

# Memorandum

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**To:** MR. TOM OSTROM, CHIEF  
SUPERVISING BRIDGE ENGINEER  
OFFICE OF EARTHQUAKE ENGINEERING

**Date:** October 21, 2014

**Attention:** Mr. Mark Yashinsky

**File:** 07-LA-010-42.44  
59-93034-N  
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E10-N57 Connector  
Bridge No. 53-2004G

**From:** K. Douglas Cook, CEG  
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**Subject:** **Evaluation of Fault Rupture Potential, E10-N57 Connector, Bridge No. 53-2004G, Post Mile 42.44, Interstate 10 (San Bernardino Freeway), Los Angeles County, California**

## SUMMARY

Based on review of the LOTB groundwater data, the southern Abutment 1 and Bents 2 and 3 of the bridge may be situated across an inferred splay of the San Jose Fault. As of the date of this report, an Alquist-Priolo Earthquake Fault Zone has yet to be established for the San Jose Fault by the California Geological Survey. However, recent work on the campus of California State Polytechnic University, Pomona has located splays of the fault and shown them to have been active within the past 3,500 years. The fault should be considered active by Caltrans criteria.

The closest inferred trace of the San Jose Fault mapped by the USGS is located about 760 feet south of the bridge abutment. This mapped fault trace is also inferred and based on groundwater data. Evidence of surface faulting was not observed at either location during a site reconnaissance conducted for this evaluation. A fault rupture analysis performed for the bridge site using Mw 6.6 and a slip rate of 0.6mm/yr, estimated 17 inches (0.42 m) deterministic and 8 inches (0.21m) probabilistic displacement. Vertical displacement may be estimated at 25% of the lateral effects due to the reverse slip component of the fault. Locally, the fault trends 075° and the local curvature of the bridge over it trends 35° over it.

The bridge will be subject to high levels of ground motion during a local seismic event occurring in the seismically active southern California region. Additional field work to accurately locate the fault is recommended if it is determined that the bridge structure(s) cannot accommodate the amount of displacement as reported in this memo.

## INTRODUCTION

This evaluation was prepared as part of the statewide evaluation of fault rupture potential at Caltrans bridges. Caltrans' policies regarding fault rupture at bridges are described in Memo to Designers (MTD 20-10, 2013). Caltrans requires a fault rupture evaluation if a bridge is located within an Alquist-Priolo Earthquake Fault Zone (EFZ) or within 1,000 feet of an un-zoned fault 15,000 years or younger in age (MTD 20-10). The E10-N57 Connector Overcrossing, Bridge No. 53-2004G (07-LA-57-R7.66) is **NOT** situated within an EFZ as one has not been designated for the San Jose Fault by the California Geological Survey as of the date of this Memo. However, the southern abutment of the bridge is located about 760 feet north of the late quaternary age (11,000 to 700,000 year old) San Jose Fault as mapped by both United States Geological Survey (Figure 1) and the California Geological Survey (Figure 2). A consultant's report (GEOCON, 2001) for California State Polytechnic University, Pomona (Cal Poly) campus has indicated both the presence of a shallow ground water barrier and displacement activity in the past 3,500 years on the San Jose Fault that is on trend with and projects under the subject bridge. Therefore, this evaluation of the fault rupture potential for this bridge was required.

Caltrans Bridge No. 57-2004G, the E10-N57 Connector, is midlevel bridge of the SR57/I-10 Interchange, spanning two other connector bridges, and the on grade San Bernardino Freeway (I-10) below. It is located east of and immediately adjacent to the campus of California State Polytechnic University, Pomona (Cal Poly), within Los Angeles County. It was constructed in 1972 as a six-span, 4 cell box, reinforced concrete (RC) box girder structure, with RC diaphragm abutments supported on 70 ton prestressed driven concrete pile foundations, and 3 single (1) and 2 double (2) column bents (total of 5 bents). The bents are also supported on driven 70 ton concrete piles. The columns and foundation of Bent 4 are shared with structure 53-2003 above, 53-2006 below and 53-2007 at grade. The columns and foundation of Bent 5 are shared with 53-2005 below. The structure for bridge 53-2004G is 707 feet long by 34 feet wide. It was seismically retrofitted circa 1995 as a part of Caltrans "Earthquake Retrofit Project No. 579" for the 57/10 interchange project (Figure 3).

