following the start of curing, the exposed pavement edges shall also be cured. If the pavement is cured by means of the curing compound method, the sawcut and all portions of the curing compound that have been disturbed by sawing operations shall be restored by spraying with additional curing compound.

· Curing shall commence as soon as the finishing process provided in Section 40-1.10, "Final Finishing," has been completed. The method selected shall conform to the provisions in Section 90-7.01, "Methods of Curing."

· When the curing compound method is used, the compound shall be applied to the entire pavement surface by mechanical sprayers. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator that provides for continual agitation of the curing compound during the time of application. The spray shall be adequately protected against wind, and the nozzles shall be so oriented or moved mechanically transversely as to result in the minimum specified rate of coverage being applied uniformly on exposed faces. Hand spraying of small and irregular areas, and areas inaccessible to mechanical spraying equipment, in the opinion of the Engineer, will be permitted. When the ambient air temperature is above 15°C, the Contractor shall fog the surface of the concrete with a fine spray of water as specified in Section 90-7.01A, "Water Method." The surface of the pavement shall be kept moist between the hours of 10:00 a.m. and 4:30 p.m. on the day the concrete is placed. However, the fogging done after the curing compound has been applied shall not begin until the compound has set sufficiently to prevent displacement. Fogging shall be discontinued if ordered in writing by the Engineer.

90-7.03 CURING STRUCTURES

· Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."

· The curing compound method using a pigmented curing compound may be used on concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only Ordinary Surface Finish is to be applied and on which a uniform color is not required and that will not be visible from a public traveled way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

· The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1). The curing compound shall be applied progressively during the deck finishing operations immediately after finishing operations are completed on each individual portion of the deck. The water cure shall be applied not later than 4 hours after completion of deck finishing or, for portions of the decks on which finishing is completed after normal working hours, the water cure shall be applied not later than the following morning.

· Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.

· When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

90-7.04 CURING PRECAST CONCRETE MEMBERS

· Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 10°C, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 10°C and 32°C.
B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.
C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.

D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 22°C per hour. The curing temperature throughout the enclosure shall not exceed 65°C and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.
E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 60 m of continuous bed length will be required for checking temperature.
F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 15°C until the stress is transferred to the concrete.
G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

90-7.05 CURING PRECAST PRESTRESSED CONCRETE PILES

· Newly placed concrete for precast prestressed concrete piles shall be cured in conformance with the provisions in Section 90-7.04, "Curing Precast Concrete Members," except that piles with a class designation ending in C (corrosion resistant) shall be cured as follows:

A. Piles shall be either steam cured or water cured. If water curing is used, the piles shall be kept continuously wet by the application of water in conformance with the provisions in Section 90-7.01A, "Water Method."
B. If steam curing is used, the steam curing provisions in Section 90-7.04, "Curing Precast Concrete Members," shall apply except that the piles shall be kept continuously wet for their entire length for a period of not less than 3 days, including the holding and steam curing periods.

90-7.06 CURING SLOPE PROTECTION

· Concrete slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

· Concreted-rock slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing," or with a blanket of earth kept wet for 72 hours, or by sprinkling with a fine spray of water every 2 hours during the daytime for a period of 3 days.

90-7.07 CURING MISCELLANEOUS CONCRETE WORK

· Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."

· Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

· Shotcrete shall be cured for at least 72 hours by spraying with water, or by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

· Mortar and grout shall be cured by keeping the surface damp for 3 days.

· After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, or by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

90-8 PROTECTING CONCRETE

90-8.01 GENERAL

· In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8.

· Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.

· Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to damage surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.

· Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

90-8.02 PROTECTING CONCRETE STRUCTURES

· Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 7°C for 72 hours after placing and at not less than 4°C for an additional 4 days. When required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

90-8.03 PROTECTING CONCRETE PAVEMENT

· Pavement concrete shall be maintained at a temperature of not less than 4°C for 72 hours. When required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

· Except as provided in Section 7-1.08, "Public Convenience," the Contractor shall protect concrete pavement against construction and other activities that abrade, scar, discolor, reduce texture depth, lower coefficient of friction, or otherwise damage the surface. Stockpiling, drifting, or excessive spillage of soil, gravel, petroleum products, and concrete or asphalt mixes on the surface of concrete pavement is prohibited unless otherwise specified in these specifications, the special provisions or permitted by the Engineer.

