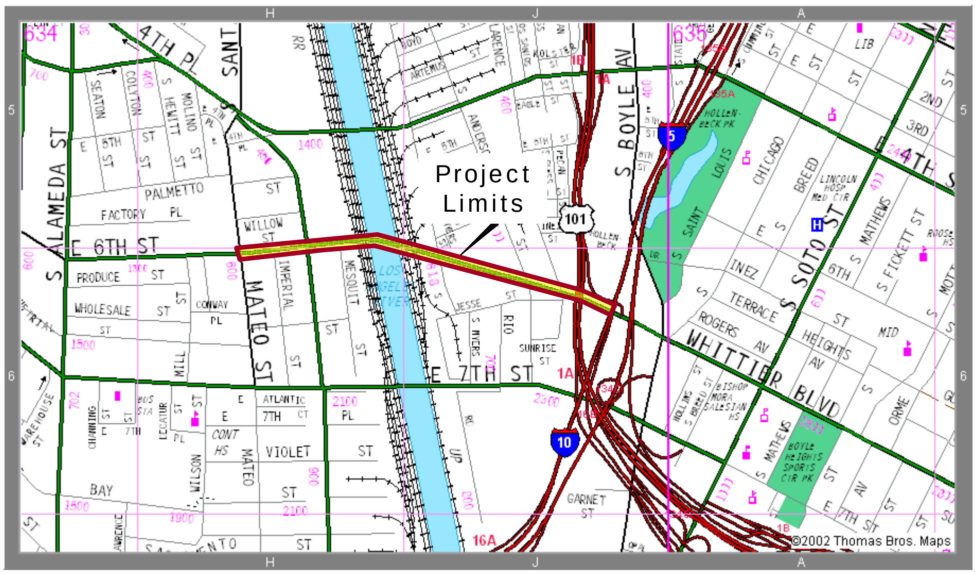
6th STREET VIADUCT SIESMIC IMPROVEMENT PROJECT

Project Location

The 6th Street Viaduct (Bridge No. 53C-1880) and Sixth Street Overcrossing (Bridge No. 53-0595) comprise a single structure, which spans a [portion of the Hollywood Freeway (US 101], the Los Angeles River, city streets, and numerous railroad tracks. The structure is located in a highly urbanized area just east of downtown and connects the downtown portion of the North Central Community Planning Area with the Boyle Heights Community Planning Area in the City and County of Los Angeles (see Exhibit1).



Thomas Bros Map
Los Angeles County Page 634, Grid H-6

Exhibit 1 – Location Map

Project Description

The 6th Street Viaduct, built in 1932, is 1 of 12 historic bridges/viaducts crossing the Los Angeles River. The 1986 Caltrans' bridge survey found the 6th Street Viaduct to be eligible for listing by the National Register of Historic Places (NRHP). The 66-foot-wide out-to-out viaduct is approximately 3,500 feet long, with a 46 foot wide four-lane roadway, stripped for 11-foot interior and 12-foot exterior traffic lanes with no shoulders. Sidewalks, varying in width, extend along both sides The viaduct is made up of a number of continuous frames and the majority, approximately 3,264 feet, is owned by the City while the 235-foot portion overcrossing US 101 at the east end is owned by Caltrans.

In June 2004, the City completed a Seismic Retrofit Strategy Report. The report studied options for seismically retrofitting the existing viaduct or its removal and replacement with a new structure. The study evaluated different strategies to mitigate the seismic vulnerabilities considering overall capital and life cycle costs. The proposed project will provide seismic safety for this critical Los Angeles River crossing by either retrofitting the existing structure or replacing the 6th Street Viaduct entirely.