The curving centerline trend of the southern portion of the bridge in the area of the fault has a trend heading 35° and the trend of the groundwater barrier inferred to be the has a heading of 075°. The Interchange and bridge are situated on the USGS San Dimas, CA 7½' Quadrangle topographic map, at Latitude 34.06528°N and Longitude 117.80649°W.

## FAULT RUPTURE EVALUATION

This fault evaluation consisted of:

- Review of available existing data,
- Review of selected aerial photography (LIDAR images were not available for the site vicinity,
- Field reconnaissance of the site and immediate vicinity,

The evaluation reached the following conclusions:

- (1) An inferred fault mapped by the USGS is located about 760 feet (218m) south of Abutment 1 of the subject bridge. However, another fault based on reported groundwater barriers disturbing Holocene alluvium is inferred to be located under the bridge.
- (2) Based upon reported investigations by consultants at Cal Poly, it is likely that at least a splay of an active fault projects beneath the southern span(s) of the bridge mapped as a groundwater barrier. The LIDAR images of the bridge vicinity were not available for review at the time of this evaluation.
- (3) The fault displacement hazard analysis which considers potential mapping errors and likelihood that rupture occurs off the observed traces, a lateral offset of about 14 inches (0.35m deterministic) should be considered for the review.

## **REVIEW OF EXISTING DATA**

The San Jose fault (SJF) is the east to northeast trending, 20 mile (32 km) long, north dipping, sinistral strike slip fault, with a minor reverse component. It extends from the central part of the San Jose Hills (south of Buzzard Peak), through the campus of Cal Poly Pomona, under the area of the State Route 57 and Interstate 10 interchange, east along the southern flank of the San Jose Hills, then northeast across the valley towards the City of Claremont. The fault is poorly exposed in the Miocene rocks of the San Jose Hills on the west of and on the Cal Poly campus. To the east of Cal Poly the fault is surficially concealed and is inferred as a shallow groundwater barrier in the Holocene (?) age valley fill alluvium (Figure 4). The expected maximum magnitude earthquake for the San Jose fault is Mw 6.6 with a slip rate of 0.6 mm/yr (Caltrans, 2012).

A Fault Evaluation Report FER-68 (Smith, 1977) and Supplemental (Smith, 1978) were prepared by the Division of Mines and Geology (predecessor in name of the California Geological Survey) to determine if an Alquist-Priolo Special Studies Zone (now Earthquake Fault Zone) would be required for the San Jose Fault. It was determined that there was insufficient evidence to meet the program criteria and that the fault would not be zoned at those times.

Numerous investigations to locate the SJF have been conducted by various consultants on the Cal Poly campus, the most recent was by GEOCON which summarized the prior investigations and conducted additional work to locate the fault (GEOCON, 2001). GEOCON reported that previous work on the campus concluded there was evidence of about 3 feet of horizontal displacement occurred on the SJC about 3,500 years ago.

The GEOCON fault investigation program consisted in part of subsurface drilling, fault trenching, and gamma ray spectrometer surveys. This investigation reported two splays of the fault on the eastern portion of the Cal Poly campus. Groundwater measurements from the drilling program

indicate groundwater barrier having a 10 feet elevation difference between 3 closely spaced borings along a 100 foot line across the fault.

Caltrans (Merriam, 2010) reviewed the GEOCON report and concluded the reported trend of the fault and groundwater barrier may project to the east and the 57/10 Interchange (Figure 4).

A review of the Log of Test Borings for the subject bridge and 57/10 Interchange indicates the possibility of a groundwater barrier south of the San Bernardino Freeway (I-10) and under the bridge. The groundwater elevations between two sets of borings appear to be separated by up to 10 feet across a distance of less than 100 feet.

## **REVIEW OF SELECTED AERIAL PHOTOGRAPHY AND LIDAR IMAGES**

Selected aerial photographs taken before and after the construction of the 57/10 Interchange and the subject bridge were reviewed (Caltrans, 1963, 1988, and 1993). No direct evidence of faulting (lineaments) was observed in any of the photos for the bridge site. LIDAR imaging of the area is was not available for review.