· When ordered by the Engineer or shown on the plans or specified in the special provisions, pavement crossings shall be constructed for the convenience of public traffic. The material and work necessary for the construction of the crossings, and their subsequent removal and disposal, will be paid for at the contract unit prices for the items of work involved and if there are no contract items for the work involved, payment for pavement crossings will be made by extra work as provided in Section 4-1.03D, "Extra Work.". Where public traffic will be required to cross over the new pavement, Type III portland cement may be used in concrete, if permitted in writing by the Engineer. The pavement may be opened to traffic as soon as the concrete has developed a modulus of rupture of 3.8 MPa. The modulus of rupture will be determined by California Test 523.

· No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement before a period of 10 days has elapsed after the concrete has been placed, nor before the concrete has developed a modulus of rupture of at least 3.8 MPa. Concrete that fails to attain a modulus of rupture of 3.8 MPa within 10 days shall not be opened to traffic until directed by the Engineer.

· Equipment for sawing weakened plane joints will be permitted on the pavement as specified in Section 40-1.08B, "Weakened Plane Joints."

· When requested in writing by the Contractor, the tracks on one side of paving equipment will be permitted on the pavement after a modulus of rupture of 2.4 MPa has been attained, provided that:

A. Unit pressure exerted on the pavement by the paver shall not exceed 135 kPa;
B. Tracks with cleats, grousers, or similar protuberances shall be modified or shall travel on planks or equivalent protective material, so that the pavement is not damaged; and
C. No part of the track shall be closer than 0.3-m from the edge of pavement.

· In case of visible cracking of, or other damage to the pavement, operation of the paving equipment on the pavement shall be immediately discontinued.

· Damage to the pavement resulting from early use of pavement by the Contractor's equipment as provided above shall be repaired by the Contractor at the Contractor's expense.

· The State will furnish the molds and machines for testing the concrete for modulus of rupture, and the Contractor, at the Contractor's expense, shall furnish the material and whatever labor the Engineer may require.

90-9 COMPRESSIVE STRENGTH

90-9.01 GENERAL

· Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated by strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the special provisions or are shown on the plans.

· The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of ASTM Designation: C 172. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of ASTM Designation: C 39. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

· When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.

· When concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall, at the Contractor's expense, make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State $14 for each in-place cubic meter of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State $20 for each in place cubic meter of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."

· If the test result indicates that the compressive strength at the maximum curing age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum curing age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the concrete placed in the work are acceptable. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

· No single compressive strength test shall represent more than 250 m^3.

· When a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. When the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.

· When concrete is specified by compressive strength, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.

· Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of cure days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.

· Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 4 MPa greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.

· Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.

· The certified test data and trial batch test reports shall include the following information:

A. Date of mixing.

B. Mixing equipment and procedures used.
C. The size of batch in cubic meters and the mass, type, and source of all ingredients used.
D. Penetration of the concrete.
E. The air content of the concrete if an air-entraining admixture is used.
F. The age at time of testing and strength of all concrete cylinders tested.

· Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.

· When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type or class of concrete required at that location.

· After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.

· The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

· When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

90-10 MINOR CONCRETE

90-10.01 GENERAL

· Concrete for minor structures, slope paving, curbs, sidewalks and other concrete work, when designated as minor concrete on the plans, in the specifications, or in the contract item, shall conform to the provisions specified herein.

· The Engineer, at the Engineer's discretion, will inspect and test the facilities, materials and methods for producing the concrete to ensure that minor concrete of the quality suitable for use in the work is obtained.

90-10.02 MATERIALS

· Minor concrete shall conform to the following requirements:

90-10.02A Cementitious Material

· Cementitious material shall conform to the provisions in Section 90-1.01, "Description."

90-10.02B Aggregate

· Aggregate shall be clean and free from deleterious coatings, clay balls, roots, and other extraneous materials.

· The Contractor shall submit to the Engineer for approval, a grading of the combined aggregate proposed for use in the minor concrete. After acceptance of the grading, aggregate furnished for minor concrete shall conform to that grading, unless a change is authorized in writing by the Engineer.

· The Engineer may require the Contractor to furnish periodic test reports of the aggregate grading furnished. The maximum size of aggregate used shall be at the option of the Contractor, but in no case shall the maximum size be larger than 37.5 mm or smaller than 19 mm.

· The Engineer may waive, in writing, the gradation requirements in this Section 90-10.02B, if, in the Engineer's opinion, the furnishing of the gradation is not necessary for the type or amount of concrete work to be constructed.

