

TYPE SELECTION REPORT

High Viaduct North Bound (34-0157 R)
Veteran's Off Ramp (34-0159)

I. INTRODUCTION

The Doyle Drive is a 1.5 mile stretch of Highway 101 extending from Marina Boulevard and Lombard Streets to the southern approach of the Golden Gate Bridge. The project objective is to replace the Doyle Drive in order to improve its seismic, structural and traffic safety aspects. The replacement project consists mainly of three sections: High Viaduct, Low Viaduct and Build and Cover Tunnels. This report is focused mainly on the High Viaduct Structure.

The High Viaduct Structure consists of a Cast-In-Place/Prestressed (CIP/PS) concrete bridge with an adjoining CIP/PS ramp. The replacement bridge will be designed in accordance with the AASHTO LRFD Design Specifications (4th Edition, 2007) and applicable California Amendments (v06, 2006).

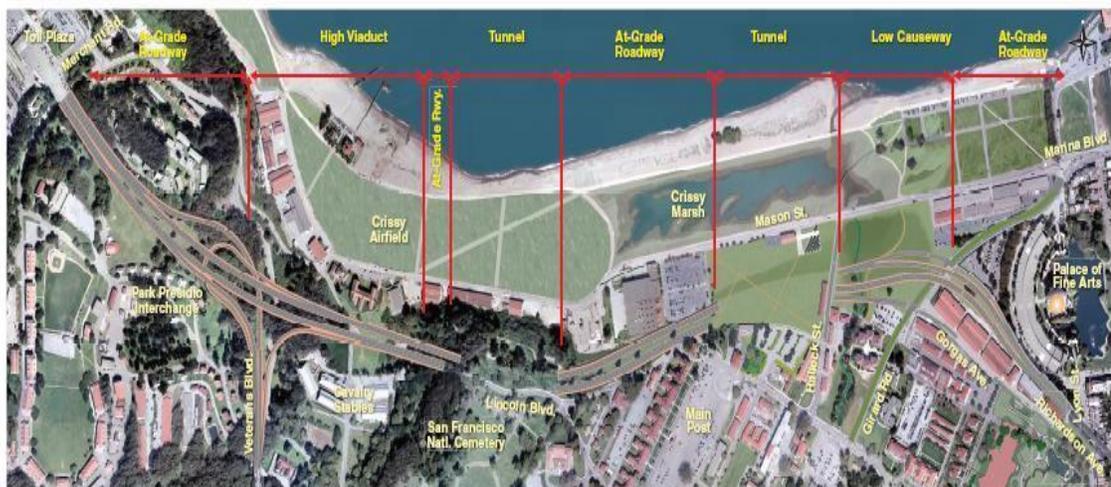
The High Viaduct Structure is classified as District 4 Recovery Route. As such, seismic performance goal is considered to be above the Caltrans Ordinary Bridge status and less than the Caltrans Important Bridge Status. Due to the Recovery Route Classification, the project will use Caltrans Seismic Design Criteria (SDC 2006), with enhancements. Namely, two levels of earthquake performances, Safety Evaluation Earthquake (SEE) and Functional Evaluation Earthquake (FEE).

Due to the following Non-standard features in the High Viaduct Structure: (Draft Caltrans Seismic Safety Peer Review, 11/20/2008 v4, Appendix)

Irregular Geometry: Variable width with bifurcating superstructures,

Unusual Geologic Conditions: Moderate to high liquefaction potential,
the design will undergo a seismic safety peer review per approval of the Caltrans Executive Earthquake Committee (11/24/08) and California State Bridge Engineer.

Two aesthetic alternatives were developed for the High Viaduct structures. Both alternatives have the same span arrangement and superstructure depth but differs in superstructure typical section and number of columns per bent and column aesthetics.