Google Earth and topographic data (Google Earth, 2014) for this area were reviewed for this evaluation does not clearly show any evidence of splays of the San Jose Fault in the area of the bridge.

## **FIELD RECONNAISSANCE**

A field reconnaissance was conducted of the 57/10 Interchange and subject bridge site and vicinity on October 7, 2014 to observe the topography, geomorphology and development of the area. No direct evidence of the San Jose Fault was observed at that time. The area has been developed for several decades, obliterating any surface expressions of the fault. However, a break in slope between the bedrock exposures on the southern flank of the San Jose Hills and valley fill alluvium was noted.

## **POTENTIAL FOR FAULT RUPTURE**

An initial estimate of potential offset was based on an analysis developed by Division of Research and Innovation in collaboration with Geotechnical Services, using methods presented in Wells and Coppersmith (1994), Abrahamson (2008), and Petersen, et al (2011). For low-slip faults, a Gutenberg-Richter Magnitude-Frequency distribution is used. Input parameters included:

- Slip rate of 0.6 mm/year (Caltrans, 2012)
- Site-to-source distance of 0 m (Inferred GW barrier under the bridge, this report)
- b-value of 0.8 (USGS, 2008)

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- Mmax of 6.6 (Caltrans, 2012)
- Apportion of 100% slip on the inferred fault (groundwater barrier) under the bridge

The bridge is located across a groundwater barrier inferred to be a fault, and 760 feet north of nearest identified trace of the inferred fault. Both a deterministic fault displacement analysis (DFDHA) and a probabilistic fault displacement analysis (PFDHA) of 5% in 50 years (975 year mean recurrence interval) were performed using magnitude, slip rate (for PFDHA), mapping and base map errors, and likelihood of secondary fault traces. The expected maximum magnitude earthquake for the San Jose Fault is Mw 6.6 and slip rate is 0.6 mm/yr. Accordingly the calculated fault displacement would be 17 inches (0.42m) deterministic and 8 inches (0.21m) probabilistic displacement (Figures 5 and 6).

### RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS

Additional work to accurately locate the fault in the field is recommended if it is determined that the bridge structure cannot accommodate the reported amount of lateral displacement. Please contact Douglas Cook at (916) 227-4514 if you have any questions.

Prepared by:

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Attachments: References  
Figures 1 through 6

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Figure 1: 53-2004G E10-N57 Connector (after USGS/Google Earth Faults, 2014).