90-10.02C Water

· Water used for washing, mixing, and curing shall be free from oil, salts, and other impurities that would discolor or etch the surface or have an adverse affect on the quality of the concrete.

90-10.02D Admixtures

· The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures."

90-10.03 PRODUCTION

· Cementitious material, water, aggregate, and admixtures shall be stored, proportioned, mixed, transported, and discharged in conformance with recognized standards of good practice that will result in concrete that is thoroughly and uniformly mixed, that is suitable for the use intended, and that conforms to requirements specified herein. Recognized

standards of good practice are outlined in various industry publications such as are issued by American Concrete Institute, AASHTO, or the Department.

· The cementitious material content of minor concrete shall conform to the provisions in Section 90-1.01, "Description."

· The amount of water used shall result in a consistency of concrete conforming to the provisions in Section 90-6.06, "Amount of Water and Penetration." Additional mixing water shall not be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer.

· Discharge of ready-mixed concrete from the transporting vehicle shall be made while the concrete is still plastic and before stiffening occurs. An elapsed time of 1.5 hours (one hour in non-agitating hauling equipment), or more than 250 revolutions of the drum or blades, after the introduction of the cementitious material to the aggregates, or a temperature of concrete of more than 32°C will be considered conditions contributing to the quick stiffening of concrete. The Contractor shall take whatever action is necessary to eliminate quick stiffening, except that the addition of water will not be permitted.

· The required mixing time in stationary mixers shall be not less than 50 seconds or more than 5 minutes.

· The minimum required revolutions at mixing speed for transit-mixed concrete shall be not less than that recommended by the mixer manufacturer, and shall be increased, if necessary, to produce thoroughly and uniformly mixed concrete.

· Each load of ready-mixed concrete shall be accompanied by a weighmaster certificate that shall be delivered to the Engineer at the discharge location of the concrete, unless otherwise directed by the Engineer. The weighmaster certificate shall be clearly marked with the date and time of day when the load left the batching plant and, if hauled in truck mixers or agitators, the time the mixing cycle started.

· A Certificate of Compliance conforming to the provisions in Section 6–1.07, "Certificates of Compliance," shall be furnished to the Engineer, prior to placing minor concrete from a source not previously used on the contract, stating that minor concrete to be furnished meets contract requirements, including minimum cementitious material content specified.

90-10.04 CURING MINOR CONCRETE

· Curing minor concrete shall conform to the provisions in Section 90-7, "Curing Concrete."

90-10.05 PROTECTING MINOR CONCRETE

· Protecting minor concrete shall conform to the provisions in Section 90-8, "Protecting Concrete," except the concrete shall be maintained at a temperature of not less than 4°C for 72 hours after placing.

90-10.06 MEASUREMENT AND PAYMENT

· Minor concrete will be measured and paid for in conformance with the provisions specified in the various sections of these specifications covering concrete construction when minor concrete is specified in the specifications, shown on the plans, or indicated by contract item in the Engineer's Estimate.

90-11 MEASUREMENT AND PAYMENT

90-11.01 MEASUREMENT

· Portland cement concrete will be measured in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

· When it is provided that concrete will be measured at the mixer, the volume in cubic meters shall be computed as the total mass of the batch in kilograms divided by the density of the concrete in kilograms per cubic meter. The total mass of the batch shall be calculated as the sum of all materials, including water, entering the batch. The density of the concrete will be determined in conformance with the requirements in California Test 518.

90-11.02 PAYMENT

· Portland cement concrete will be paid for in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

· Full compensation for furnishing and incorporating admixtures required by these specifications or the special provisions will be considered as included in the contract prices paid for the concrete involved and no additional compensation will be allowed therefor.

· Should the Engineer order the Contractor to incorporate any admixtures in the concrete when their use is not required by these specifications or the special provisions, furnishing the admixtures and adding them to the concrete will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

· Should the Contractor use admixtures in conformance with the provisions in Section 90-4.05, "Optional Use of Chemical Admixtures," or Section 90-4.07, "Optional Use of Air-entraining Admixtures," or should the Contractor request and obtain permission to use other admixtures for the Contractor's benefit, the Contractor shall furnish those admixtures and incorporate them into the concrete at the Contractor's expense and no additional compensation will be allowed therefor.