Purpose and Need

The concrete elements of the 6th Street Viaduct are subject to an ongoing chemical reaction, known as *Alkali Silica Reaction (ASR)*, which has led to significant deterioration of the structure and loss if its seismic integrity. This deterioration of the 6th Street Viaduct has been occurring for at least 75 years, despite many efforts to arrest or limit its effect. In the 1940s, the two large pylons (decorative towers) at the center river bent were removed because of concerns for public safety due to the poor condition of the concrete. In the late 1980s, the deck of the viaduct was stripped of asphalt, and a waterproof coating applied to the underlying concrete in an attempt to prevent moisture infiltration (water is a necessary component for ASR). In addition, the viaduct has been repeatedly patched using epoxy injection; an activity that has left stains and discoloration and necessitated the application of a cementitous coating to hide the unsightly honeycomb effect of these repairs and to seal the surface from moisture.. Cracking is once again evident throughout the viaduct, with large cracks and spalling clearly evident on the outer columns.

While the deteriorated surface appearance of the viaduct is of concern, its underlying structural integrity is of much greater concern. In 1989, the Whittier Narrows earthquake caused damage to shear keys and caused a column crack at Bent 33 of the viaduct. The structure has since been classified by Caltrans as Category I and placed on the mandatory seismic retrofit list. The City elected to not move forward with an approved retrofit design owing to concerns surrounding the inability to stop the degradation of the viaduct substructure due to ASR deterioration. The ASR deterioration weakens the concrete strength which results in greater seismic vulnerabilities. ASR damage cannot be reversed after the reaction has taken place within the concrete.

In late 2000, the City engaged a consultant to conduct a material testing program and study to determine the material strength of the existing concrete and the overall condition of the deteriorated structure. The extensive material testing and investigation program, completed in January 2002 confirmed the presence of severe cracking and low concrete strength throughout the structure and its cause to be primarily due to ASR.

Seismic vulnerability studies concluded in 2004 that the viaduct, with its current state of material deterioration and lack of structural detailing has a high vulnerability to failure under a moderate seismic event (an earthquake is expected to occur every 40 years). The probability that the viaduct will experience significant failure, and possibly collapse, under seismic events exceeds 70 percent over 50 years. This vulnerability level is extremely high compared to the normally accepted collapse probability of 5 percent or less over 50 years. The high risk of collapse and continuing concrete deterioration indicates the need for timely corrective action to 1) seismically retrofit vulnerable viaduct and remove all concrete members experiencing ASR or 2) replace the existing viaduct.

In addition to its vulnerability to collapse under predictable seismic forces, the 6th Street Viaduct also displays various design deficiencies and safety issues. In the mid 1990s, Caltrans conducted an evaluation of Bridge No. 53-0595 (overcrossing US 101) and determined that seismic retrofit was warranted. In 1995, Caltrans undertook a seismic retrofit project for this portion of the 6th Street Viaduct, which is owned by Caltrans. The constructed Caltrans retrofit project utilized infill walls between the existing columns at the bents adjacent to the mainline roadbed (from Bent 37 to the east abutment). While this improvement was consistent with the City of Los Angeles preliminary investigation, it did not address the ASR problem and only improved a 235-foot (ft) portion of the 3,500-ft viaduct. Thus, the majority of the structure has not been seismically retrofitted and is still vulnerable to collapse in a major seismic event.

The City owned viaduct (Bridge No. 53C-1880) has a sufficiency rating of 52.4. The deficiencies consist of:

- Inadequate roadway width that does not meet minimum City safety standards for a secondary highway. This is due to substandard sidewalk width.
- Damaged and cracked railings on the north and south sides of the viaduct, resulting in unsafe conditions.
- Railings that do not meet current Caltrans vehicle crash or Americans with Disabilities Act (ADA) standards.

Project Alternatives

Among five retrofit alternatives studied in the Final Seismic Retrofit Strategy Report (June 2004), only one strategy, using heavy steel casing at the column bents, slows down the ASR deterioration but only in the columns. Its life expectancy would be 30 years. The five retrofit alternatives consist of:

- Infill Shear Walls
- Steel Column Casing
- Catcher Walls
- Concrete Casings
- Heavy Steel Columns Casings

The replacement alternatives resolve the ASR deterioration by complete removal of the viaduct. Several replacement alternatives were identified in the 2004 report, and these are now being further assessed along with others.

For the purpose of the environmental analysis, a No Build Alternative and two Build Alternatives are being considered. These are briefly described below.

