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To: MR. TOM OSTROM, CHIEF
Supervising Bridge Engineer
OFFICE OF EARTHQUAKE ENGINEERING

Date: December 29, 2014

Attention: Mr. Mark Yashinsky

File: 07-LA-010-45.73
59-93034-N
0000001016- 6SSCN
Gary Avenue UC
Bridge No. 53-0855

From: K. Douglas Cook, CEG
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Division Of Engineering Services

Subject: Evaluation of Fault Rupture Potential, Gary Avenue UC, Bridge No. 53-0855, Post Mile 45.73, Interstate 10 (San Bernardino Freeway), Los Angeles County, California

SUMMARY

The closest trace of the San Jose Fault mapped by the USGS is located about 170 feet north of abutment 1 of the Gary Avenue UC bridge. However, the fault trace as mapped by the DWR based on an inferred groundwater barrier is located about 490 feet south of the bridge. Evidence of a shallow groundwater barrier indicative of a fault in the alluvium under the bridge was not evident from the Log of Test Borings for the bridge that were reviewed for this evaluation. Geotechnical work on the campus of California State Polytechnic University, Pomona located 3.7 miles west of the bridge, has located shallow groundwater barrier faults, and reports the fault to have been active within the past 3,500 years. Other shallow groundwater barriers that are also defined as the fault are located 2 miles northeast of the bridge, at the Pilgrim Place Manor in Claremont. The fault should be considered active by Caltrans criteria.

A fault rupture analysis performed for the bridge site using moment magnitude, Mw=6.6 and a slip rate of 0.6 mm/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 generally trends 056° and the bridge trends 063°.

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 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 Gary Avenue Undercrossing, Bridge No. 53-0855 (07-LA-010-45.73) 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 inferred trace of the late quaternary age (11,700 to 700,000 year old) San Jose Fault as mapped by the United States Geological Survey is located about 170 feet north of the bridge (Figure 1). The shallow groundwater barriers as mapped by the DWR on which the fault is based are located about 490 feet south of the bridge A consultant's report (GEOCON, 2001) for the campus of Cal Poly, Pomona has indicated both the presence of a shallow groundwater barrier and fault displacement activity in the past 3,500 years on the San Jose Fault that is on trend with and projects adjacent to the subject bridge. Therefore, this evaluation of the fault rupture potential for this bridge was required.

REVIEW OF EXISTING DATA

Caltrans Bridge No. 53-0855, the Gary Avenue UC was constructed in 1954 as two separate (left and right), 10 span bridges supported on a combination of PCC piles (abutment 1, bents 2, 3, 4, and abutment 11) and spread foundations (bents 5, 6, 7, 8, 8, 9, 10). Each bridge was a 4 cell box girder reinforced concrete (RC) structure, with closed end seated abutments. The original structures (L/R) were respectively 800 feet and 845 feet long (822 feet freeway centerline length), each were 29 feet wide, and were separated by a 35 feet wide median. The structures not only spanned Gary Avenue but also spanned McKinley Street and Orange Grove Avenue to the east. The left and right structures were connected in 1969 by widening both (L/R) bridges into the median with a 4 cell addition with the same box girder type of construction as originally built in 1954. The bridge was seismically retrofitted in 1994 as a part of Caltrans Seismic Retrofit Project No. 579.

The bridge was again widened in 2004 by additions to the respective outside edges of the existing structure. The resultant bridge is now about 822 feet long (centerline), and 164 feet wide (Figure 2).

The centerline trend of the bridge has a heading of 063° and that of San Jose fault as mapped by the USGS immediately north of the bridge has a heading of 056°. It is situated on the USGS San Dimas, CA 7½' Quadrangle topographic map, at Latitude 34.07390°N and Longitude 117.75220°W.