Doyle Drive Project Limits

II. Bridges & Structures

No.	Bridge Name	Bridge Number	Width	Length	Comments
1	High Viaduct (NB)	34-0157 R	87'-5" to 54'-4"	1399'-0"	6 Spans – 4 Frames
2	Veterans Off-Ramp	34-0159	29'-4"	197'-0"	3 Spans

III. Geology

High Viaduct (Bridge No. 34-157R)

The geology varies drastically throughout the alignment. At proposed **Abutment 1**, the geology consists of about 20 feet of very dense Colma sand underlain by intensely weathered sandstone grading to slightly weathered, and hard/massive sandstone at lower depths. At proposed **Bent 2**, the dense Colma sand layer increased to about 55 feet underlain by intensely weathered sandstone grading to slightly weathered, and hard/massive sandstone at lower depths. At proposed **Bent 3**, the geology consists of 50 feet of very loose to medium dense sand, silt, and sandy silt, 20 feet of dense to very dense sand (total of 70 feet), below which 60 feet of firm to stiff clay, sandy clay, and plastic silt was encountered. Bedrock consisting of intensely weathered Greywacke and Sandstone grading to slightly weathered Sandstone at lower depths is present below the clay layers. The geology at **Bent 4** is similar to Bent 3, except the sand and clay layers are reduced to 50 feet and 30 feet, respectively. Bedrock consisting of intensely weathered Shale and Sandstone grading to slightly weathered and hard Sandstone at lower depths is present below the clay layers. At **Bents 5, 6, and Abutment 7**, the rock drastically dips up. The geology consists of about 15 feet of very dense silt and gravelly sand underlain by the same rock materials present at the previous bents.

In addition, the geology at the columns across each bent remains fairly consistent except for Bent 3 in which the sand layers dip down from the South Bound to the North Bound columns as illustrated in the cross sections.

Liquefaction Potential

The latest piezometer readings from the borings (October 2008) show the water table to be approximately 10 feet below ground at Bent 3 and about 20 feet below ground at Bent 4. Due to the presence of high water table and loose to medium dense granular materials, there is a moderate to high liquefaction potential from elevation 40 feet to -10 feet at **Bent 3** and from elevation 30 feet to 15 feet at **Bent 4**. The liquefaction potential at the other supports is very low.

Veterans Off-Ramp (Bridge No. 34-0159)

The geology throughout the proposed 2-span Off-Ramp remains fairly steady consisting of 5 to 10 feet of gravelly sand, and soft to very stiff clay underlain by intensely weathered and decomposed Shale/Serpentine grading to slightly weathered, and hard/massive at lower depths.

Liquefaction Potential

Due to the nature of materials present and lack of shallow water table, the liquefaction potential is very low.

IV. Seismic Evaluation

The controlling fault for the project site is the San Andreas/North (SAN, Strike-slip) with a maximum moment magnitude, $M_{max}=7.9$ located between 9 to 10 km southwest of the 2.4 km Doyle Drive. The peak bedrock acceleration (PBA) at this site, based on the California Seismic Hazard Map, 1996, as well as the Attenuation Relationship Equation by Sadigh, et. Al. 1997 was estimated to be 0.5g. However, based on the New Generation Attenuation relationships, as well as the new Seismic Hazard Map adopted by the Department, the PBA at this site is estimated to be 0.4g and will be used as the basis for the generic/preliminary analysis. There are non known faults projecting

towards or passing directly through the project site. Therefore, the potential for surface rupture at the site due to fault movement is considered low.

V. Foundation Types

It is proposed to use CIDH piles for the two bridges. Site corrosivity due to proximity to the San Francisco Bay and fear of Vibration effect on nearby historic buildings makes the CISS piles an unfeasible choice.

For Alternative 1: CIDH piles with 10 and 12 ft diameter are proposed for the High Viaduct North Bound Bent 2 to Bent 6. Casing may be needed for CIDH piles at proposed Bent 3 and Bent 4 because of the caving potential due to presence of granular materials and ground water. 2-foot diameter CIDH piles are proposed for the abutments.

For Alternative 2: CIDH pile shafts are proposed for High Viaduct North Bound Bents 5 and 6 with 8' diameter. For NB bent 2, 3 and 4, a pile cap with 6 foot diameter piles are proposed.

Soil improvement may be needed at both Bent 3 and Bent 4 for the NB High Viaduct Structure.

It is proposed to use 8 ft and 6 ft CIDH piles for the Veteran's Off ramp. Soil profile under the bridge does not suggest any casing.