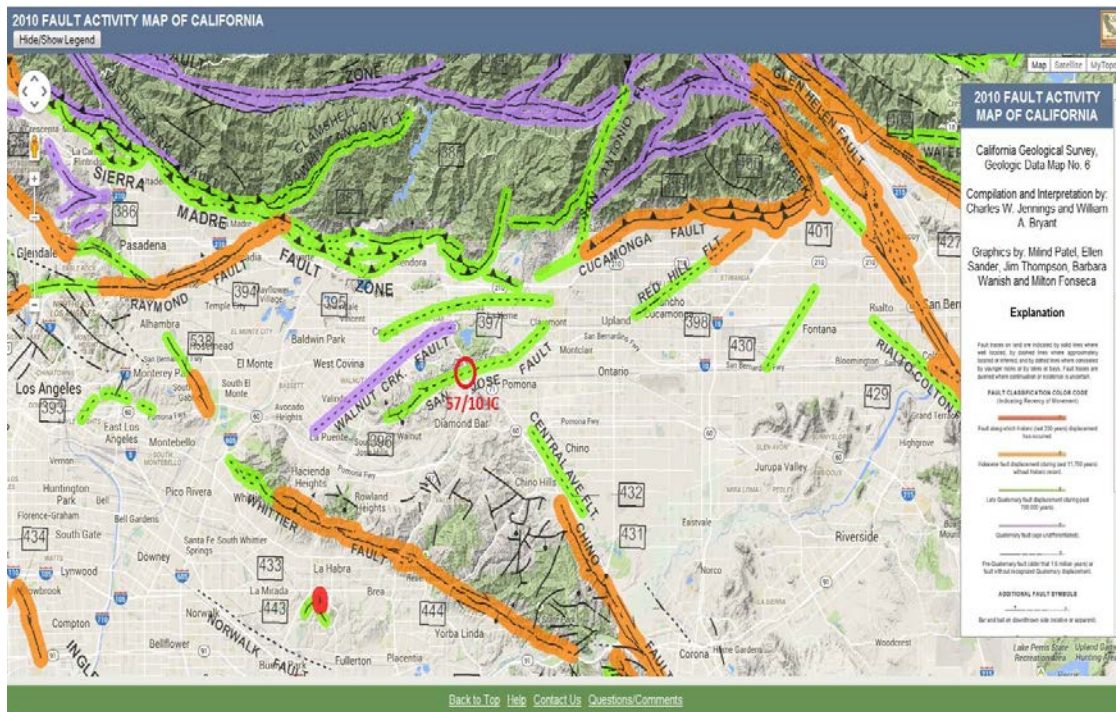


Figure 2: Regional Fault Activity Map (CGS, 2010).

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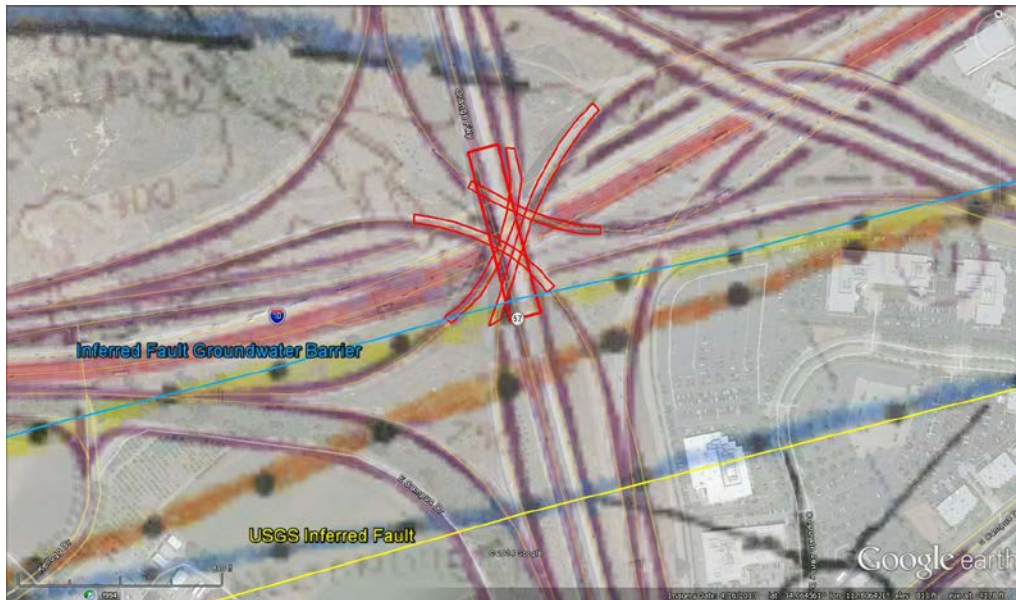


Figure 4: Image of 57/10 Interchange with USGS/Google Fault and CGS FER overlays  
Bridges shown (in red), CGS Inferred Groundwater Barriers dotted (in blue, orange  
and yellow), faults shown solid in blue and yellow). From CGS FER-68 (1977) and  
FER-68S (1978) after DWR (1970)