SECTION 12. (BLANK)

SECTION 13. (BLANK)

SECTION 14 FEDERAL REQUIREMENTS FOR FEDERAL-AID CONSTRUCTION PROJECTS

GENERAL.—The work herein proposed will be financed in whole or in part with Federal funds, and therefore all of the statutes, rules and regulations promulgated by the Federal Government and applicable to work financed in whole or in part with Federal funds will apply to such work. The "Required Contract Provisions, Federal-Aid Construction Contracts, "Form FHWA 1273, are included in this Section 14. Whenever in said required contract provisions references are made to "SHA contracting officer", "SHA resident engineer", or "authorized representative of the SHA", such references shall be construed to mean "Engineer" as defined in Section 1-1.18 of the Standard Specifications.

PERFORMANCE OF PREVIOUS CONTRACT.—In addition to the provisions in Section II, "Nondiscrimination," and Section VII, "Subletting or Assigning the Contract," of the required contract provisions, the Contractor shall comply with the following:

The bidder shall execute the CERTIFICATION WITH REGARD TO THE PERFORMANCE OF PREVIOUS CONTRACTS OR SUBCONTRACTS SUBJECT TO THE EQUAL OPPORTUNITY CLAUSE AND THE FILING OF REQUIRED REPORTS located in the proposal. No request for subletting or assigning any portion of the contract in excess of $10,000 will be considered under the provisions of Section VII of the required contract provisions unless such request is accompanied by the CERTIFICATION referred to above, executed by the proposed subcontractor.

NON-COLLUSION PROVISION.—The provisions in this section are applicable to all contracts except contracts for Federal Aid Secondary projects.

Title 23, United States Code, Section 112, requires as a condition precedent to approval by the Federal Highway Administrator of the contract for this work that each bidder file a sworn statement executed by, or on behalf of, the person, firm, association, or corporation to whom such contract is to be awarded, certifying that such person, firm, association, or corporation has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the submitted bid. A form to make the non-collusion affidavit statement required by Section 112 as a certification under penalty of perjury rather than as a sworn statement as permitted by 28, USC, Sec. 1746, is included in the proposal.

PARTICIPATION BY MINORITY BUSINESS ENTERPRISES IN SUBCONTRACTING.—Part 23, Title 49, Code of Federal Regulations applies to this Federal-aid project. Pertinent sections of said Code are incorporated in part or in its entirety within other sections of these special provisions.

Schedule B—Information for Determining Joint Venture Eligibility

(This form need not be filled in if all joint venture firms are minority owned.)

1. Name of joint venture _____
2. Address of joint venture _____
3. Phone number of joint venture _____
4. Identify the firms which comprise the joint venture. (The MBE partner must complete Schedule A.) _____
   _____

   a. Describe the role of the MBE firm in the joint venture. _____
      _____
   b. Describe very briefly the experience and business qualifications of each non-MBE joint venturer: _____
      _____

5. Nature of the joint venture's business _____
   _____
6. Provide a copy of the joint venture agreement.
7. What is the claimed percentage of MBE ownership? _____
8. Ownership of joint venture: (This need not be filled in if described in the joint venture agreement, provided by question 6.).

   a. Profit and loss sharing.
   b. Capital contributions, including equipment.

c. Other applicable ownership interests.

9. Control of and participation in this contract. Identify by name, race, sex, and "firm" those individuals (and their titles) who are responsible for day-to-day management and policy decision making, including, but not limited to, those with prime responsibility for:

a. Financial decisions _____

b. Management decisions, such as:

(1) Estimating _____

(2). Marketing and sales _____

(3). Hiring and firing of management personnel _____

_____

(4) Purchasing of major items or supplies _____

_____

c. Supervision of field operations _____

Note.—If, after filing this Schedule B and before the completion of the joint venture's work on the contract covered by this regulation, there is any significant change in the information submitted, the joint venture must inform the grantee, either directly or through the prime contractor if the joint venture is a subcontractor.

Affidavit

"The undersigned swear that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operation of our joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned covenant and agree to provide to grantee current, complete and accurate information regarding actual joint venture work and the payment therefor and any proposed changes in any of the joint venture arrangements and to permit the audit and examination of the books, records and files of the joint venture, or those of each joint venturer relevant to the joint venture, by authorized representatives of the grantee or the Federal funding agency. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statements."

Name of Firm	Name of Firm
Signature	Signature
Name	Name
Title	Title
Date	Date

Date _____

State of _____

County of _____

On this ____ day of _____, 19 __, before me appeared (Name) _____, to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (Name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission expires _____

[Seal]

Date _____

State of _____

County of _____

On this ___ day of _____, 19 __, before me appeared (Name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (Name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission expires _____

[Seal]

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. These contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

2. Except as otherwise provided for in each section, the contractor shall insert in each subcontract all of the stipulations contained in these Required Contract Provisions, and further require their inclusion in any lower tier subcontract or purchase order that may in turn be made. The Required Contract Provisions shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with these Required Contract Provisions.