The San Jose fault (SJF) is a northeast trending, 20 mile (32 km) long, north dipping, sinistral strike slip fault, with a minor reverse component. It extends east from the central part of the San Jose Hills, through the campus of Cal Poly Pomona, south of and adjacent to Interstate 10 along the margin of the San Jose Hills. Then near the eastern edge of the San Jose hills the fault bends to the northeast, crossing Interstate 10, and continuing towards the City of Claremont (Figure 3). The fault is poorly exposed in the Miocene rocks of the San Jose Hills of the Cal Poly campus. To the east of Cal Poly the inferred fault is expressed as a surficially concealed shallow groundwater barrier in the Holocene aged valley fill alluvium near the southern flank of the San Jose Hills, and beyond (Figure 4). The expected maximum moment 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 at those times that there was insufficient evidence to meet the program criteria and that the fault would not be zoned.

Aerial photographs taken before and after the construction of the bridge and roadway were not available for review during this evaluation as the area was previously developed prior to construction of the roadway in 1959. LIDAR imaging of the area was not available for review. Google Earth and topographic data (Google Earth, 2014) for this area were reviewed for this evaluation and do not show any evidence of splays of the San Jose Fault in the area of the subject bridge.

A review of the Log of Test Borings (LOTB) for the Gary Avenue UC bridge indicates that the bridge is underlain by Holocene aged (to 11,700 year) alluvial deposits to the maximum depth explored (elevation 860 feet). Groundwater is reported at the shallowest elevation of 880 feet in only 2 of the 17 borings reviewed. Evidence of a shallow groundwater barrier indicative of a fault in the alluvium under the bridge was not evident from the reviewed LOTBs.

FIELD RECONNAISSANCE

A field reconnaissance was conducted of the 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.

POTENTIAL FOR FAULT RUPTURE

An initial estimate of potential offset was based on an analysis developed by the 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 and Mw=6.6 (Caltrans, 2012)
- Site-to-source distance of 9 m (USGS mapped trace north of the bridge, this report)
- b-value of 0.8 (USGS, 2008)
- Apportion of 100% slip on the inferred fault under the bridge due to the differing locations between the USGS mapped fault and the DWR/CGS reported groundwater barriers

The bridge is located across an inferred trace of the fault. A deterministic fault displacement hazard analysis (DFDHA) and a probabilistic fault displacement hazard 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 moment 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 maybe 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: Date: December 29, 2014

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Research and Innovation – Tom Shantz
Earthquake Engineering – Fadel Alameddine
Geotechnical Design West – Anna Sojourner

Attachments: References
Figures 1 through 6

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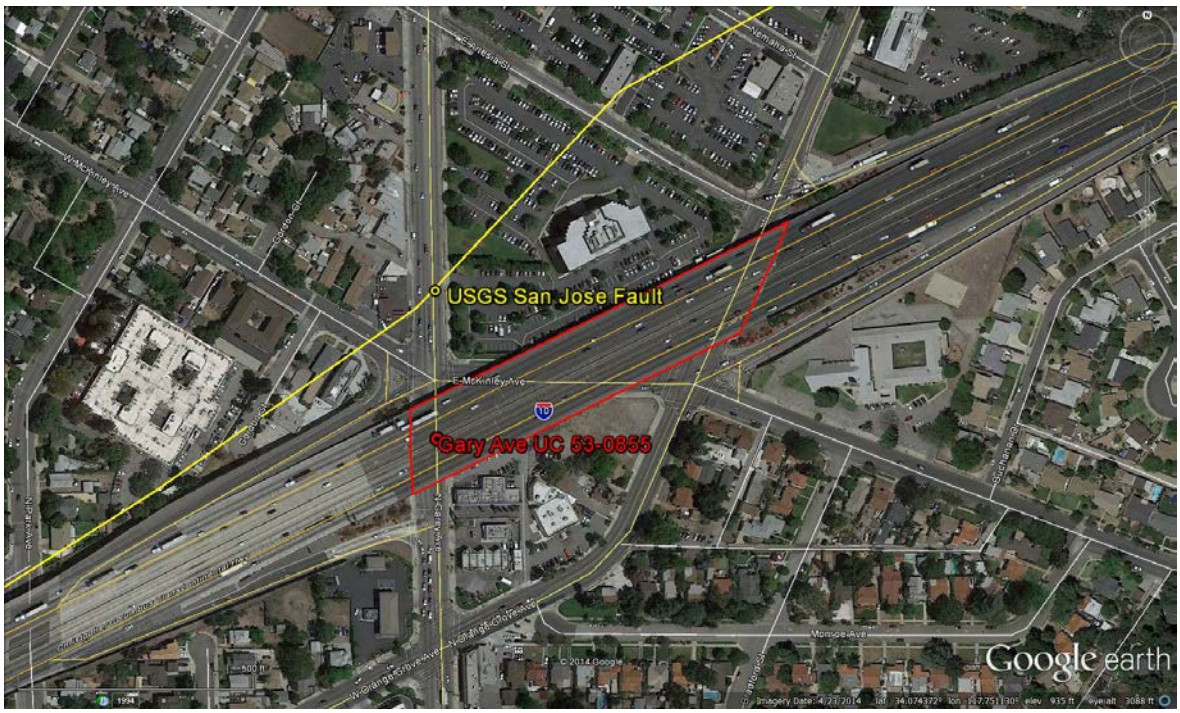