Alternative 1 – No Build: This alternative provides no retrofit or replacement of the 6th Street Viaduct. The ASR deterioration of the structure would continue. The City would provide ongoing inspection and maintenance on the viaduct to keep it open to traffic as long as possible, given the ongoing ASR deterioration. The 6th Street Viaduct would maintain a roadway width of 46 feet, which accommodates two travel lanes in each direction with no outside shoulders. The unsafe railings would not be improved to acceptable standards.

Alternative 2 – Viaduct Retrofit: The viaduct’s columns would be retrofitted with steel casings, and infill walls would be constructed at additional columns and bents. All columns that are currently identified to have “Moderate-Severe” to “Severe” damage ratings would be encased to reduce the possibility of further deterioration. Additionally, the steel casings would be designed to withstand the high level of internal pressure due to ASR-induced lateral dilation of the encased column. Bent 12 is excluded from retrofitting because of lack of room available for construction of the column encasement due to the proximity of railroad tracks. Under this retrofit alternative, 76 columns would be encased, of which 26 would utilize 7/8-inch plates and 50 would use 5/8-inch steel plates. The exposed plates, channels, and bars would be concealed by a 6-inch layer of architectural mortar. All exterior columns with “Light” or “Moderate” damage ratings would also be encased to account for future concrete degradation due to ASR. Encasement of all exterior columns would also maintain visual balance and consistency for the retrofitted structure. The interior columns in Bents 1, 4, and 5 would be encased to enhance their shear strengths. A conceptual drawing of this proposed retrofit alternative is presented in Exhibit 1.

Alternative 3** – **Viaduct Replacement: The 6th Street Viaduct would be demolished and replaced with a new four-lane structure. Four alignment alternatives have been defined for the purpose of environmental evaluation (Exhibit 2). Each alignment alternative may be evaluated with multiple bridge types and profiles. Based on the public input, the new viaduct may be designed with various use features, but no additional traffic capacity would be provided. The bridge types and profiles for the following alignment options have yet to be determined.

- Alignment Option 1: The replacement structure would be built along a new horizontal alignment (blue line on Exhibit 2). The new structure would have a cross section that meets secondary highway standards as required by the City of Los Angeles Bureau of Engineering (LABOE). The new 70-foot wide (curb-to-curb) viaduct would consist of two 11-foot wide lanes in each direction, a 10-foot median, and 8-foot shoulders. The proposed cross section also allows for 10-foot sidewalks.

  The new viaduct structure would extend east from Mateo Street to just east of the U.S. 101 interchange. The new structure design would allow for a transition on the west side between Mateo Street and Mill Street to blend in with existing conditions. Due to the wider viaduct structure, the north side of the viaduct footprint would extend to the north while the south side of the footprint would remain at the same location except for the segment of the alignment that spans over the Los Angeles River, which would be shifted slightly to the south to improve the existing horizontal curve radius and provide better design speeds and stopping sight distances.

- Alignment Option 2: The new structure would be built along a new horizontal alignment (yellow line on Exhibit 2) similar to that described in Option 1, with the exception of a larger radius span over the Los Angeles River to allow for better design speeds and sight distances.

- Alignment Option 3: This option (green line on Exhibit 2) proposes a horizontal straight line alignment for the segment from Mateo Street to the west bank of the Los Angeles River, allowing for more bridge type options. The alignment under this option would swing to the north approximately 182 feet from the existing alignment eliminating the existing radius at the east end and providing the best design speeds compared to the other alignment options under consideration.

- Alignment Option 4: The alignment under this option (red line on Exhibit 2) is similar to that described under Option 3 except that the radius east of the river is much larger, resulting in less extension of the viaduct footprint to the north. The alignment under this option would swing to the north approximately 85 feet from the existing alignment, eliminating the existing radius at the east end.

Construction Schedule and Phasing

A four year construction is scheduled to commence in 2010 to 2014. The viaduct would be close for traffic during the demolition and construction phases. A Traffic Detour and Management Plan would be implemented to minimize traffic impacts during project construction.