3. A breach of any of the stipulations contained in these Required Contract Provisions shall be sufficient grounds for termination of the contract.

4. A breach of the following clauses of the Required Contract Provisions may also be grounds for debarment as provided in 29 CFR 5.12:

   Section I, paragraph 2;
   Section IV, paragraphs 1, 2, 3, 4, and 7;
   Section V, paragraphs 1 and 2a through 2g.

5. Disputes arising out of the labor standards provisions of Section IV (except paragraph 5) and Section V of these Required Contract Provisions shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor (DOL) as set forth in 29 CFR 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the DOL, or the contractor's employees or their representatives.

6. **Selection of Labor:** During the performance of this contract, the contractor shall not:

   a. discriminate against labor from any other State, possession, or territory of the United States (except for employment preference for Appalachian contracts, when applicable, as specified in Attachment A), or

   b. employ convict labor for any purpose within the limits of the project unless it is labor performed by convicts who are on parole, supervised release, or probation.

II. NONDISCRIMINATION

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, and 41 CFR 60) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The Equal Opportunity Construction Contract Specifications set forth under 41 CFR 60-4.3 and the provisions of the American Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

   a. The contractor will work with the State highway agency (SHA) and the Federal Government in carrying out EEO obligations and in their review of his/her activities under the contract.

   b. The contractor will accept as his operating policy the following statement:

   "It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall

include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, preapprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the SHA contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of EEO and who must be assigned adequate authority and responsibility to do so.

3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

   a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

   b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

   c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minority group employees.

   d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

   e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. **Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.

   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with EEO contract provisions. (The DOL has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended.)

   c. The contractor will encourage his present employees to refer minority group applicants for employment. Information and procedures with regard to referring minority group applicants will be discussed with employees.

5. **Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

   a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

7. **Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

a. The contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

b. The contractor will use best efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the SHA and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The DOL has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the SHA.

8. **Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

   a. The contractor shall notify all potential subcontractors and suppliers of his/her EEO obligations under this contract.

   b. Disadvantaged business enterprises (DBE), as defined in 49 CFR 23, shall have equal opportunity to compete for and perform subcontracts which the contractor enters into pursuant to this contract. The contractor will use his best efforts to solicit bids from and to utilize DBE subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of DBE construction firms from SHA personnel.

   c. The contractor will use his best efforts to ensure subcontractor compliance with their EEO obligations.

9. **Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the SHA and the FHWA.

   a. The records kept by the contractor shall document the following:

      (1) The number of minority and non-minority group members and women employed in each work classification on the project;

      (2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women;

      (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees; and

      (4) The progress and efforts being made in securing the services of DBE subcontractors or subcontractors with meaningful minority and female representation among their employees.

   b. The contractors will submit an annual report to the SHA each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.

III. NONSEGREGATED FACILITIES

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

a. By submission of this bid, the execution of this contract or subcontract, or the consummation of this material supply agreement or purchase order, as appropriate, the bidder, Federal-aid construction contractor, subcontractor, material supplier, or vendor, as appropriate, certifies that the firm does not maintain or provide for its employees any segregated facilities at any of its establishments, and that the firm does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The firm agrees that a breach of this certification is a violation of the EEO provisions of this contract. The firm further certifies that no employee will be denied access to adequate facilities on the basis of sex or disability.

b. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are, in fact, segregated on the basis of race, color, religion, national origin, age or disability, because of habit, local custom, or otherwise. The only exception will be for the disabled when the demands for accessibility override (e.g. disabled parking).

c. The contractor agrees that it has obtained or will obtain identical certification from proposed subcontractors or material suppliers prior to award of subcontracts or consummation of material supply agreements of $10,000 or more and that it will retain such certifications in its files.

IV. PAYMENT OF PREDETERMINED MINIMUM WAGE

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural minor collectors, which are exempt.)