Figure 1: Gary Avenue Undercrossing (after USGS/Google Earth Faults, 2014).

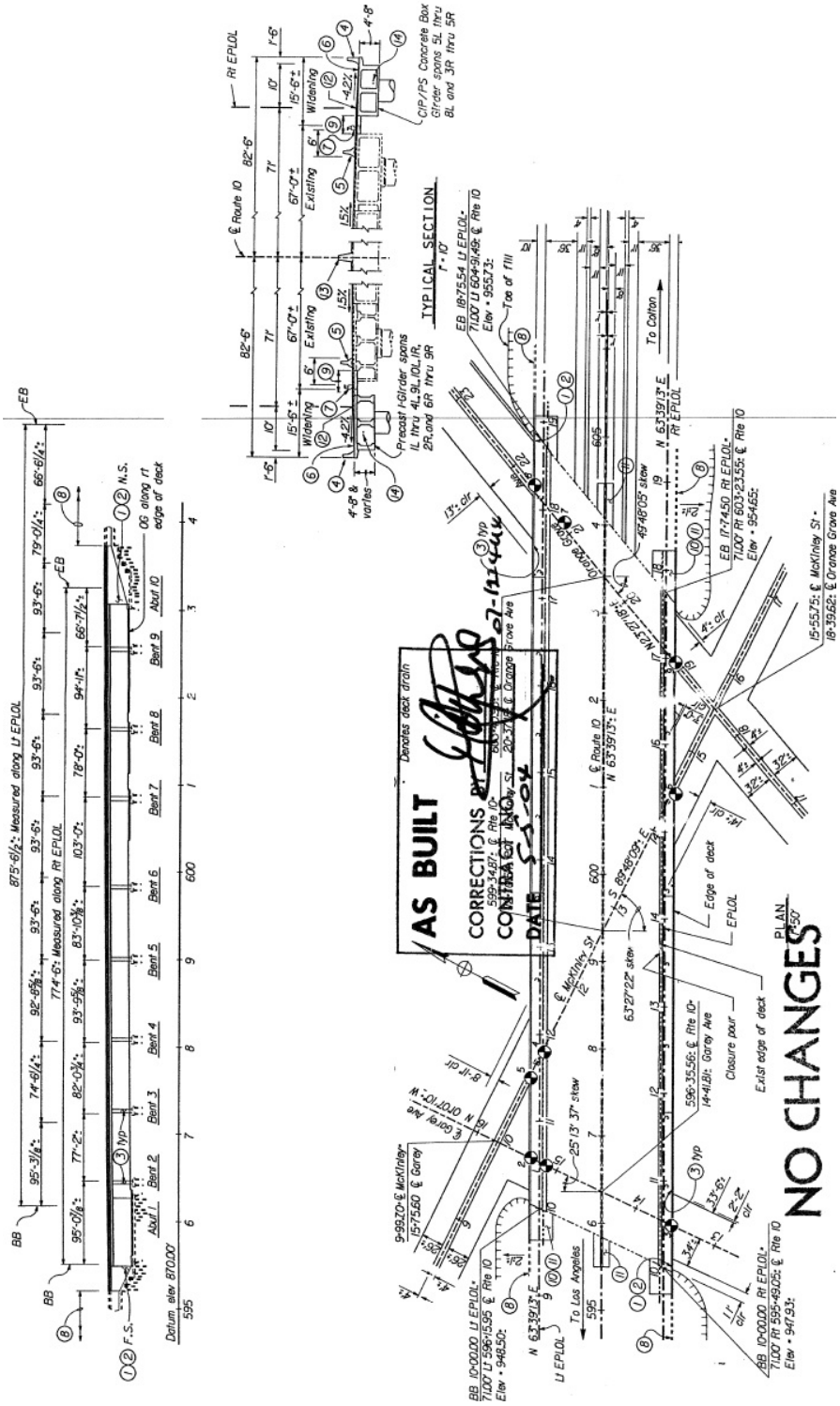

Figure 2: Gary Avenue Undercrossing Elevation and General