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January 19, 2012

City Council  
Room No. 395  
City Hall

Dear Honorable Members:

**6<sup>TH</sup> STREET VIADUCT – STRUCTURAL INTEGRITY – COUNCIL FILE 11-1789**

As requested by Councilmember Koretz during the November 18, 2011 City Council meeting, please find a report and recommendations from the Bureau of Engineering on the structural integrity of the 6<sup>th</sup> Street Viaduct attached.

Respectfully submitted,

Gary Lee Moore, P.E.  
City Engineer

Attachment

cc: Miguel Santana, City Administrative Officer  
Gerry Miller, Chief Legislative Analyst  
Chris Espinosa, Mayor's Office  
Deborah Weintraub, Bureau of Engineering  
Jim Treadaway, Bureau of Engineering  
Shailesh Patel, Bureau of Engineering

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**CITY OF LOS ANGELES**  
INTERDEPARTMENTAL CORRESPONDENCE

Date: January 19, 2012

To: Gary Lee Moore, P.E.  
City Engineer

From: Shailesh "Sunny" Patel, S.E., Division Engineer  
Structural Engineering Division

Subject: **6<sup>TH</sup> STREET VIADUCT – STRUCTURAL INTEGRITY**

On November 18, 2011, the Los Angeles City Council approved and certified the Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the 6<sup>th</sup> Street Viaduct Improvement Project (Council File 11-1789). This memo is in response to the request by Councilman Koretz for a review of the structural integrity of the existing viaduct, and recommendations on whether it is prudent to keep the viaduct open to traffic for the next three to five years before construction of the new bridge commences.

**Recommendations**

My recommendations are based on the following: a review of the data presented in the EIR/EIS dated October 2011; a review of the Field Sampling and Testing Program Final Report (FSTPFR) from 2002; a review of the last Bridge Inspection Report (BIR) from October 2010; a review of the history of the bridge, past earthquakes in the local area, and performance of bridges in the vicinity; and on the fact that this is a major artery connecting the east side of the Los Angeles River to the west side with about 12,283 vehicles traveling this bridge each day (reference: LADOT Traffic Count, dated June 2, 2011). Considering this information, I recommend the following:

1. Based on the current condition of the bridge, it can remain open for regular, normal, day-to-day traffic operations, until there is a change in the condition of the bridge based on the most recent BIR, and based on inspections following a seismic event.
2. For the interim, regular bridge inspections should be performed annually until construction of the new bridge begins. The Bureau of Engineering (BOE) has requested that the Caltrans Office of Structure Maintenance and Investigations provide inspection support and BIR's on an annual basis for this bridge. Caltrans is in agreement and will schedule an inspection by January 30, 2012.
3. Should there be an earthquake in the vicinity, BOE and Caltrans will immediately inspect and re-evaluate the condition of this bridge. A new recommendation would be based on the field inspection and the condition of the bridge after such an event.

## **Background**

The 6<sup>th</sup> Street Viaduct was originally designed in the late 1920's, and was constructed in 1932. Structural designs for bridges during that era were predominantly designed for gravity and wind loading. This design resulted in a horizontal force capacity of only 10% of the total dead weight of the structure.

The October 2011 EIR/EIS discusses the presence of Alkali-Silica Reaction (ASR) at length. It makes reference to the 2002 FSTPFR prepared by W. Koo & Associates, Inc., which investigated the effects of ASR in great detail, and found that the material strength properties of this structure have been reduced. It concluded that the seismic resistance capacity of the viaduct has degraded severely, which would impact the structure's performance in a major earthquake event. This is the only City bridge that suffers from ASR.

In addition, the FSTPFR (page 3) concludes that due to a lack of obvious indications of structural failure, the structure appears adequate to remain in service for the near future, absent seismic considerations.

Presently, the bridge is being inspected every two years by the Caltrans Office of Structure Maintenance and Investigations. Caltrans provides each BIR to the City of Los Angeles for our records and for maintenance. The latest inspection date for this bridge is October 25, 2010.