1. General:

a. All mechanics and laborers employed or working upon the site of the work will be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account [except such payroll deductions as are permitted by regulations (29 CFR 3)] issued by the Secretary of Labor under the Copeland Act (40 U.S.C. 276c) the full amounts of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment. The payment shall be computed at wage rates not less than those contained in the wage determination of the Secretary of Labor (hereinafter "the wage determination") which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor or its subcontractors and such laborers and mechanics. The wage determination (including any additional classifications and wage rates conformed under paragraph 2 of this Section IV and the DOL poster (WH-1321) or Form FHWA-1495) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. For the purpose of this Section, contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act (40 U.S.C. 276a) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section IV, paragraph 3b, hereof. Also, for the purpose of this Section, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in paragraphs 4 and 5 of this Section IV.

b. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.

c. All rulings and interpretations of the Davis-Bacon Act and related acts contained in 29 CFR 1, 3, and 5 are herein incorporated by reference in this contract.

2. Classification:

a. The SHA contracting officer shall require that any class of laborers or mechanics employed under the contract, which is not listed in the wage determination, shall be classified in conformance with the wage determination.

b. The contracting officer shall approve an additional classification, wage rate and fringe benefits only when the following criteria have been met:

(1) the work to be performed by the additional classification requested is not performed by a classification in the wage determination;

(2) the additional classification is utilized in the area by the construction industry;

(3) the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) with respect to helpers, when such a classification prevails in the area in which the work is performed.

c. If the contractor or subcontractors, as appropriate, the laborers and mechanics (if known) to be employed in the additional classification or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the DOL, Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, D.C. 20210. The Wage and Hour Administrator, or an authorized

representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

d. In the event the contractor or subcontractors, as appropriate, the laborers or mechanics to be employed in the additional classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. Said Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary

e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 2c or 2d of this Section IV shall be paid to all workers performing work in the additional classification from the first day on which work is performed in the classification.

3. Payment of Fringe Benefits:

a. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor or subcontractors, as appropriate, shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly case equivalent thereof.

b. If the contractor or subcontractor, as appropriate, does not make payments to a trustee or other third person, he/she may consider as a part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

4. Apprentices and Trainees (Programs of the U.S. DOL) and Helpers:

a. Apprentices:

(1) Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the DOL, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or if a person is employed in his/her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State apprenticeship agency (where appropriate) to be eligible for probationary employment as an apprentice.

(2) The allowable ratio of apprentices to journeyman-level employees on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate listed in the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor or subcontractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman-level hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

(3) Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator for the Wage and Hour Division determines that a different

practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

(4) In the event the Bureau of Apprenticeship and Training, or a State apprenticeship agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor or subcontractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the comparable work performed by regular employees until an acceptable program is approved.

b. Trainees:

(1) Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the DOL, Employment and Training Administration.

(2) The ratio of trainees to journeyman-level employees on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(3) Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman-level wage rate on the wage determination which provides for less than full fringe benefits for apprentices, in which case such trainees shall receive the same fringe benefits as apprentices.

(4) In the event the Employment and Training Administration withdraws approval of a training program, the contractor or subcontractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Helpers**:**

Helpers will be permitted to work on a project if the helper classification is specified and defined on the applicable wage determination or is approved pursuant to the conformance procedure set forth in Section IV.2. Any worker listed on a payroll at a helper wage rate, who is not a helper under an approved definition, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

5. Apprentices and Trainees (Programs of the U.S. DOT):

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

6. Withholding:

The SHA shall upon its own action or upon written request of an authorized representative of the DOL withhold, or cause to be withheld, from the contractor or subcontractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements which is held by the same prime contractor, as much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or

part of the wages required by the contract, the SHA contracting officer may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

7. **Overtime Requirements:**
No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen, or guards (including apprentices, trainees, and helpers described in paragraphs 4 and 5 above) shall require or permit any laborer, mechanic, watchman, or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman, or guard receives compensation at a rate not less than one-and-one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

8. **Violation:**
Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in paragraph 7 above, the contractor and any subcontractor responsible thereof shall be liable to the affected employee for his/her unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman, or guard employed in violation of the clause set forth in paragraph 7, in the sum of $10 for each calendar day on which such employee was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in paragraph 7.

9. **Withholding for Unpaid Wages and Liquidated Damages:**
The SHA shall upon its own action or upon written request of any authorized representative of the DOL withhold, or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 8 above.

V. STATEMENTS AND PAYROLLS

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural collectors, which are exempt.)

1. Compliance with Copeland Regulations (29 CFR 3):

   The contractor shall comply with the Copeland Regulations of the Secretary of Labor which are herein incorporated by reference.