Plan, After As-Built General Plans, 2004.
(Note: Bent 10 and Abut 11, Abut 10 is incorrect)

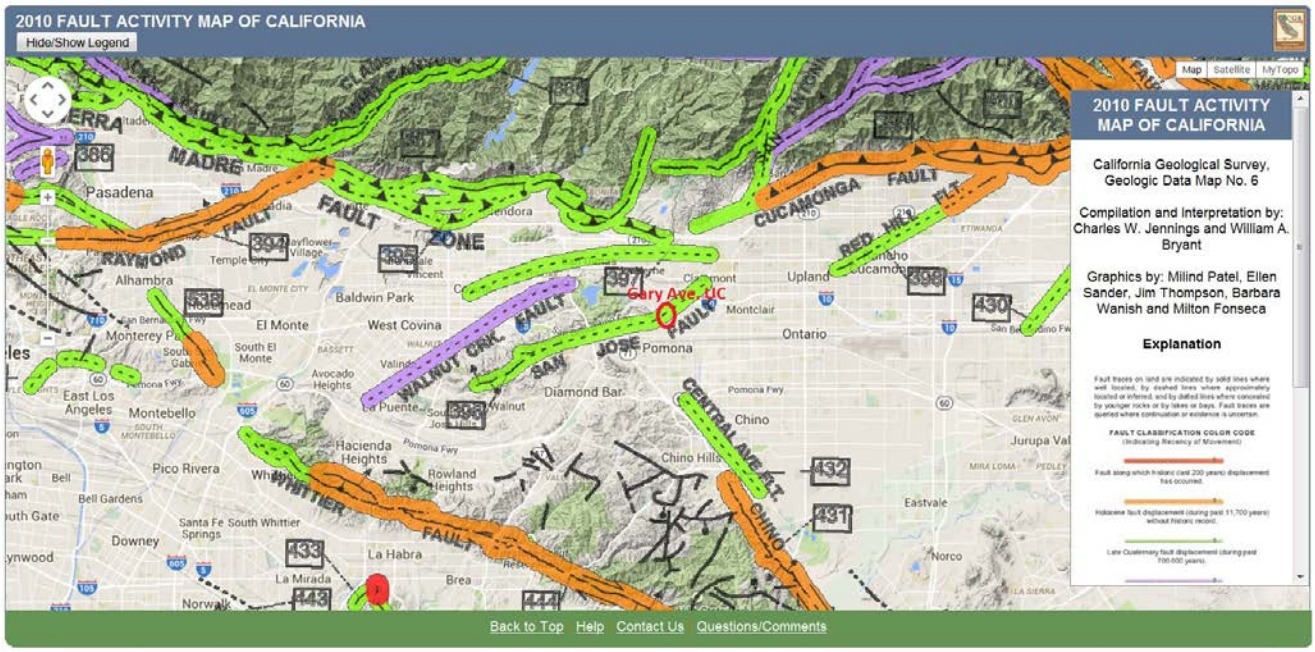

Figure 3: Regional Fault Activity Map (CGS, 2010).