VI. Seismic Design

High Viaduct Structures consists of two CIP/PS concrete bridges with two adjoining ramps. The High Viaduct Structures has the following Non-standard features: (Caltrans Memo to Designer 20-1):

- Irregular Geometry: Variable width with bifurcating superstructures
- Unusual Geologic Conditions: Moderate to high liquefaction potential

In addition, the High Viaduct Structure is classified as District 4 Recovery Route. As such, seismic performance goal is considered to be above the Caltrans Ordinary Bridge status and less than the Caltrans Important Bridge Status. The project will use Caltrans Seismic Design Criteria (SDC 2006), with enhancements, Safety evaluation earthquake (SEE) and Functional evaluation earthquake (FEE).

VII. Falsework

Bridge	Vehicular Traffic	
	Location	Temporary Opening
NB High Viaduct	Span 6 @Sta 95+02 Over HWY 1 UC	14.5'
Veteran Off ramp	Span 2 @Sta 100+27 Over HWY 1 UC	14.5'

VIII. Aesthetics

Doyle Drive Project Architectural Criteria Report (Aug 2008) stipulates the aesthetics requirements for the High Viaduct structures to:

- Be consistent with the existing Doyle Drive structure by remaining subordinate to the Golden Gate Bridge in scale and design.
- Minimize the number of columns for the High Viaduct for preserving views to Crissy Field, Stillwell Hall, Angel Island and the Golden Gate Bridge, from specific viewpoints.

- Develop continuity with the historic Golden Gate Bridge through the design of guardrails and light fixtures for the new High Viaduct Structure.
- Light pole attachments for the High Viaduct structure shall coincide with the new bridge rail and post attachments.

Two aesthetic alternatives were developed for the two High Viaduct structures. The two main alternatives have the same span arrangement and structured depth but differs in haunch shape (parabolic versus straight line), columns' shape, dimensions and number per bent, and shape of superstructure cross section.

IX. Construction Stages

The proposed sequence of construction staging of the whole projects includes the following for the High Viaduct Structure:

Contract 7: Constructing High Viaduct North Bound and Veterans Off Ramp.

X. Project Milestones

Project EA: 04-163700	Structures P&Q Date	Structures PS&E Date
Contract 7 (04-163771) High Viaduct NB, Veteran's Off Ramp	November 1, 2009	January 1, 2010

XI. Doyle Dr. High Viaduct NB (Br. No. 34-0157R)

Structure Type	CIP/PS Box Girder Bridge
Spans	163', 240', 340', 275', 213', 168'
Structure Depth	6.25' to 19'
Abutments	Seat type cantilever Abutments supported on 2' dia. CIDH piles.
Bents	5-Two column bents supported on 10' or 12' dia. CIDH pile shafts.
Vertical Clearance	16.5'
Temp Vertical Clearance	14.5'
Barriers	Type ST-10
Slope Paving	NA
Approaches:	Structure Approach will be Type N (30S).
Drains	To be determine later.
Temp Range	43°F to 106°F
Joints	Joint Seal at abutments: MR = 1", 2" Join Seal at Hinges: MR = 5", 6" and 4".
Utilities	None at this time.
Safety Fence	None
Future Widening	None

XII. Veterans Off-Ramp (Br. No. 34-0159)

Structure Type	CIP/PS Box Girder Bridge
Spans	34', 101' and 62'.
Structure Depth	3'-6"
Abutments	Seat type cantilever Abutments supported on 24" diameter CIDH piles.
Bents	One 3'-6" circular single-column bents supported on 5'-6" diameter CIDH pile shafts.
Vertical Clearance	16.61'
Temp Vertical Clearance	None
Barriers	Type California ST-10
Slope Paving	NA
Approaches:	Structure Approach will be Type N (30S).
Drains	To be determine later.
Temp Range	43°F to 106°F
Joints	Joint Seal at Abutment: MR (including seismic) = 2". Joint Seal at Hinge: MR (including seismic) = 1".
Utilities	None at this time.
Safety Fence	None
Future Widening	None

XIII. Structure Costs

Bridge Name	Bridge Number	Cost	Area (SF)	Cost/ sf
High Viaduct NB, Alt 1	34-0157 R	\$ 49,748,000	84,094	\$ 592
High Viaduct NB, Alt 2		\$ 67,020,000		\$ 797
Veteran's Off Ramp, Alt 1	34-0159	\$ 3,673,000	5,780	\$ 635
Veteran's Off Ramp, Alt 2		\$ 3,500,000		\$ 605