2. Payrolls and Payroll Records:

   a. Payrolls and basic records relating thereto shall be maintained by the contractor and each subcontractor during the course of the work and preserved for a period of 3 years from the date of completion of the contract for all laborers, mechanics, apprentices, trainees, watchmen, helpers, and guards working at the site of the work.

   b. The payroll records shall contain the name, social security number, and address of each such employee; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalent thereof the types described in Section 1(b)(2)(B) of the Davis Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. In addition, for Appalachian contracts, the payroll records shall contain a notation indicating whether the employee does, or does not, normally reside in the labor area as defined in Attachment A, paragraph 1. Whenever the Secretary of Labor, pursuant to Section IV, paragraph 3b, has found that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis Bacon Act, the contractor and each subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, that the plan or program has been communicated in writing to the laborers or mechanics affected, and show the cost anticipated or the actual cost incurred in providing benefits. Contractors or subcontractors employing

apprentices or trainees under approved programs shall maintain written evidence of the registration of apprentices and trainees, and ratios and wage rates prescribed in the applicable programs.

c. Each contractor and subcontractor shall furnish, each week in which any contract work is performed, to the SHA resident engineer a payroll of wages paid each of its employees (including apprentices, trainees, and helpers, described in Section IV, paragraphs 4 and 5, and watchmen and guards engaged on work during the preceding weekly payroll period). The payroll submitted shall set out accurately and completely all of the information required to be maintained under paragraph 2b of this Section V. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal stock number 029-005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

d. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his/her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) that the payroll for the payroll period contains the information required to be maintained under paragraph 2b of this Section V and that such information is correct and complete;

(2) that such laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR 3;

(3) that each laborer or mechanic has been paid not less that the applicable wage rate and fringe benefits or cash equivalent for the classification of worked performed, as specified in the applicable wage determination incorporated into the contract.

e. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 2d of this Section V.

f. The falsification of any of the above certifications may subject the contractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

g. The contractor or subcontractor shall make the records required under paragraph 2b of this Section V available for inspection, copying, or transcription by authorized representatives of the SHA, the FHWA, or the DOL, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the SHA, the FHWA, the DOL, or all may, after written notice to the contractor, sponsor, applicant, or owner, take such actions as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

VI. RECORD OF MATERIALS, SUPPLIES, AND LABOR

1. On all Federal-aid contracts on the National Highway System, except those which provide solely for the installation of protective devices at railroad grade crossings, those which are constructed on a force account or direct labor basis, highway beautification contracts, and contracts for which the total final construction cost for roadway and bridge is less than $1,000,000 (23 CFR 635) the contractor shall:

a. Become familiar with the list of specific materials and supplies contained in Form FHWA-47, "Statement of Materials and Labor Used by Contractor of Highway Construction Involving Federal Funds," prior to the commencement of work under this contract.

b. Maintain a record of the total cost of all materials and supplies purchased for and incorporated in the work, and also of the quantities of those specific materials and supplies listed on Form FHWA-47, and in the units shown on Form FHWA-47.

c. Furnish, upon the completion of the contract, to the SHA resident engineer on Form FHWA-47 together with the data required in paragraph 1b relative to materials and supplies, a final labor summary of all contract work indicating the total hours worked and the total amount earned.

2. At the prime contractor's option, either a single report covering all contract work or separate reports for the contractor and for each subcontract shall be submitted.

VII. SUBLETTING OR ASSIGNING THE CONTRACT

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the State. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635).

   a. "Its own organization" shall be construed to include only workers employed and paid directly by the prime contractor and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor, assignee, or agent of the prime contractor.

   b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph 1 of Section VII is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the SHA contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the SHA contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the SHA has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

VIII. SAFETY: ACCIDENT PREVENTION

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the SHA contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

Notice To All Personnel Engaged On Federal-Aid Highway Projects

18 U.S.C. 1020 READS AS FOLLOWS:

"Whoever being an officer, agent, or employee of the United States, or any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined not more that $10,000 or imprisoned not more than 5 years or both."

X. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $100,000 or more.)

By submission of this bid or the execution of this contract, or subcontract, as appropriate, the bidder, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any facility that is or will be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Pub.L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Pub.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR 15) is not listed, on the date of contract award, on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.

2. That the firm agrees to comply and remain in compliance with all the requirements of Section 114 of the Clean Air Act and Section 308 of the Federal Water Pollution Control Act and all regulations and guidelines listed thereunder.

3. That the firm shall promptly notify the SHA of the receipt of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility that is or will be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

4. That the firm agrees to include or cause to be included the requirements of paragraph 1 through 4 of this Section X in every nonexempt subcontract, and further agrees to take such action as the government may direct as a means of enforcing such requirements.

