

## TYPE SELECTION REPORT

Girard Road Depressed - RW (Br. No. 34-0166)  
Girard Road UC – NB & SB (Br. No. 34-0165L/R)

### I. INTRODUCTION

This project proposes to replace the existing southern approach to the Golden Gate Bridge. The locations covered in this document are at the east end of the project near the Marina District of San Francisco.

The Girard Road Depressed – RW and the Girard Road UC – NB & SB bridges are co-located with the piers of the bridges founded within the depressed section and the bridge abutments located to either side. Although they are officially separate structures, they are covered jointly here.

The Girard Road Depressed – RW structure requires excavation to a depth that risks blow-out of an artesian aquifer which covers the entire area. The aquifer is confined by a layer of bay mud which is currently held in place by the existing overburden. Underlying the aquifer zone is a zone of very dense material that will serve as the anchorage for the structures.

In the interest of conforming to the aesthetic theme of this project which calls for haunched bridges, structure types considered were CIP P/S voided slab and CIP P/S box girder for the bridges. The Depressed Section slab will be buried with only a small portion of the perimeter walls being exposed to view. Architectural treatment can be applied to the perimeter walls where they are exposed to view.

It is anticipated that the entire Depressed Section will be constructed in one stage. It will be necessary to complete the seal slab and perimeter walls prior to constructing the bridges. Traffic will be detoured and is not a consideration.

A pumping station will be required to handle surface drainage and seepage through the Seal Slab.

The new structures will be designed in accordance with the AASHTO LRFD Design Specifications (3<sup>rd</sup> Edition, with 2006 Interim Revisions) and applicable California Amendments.



## II. Bridges & Structures

	Bridge Name	Bridge Number	Width	Length	Comments
1	Girard Road Depressed - RW	34-0166	Varies	523'-0"	N/A
2.	Girard Road UC NB	34-0165 R	39'-6"	220'-0"	3 Span
3.	Girard Road UC SB	34-0165 L	53'-4"	220'-0"	3 Span

## III. Geology

The Girard Road Depressed – RW subsurface conditions are extremely variable. The existing surface is at approximately 11 feet elevation. Artificial fill and loose sandy material typify the upper 10 feet of material. This material is underlain by a relatively impermeable layer of bay mud approximately 6 feet thick. Groundwater is perched on this layer of bay mud and was encountered at 5 feet below the surface. This layer is underlain by a thick layer of highly variable characteristics including a significant quantity of loose, highly permeable material. Groundwater encountered in this layer was found to be under significant pressure, resulting in an artesian aquifer condition. This material is underlain by an approximately 44 foot thick layer of very dense sandy clay, silty clay and clay with sand and very dense silty sand. Below this layer, a third zone of groundwater was encountered. This groundwater was found to be under significant pressure, creating an artesian condition which exceeded that of the upper confined zone.

## IV. Seismic Evaluation

The controlling fault for the project site is the San Andreas with a maximum moment magnitude,  $M_w = 8$  located between 9 to 10 KM southwest of the project site. The peak bedrock acceleration (PBA) at this site, based on the California Hazard Map, 1996, as well as the Attenuation Relationship Equation by Sidigh, et. Al. 1997 is estimated to be 0.5g. The potential for surface rupture due to fault movement is considered low.

## V. Liquefaction Potential

Liquefaction is considered to be a significant problem. The pressurized aquifer, occupying a zone from approximately -4 feet to -24 feet is subject to approximately 6 inches of settlement should liquefaction occur.

## VI. Foundation Types

The Girard Road Depressed section encroaches on an artesian aquifer which is to be impacted to the minimum extent possible. Impacts include excessive blockage and/or blow-out of the aquifer. Due to the high risk of blow-out of the pressurized aquifer during excavation of the Depressed Section, deep soil mixing will be employed. Deep soil mixing into the aquifer zone will create some blockage. However, permeability of the zone is very high and aquifer flow will remain near existing conditions. The entire area of the Depressed Section will be improved through soil mixing to provide a 10 foot thick relatively impermeable and stable zone to allow for excavation. This will encroach approximately 5 feet into the

aquifer at the deepest soil improvement zone. In addition, deep soil mixing will be done to a depth of approximately -24 feet where firm material is encountered. This mixing extends through the entire vertical profile of the aquifer but is limited to a 7' x 7' column approximately every 28 feet. These improved columns will allow for installation of 24" CIDH piles which will serve as tie-down anchors during the critical excavation phase and provide vertical support for the finished product. This procedure for installing the Depressed Section is proposed in lieu of cut-off walls around the entire Depressed Section, which in effect permanently eliminates the aquifer over the entire footprint of the structure.

The Girard Road UC – NB & SB bridge pier foundations are to be integrated into the seal slab of the Depressed Section. This allows for a slender superstructure required to meet vertical clearance requirements. The bridge abutments are to be placed on pile foundations, utilizing closed end pipe piles which can be placed without deep soil mixing.