Figure 4: Image of Gary Avenue UC after CGS FER-68 (1977) and FER-68S (1978) after DWR (1970). Inferred groundwater barriers are black dotted and highlighted in yellow, blue and orange.

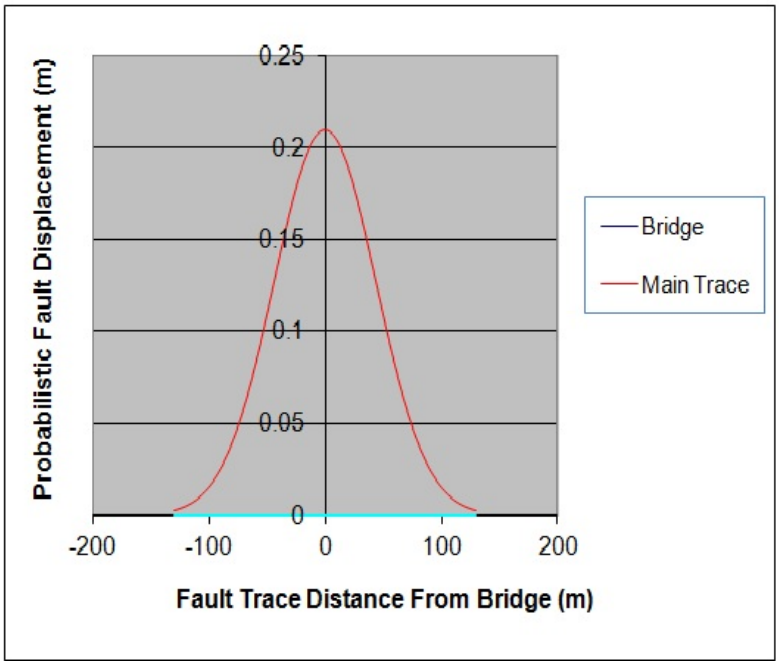

Figure 5: About 17 inches (0.42m) of deterministic displacement at the bridge

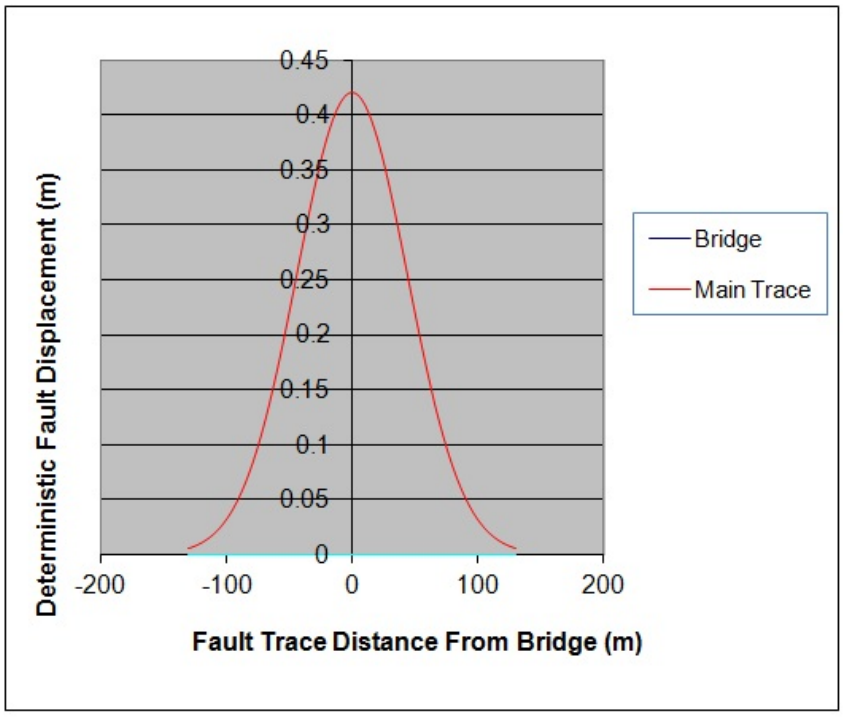

Figure 6: About 8 inches (0.21m) of probabilistic displacement at the bridge