XI. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

1. Instructions for Certification - Primary Covered Transactions:

(Applicable to all Federal-aid contracts - 49 CFR 29)

a. By signing and submitting this proposal, the prospective primary participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective primary participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

d. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if any time the prospective primary participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department or agency to which this proposal is submitted for assistance in obtaining a copy of those regulations.

f. The prospective primary participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective primary participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the nonprocurement portion of the "Lists of Parties Excluded From Federal Procurement or Nonprocurement Programs" (Nonprocurement List) which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph f of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion — Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

b. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph 1b of this certification; and

d. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Covered Transactions:

(Applicable to all subcontracts, purchase orders and other lower tier transactions of $25,000 or more - 49 CFR 29)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "primary covered transaction," "participant," "person," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is

not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion — Lower Tier Covered Transactions

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

XII. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

(Applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 - 49 CFR 20)

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

   a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

   b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

FEDERAL-AID FEMALE AND MINORITY GOALS

In accordance with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-aid Construction Contracts" the following are the goals for female utilization:

Goal for Women (applies nationwide).....(percent) 6.9

The following are goals for minority utilization:

CALIFORNIA ECONOMIC AREA

		Goal (Percent)
174	**Redding, CA:**	
	Non-SMSA Counties	6.8
	CA Lassen; CA Modoc;CA Plumas;CA Shasta; CA Siskiyou; CA Tehama.	
175	**Eureka, CA**	
	Non-SMSA Counties	6.6
	CA Del Norte; CA Humboldt; CA Trinity.	
176	**San Francisco-Oakland-San Jose, CA:**	
	SMSA Counties:	
	7120 Salinas-Seaside-Monterey, CA	28.9
	CA Monterey.	
	7360 San Francisco-Oakland	25.6
	CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo.	
	7400 San Jose, CA	19.6
	CA Santa Clara.	
	7485 Santa Cruz, CA.	14.9
	CA Santa Cruz.	
	7500 Santa Rosa, CA	9.1
	CA Sonoma.	
	8720 Vallejo-Fairfield- Napa, CA	17.1
	CA Napa; CA Solano	
	Non-SMSA Counties	23.2
	CA Lake; CA Mendocino; CA San Benito	
177	**Sacramento, CA**:	
	SMSA Counties:	
	6920 Sacramento, CA	16.1
	CA Placer; CA Sacramento; CA Yolo.	
	Non-SMSA Counties	14.3
	CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba.	
178	**Stockton-Modesto, CA:**	
	SMSA Counties:	
	5170 Modesto, CA	12.3
	CA Stanislaus.	
	8120 Stockton, CA	24.3
	CA San Joaquin.	
	Non-SMSA Counties	19.8
	CA Alpine; CA Amador; CA Calaveras; CA Mariposa;CA Merced; CA Tuolumne.	

		Goal (Percent)
179	**Fresno-Bakersfield, CA**	
	SMSA Counties:	
	0680 Bakersfield, CA	19.1
	CA Kern.	
	2840 Fresno, CA	26.1
	CA Fresno.	
	Non-SMSA Counties	23.6
	CA Kings; CA Madera; CA Tulare.	
180	**Los Angeles, CA:**	
	SMSA Counties:	
	0360 Anaheim-Santa Ana-Garden Grove, CA	11.9
	CA Orange.	
	4480 Los Angeles-Long Beach, CA	28.3
	CA Los Angeles.	
	6000 Oxnard-Simi Valley-Ventura, CA	21.5
	CA Ventura.	
	6780 Riverside-San Bernardino-Ontario, CA.	19.0
	CA Riverside; CA San Bernardino.	
	7480 Santa Barbara-Santa Maria-Lompoc, CA	19.7
	CA Santa Barbara.	
	Non-SMSA Counties	24.6
	CA Inyo; CA Mono; CA San Luis Obispo.	
181	**San Diego, CA:**	
	SMSA Counties	
	7320 San Diego, CA.	16.9
	CA San Diego.	
	Non-SMSA Counties	18.2
	CA Imperial.	

In addition to the reporting requirements set forth elsewhere in this contract the Contractor and subcontractors holding subcontracts, not including material suppliers, of $10,000 or more, shall submit for every month of July during which work is performed, employment data as contained under Form FHWA PR-1391 (Appendix C to 23 CFR, Part 230), and in accordance with the instructions included thereon.