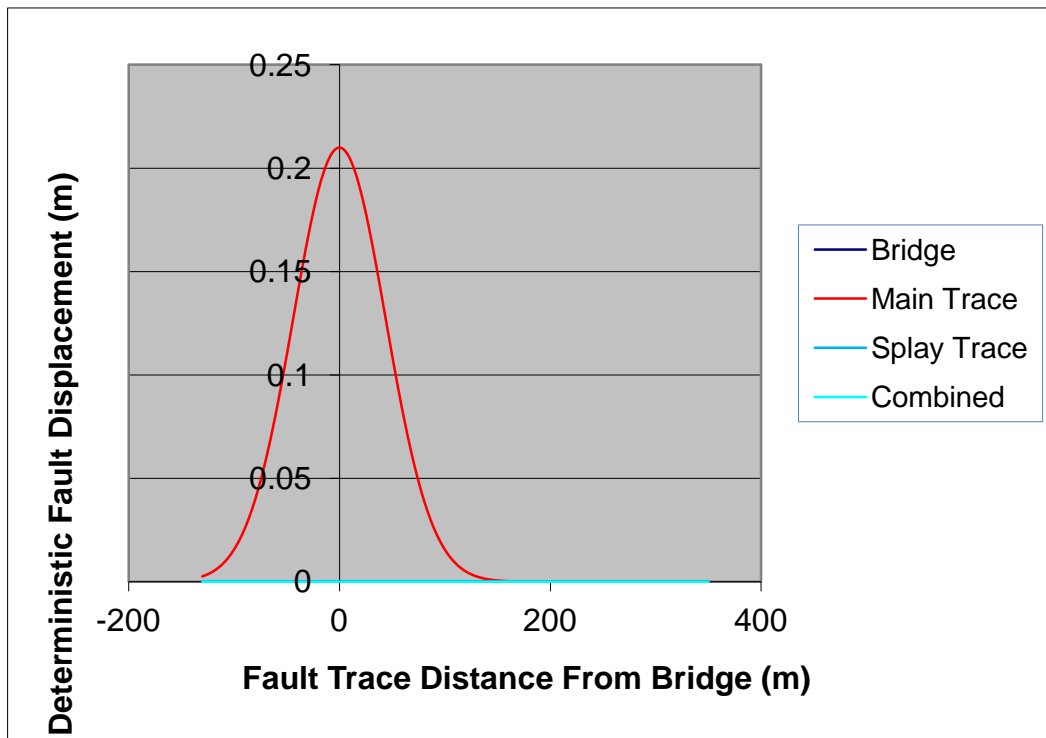


Figure 5: About 17 inches (0.42m) of deterministic displacement at the bridge

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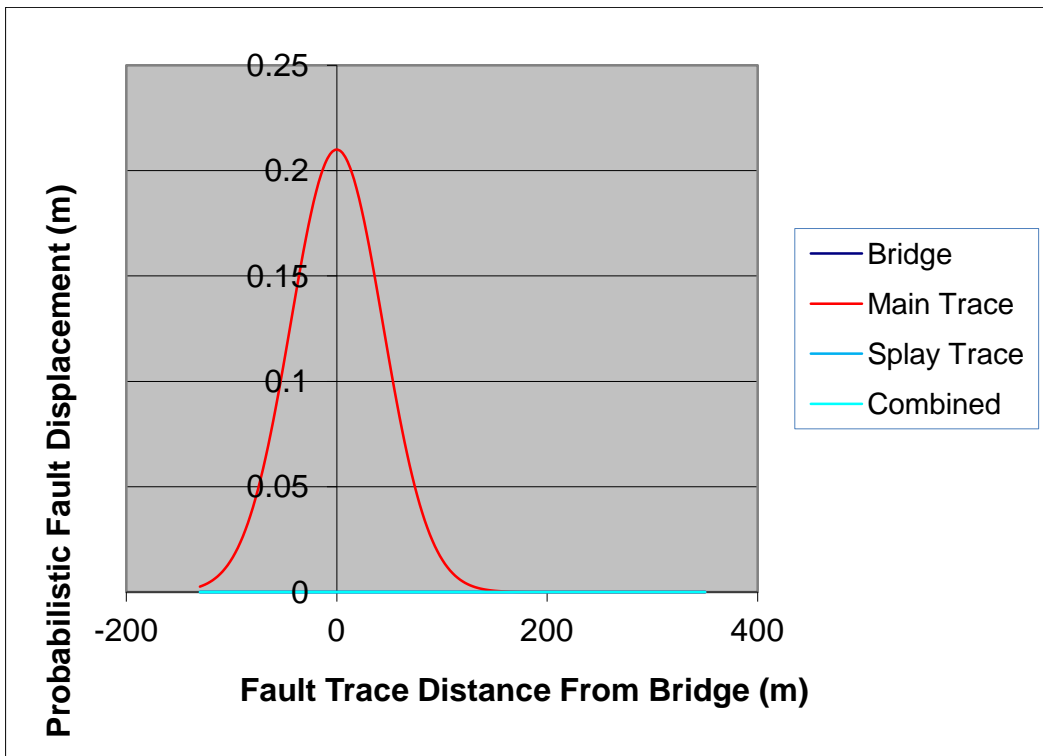


Figure 6: About 8 inches (0.21m) of probabilistic displacement at the bridge