## **Bridge Inspection Report (BIR)**

The BIR mainly utilizes a visual inspection of the bridge elements, and provides essential data for the load rating calculations. This data provides an analysis of the current condition of the bridge due to daily normal use, wear and tear due to gravity loading, and impacts due to accidents, weather and other events.

The last Caltrans BIR evaluated the overall structural condition, and assigned this bridge a level 5 rating. Level 5 is "Fair Condition", meaning that all primary structural elements are sound, but may have minor section loss, cracking, spalling or scouring. Based on these findings, the Caltrans BIR recommended that the bridge remain open to normal traffic, with no restrictions.

## **Seismic Issues**

- **Seismic Design Code Changes**

In terms of earthquake resistance, seismic code upgrades have occurred after each major earthquake event. The current code is such that every bridge is designed based

on site specific earthquake and geotechnical data, which has resulted in significant increases in the seismic demands on the structural design in comparison to the late 1920's. Today's structures are designed for similar gravity and wind loads as were used in the 1920's for this bridge. However, the latest seismic codes have increased designed seismic forces significantly.

- **Probability of Seismic Event**

I briefly discussed a statistical approach to predicting a seismic event at this site with Steve Thoman, the structural engineer who contributed to the preparation of the EIR/EIS. Caltrans uses "Maximum Credible Earthquake" for bridge design, a hypothetical statistical approach. Bridges are normally designed for a life span of 75-100 years. Per the Strategy Report, the current bridge has a lateral capacity that is equivalent to a ground motion of 0.17g (17% of the total weight of the structure). The ground motion at this site could be as high as 0.7g (70% of the total weight of the structure). However, per Mr. Thoman, there is only a 10% chance of an earthquake of this magnitude occurring at this site for the next four years.

Mr. Thoman's statements were additionally confirmed in a phone conversation and follow up e-mail with Dr. Lucile Jones, Science Advisor for Risk Reduction with the U.S. Geological Survey. Her e-mail of January 5, 2012 states;

"As we discussed on the phone, the most likely source of problems for this bridge would be a San Andreas earthquake, because in spite of the great distance to the San Andreas, the large size of that earthquake would produce long period ground motions that would be more damaging to large structures such as this bridge. The probability of a M~7.8 (magnitude 7.8) earthquake on the San Andrea fault is on the order of 5-10% for a 5-year period, according to the National Seismic Hazard Maps.

Other earthquakes, especially a  $M \geq 6.5$  (magnitude equal or greater to 6.5) on a fault near downtown such as the Hollywood fault or the Puente Hills fault, would also damage this bridge, but the sum of the probability of any of those faults in 5 years is still quite a bit less than the probability of the San Andrea earthquake. So the total probability of something that would damage the bridge in the next 5 years is no more than 10%."

Dr. Jones has offered to be available for a City Council meeting, schedule permitting.

One would anticipate significant damage to this bridge, should an earthquake of magnitude 7.0 or greater occur at the bridge location. The damage could range from localized failures of individual elements such as girders, beams, columns, electroliers, or the road deck, to the total collapse of the bridge at one or more spans. It should be noted that similar seismic performance and anticipated damage can also be expected from other bridges and buildings in Los Angeles that were built around the same period.

Gary Lee Moore, P.E.  
January 19, 2012  
Page 4

If you have any questions, please call me at (213) 485-5445.

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cc: Deborah Weintraub, Chief Deputy City Engineer, Bureau of Engineering  
Vincent Jones, Deputy City Engineer, Bureau of Engineering  
James Treadaway, Program Manager, Bridge Improvement Program, Bureau of Engineering  
Michael Miles, Director, Caltrans District 7  
Ching Chao, Office Chief, Structures Maintenance and Investigations, Caltrans District 7  
Gedion Werrede, Structures Maintenance and Investigations, Caltrans District 7  
Steve Thoman, S.E., Structural Engineer, Surewest  
Dr. Lucile Jones, Science Advisor for Risk Reduction, U.S. Geological Survey