## VII. Seismic Design

Based on the geological data from available sources, the geological profile at various locations of Doyle Drive falls within the California seismic Design Criteria (CSDC), May 1999, types C and D soil profiles. Due to the proximity of the site to the fault, the corresponding standard ARS curves have been modified. The modifications are such that there is no increase in spectral acceleration in periods less than 0.5 seconds and a 20% increase for periods greater than one second. A linear interpolation was used between 0.5 and one second.

## VIII. Falsework

Bridge Name	Vehicular Traffic		Pedestrian Traffic		Railroad	
	Location	Temporary Opening	Location	Temporary Opening	Location	Temporary Opening
Girard Road Depressed - RW	NA		NA		NA	
Girard Road UC – NB & SB	NA		NA		NA	

## IX. Aesthetics

The bridge aesthetic branch is providing aesthetic concepts for the Girard Road UC – NB & SB bridges. Aesthetic treatments have focused on the haunched superstructure and columns.

### Preliminary Aesthetic Features:

#### Girard Road Depressed – RW

- The only exposed portion of the structure is the top 3 or 4 feet of the perimeter walls. Architectural treatment can be applied.

#### Girard Road UC – NB & SB

- The superstructure is proposed to be haunched, with a structure depth of 2'-6" at mid span and 4'-0" at the bents. End spans are haunched only at the bents, not at the abutments.
- Exterior Girders to have sloped exterior face with a constant slope of 2:1. This results in a variable width bottom slab.
- The columns are a 3'-0" diameter core shape with faceted architectural treatment flaring at the top.
- An ST-10 Barrier Railing consistent with the rest of the project is to be used.

**X. Project Milestones**

Project EA: 07-238500	Structures P&Q Date	Structures PS&E Date
Doyle Drive	March, 2009	May, 2009

**XI. Girard Road Depressed – RW (Br. No. 34-0166)**

Structure Type	CIP Seal Slab with retaining walls (Concrete boat section)
Spans	N / A
Structure Depth	Typical 2'-0" 3'-0" at pile locations
Abutments	N / A
Vertical Clearance	N / A
Barriers	NA
Slope Paving	NA
Shoring	Soil improvement extending beyond limits of Seal Slab to provide stable material for excavation and water resistant barrier to exclude groundwater
Approaches:	Structure Approaches will be Type N(30S).
Drains	Standard plan Drainage Inlets (Type GDO) with 12" diameter pipes. Geo-grid drainage for seepage through Seal Slab.
Temp Range	Seal Slab is not exposed to seasonal temperature fluctuations
Joints	Joint Seal at abutments: MR = ½"
Utilities	None on structure.
Safety Fence	Cable railing along top of retaining walls parallel to Girard Road.
Future Widening	None

**XII. Girard Road UC – NB (Br. No. 34-0165 R)**

Structure Type	CIP Voided Slab Bridge
Spans	66', 88', 66'
Structure Depth	4'-0" at bents. 2'-6" at mid span and abutments
Abutments	Short seat type abutments on 12" dia. Closed end pipe piles. Retaining wall type wing walls on 12" dia. Closed end pipe piles.
Bents	Bents 2 and 3: Three columns per bent. Pile cap integrated with Seal Slab of the Girard Road Depressed – RW structure. Deep soil improvement under the pier footing area to facilitate installation of 2' diameter CIDH piles.
Vertical Clearance	Girard Road = 15'-3"
Temp Vertical Clearance	N/A
Barriers	Type ST-10
Slope Paving	N/A
Approaches:	Structure Approach will be Type N(30S).
Drains	To be determine later.

Temp Range	40°F to 90°F
Joints	Joint Seal at abutments: MR = 2 ½"
Utilities	None at this time.
Safety Fence	None
Future Widening	None

### XIII. Girard Road UC – SB (Br. No. 34-0165 L)

Structure Type	CIP/PS Box Girder Bridge
Spans	66', 88', 66'
Structure Depth	4'-0" at bents. 2'-6" at mid span and abutments
Abutments	Abutment 1, short seat type on 2' dia. CIDH piles. Abutment 4, high cantilever seat type on 2' dia. CIDH piles with retaining wall type wing walls.
Bents	Bents 2 and 3: Four columns per bent. Pile cap integrated with Seal Slab of the Girard Road Depressed – RW structure. Deep soil improvement under the pier footing area to facilitate installation of 2' diameter CIDH piles.
Vertical Clearance	Girard Road = 15'-6"
Temp Vertical Clearance	N/A
Barriers	Type ST-10
Slope Paving	N/A
Approaches:	Structure Approach will be Type N(30S).
Drains	To be determine later.
Temp Range	40°F to 90°F
Joints	Joint Seal at abutments: MR = 2 ½"
Utilities	None at this time.
Safety Fence	None
Future Widening	None

### XIV. Structure Costs

Bridge Name	Bridge Number	Cost	Area (SF)	Cost/ sf
Girard Road Depressed - RW	34-0166	\$ 28,328,000	Slab 60,710 RW 8,180	\$ 411
Girard Road UC – NB	34-0165 R	\$ 5,293,000	12,505	\$ 423
Girard Road UC - SB	34-0165 L	\$ 6,619,000	16,586	\$ 399