

Interstate 280 Bridge, San Francisco, California

>>> BRIDGE HINGE REPLACEMENT

CALIFORNIA FACES a unique challenge when it comes to repairing its bridge structures. The state has more than 8,000 bridges that are older than the typical 50-year average life span. Nearly 3,000 of its bridges are in need of rehabilitation. Furthermore, earthquakes that occurred in the late 1980s and early 1990s led to an intensive period of seismic upgrades to bridge structures. These seismic retrofits made critical gains in terms of earthquake preparedness, but they also resulted in bridge sections that were built with new designs and new technologies, giving the California Department of Transportation (Caltrans) even more to inspect and maintain.

Bridge hinges (joints designed to accommodate thermal movement) on the Southern Freeway Viaduct, a portion of I-280 located in downtown San Francisco, were showing signs of disintegration by 2014. Originally built in 1964 – though receiving some retrofits after the 1989 earthquake -- they needed to be reconstructed according to current Caltrans seismic standards. This entailed configuring them with 2-foot seatings, as opposed to the existing 6 inches, so that they would be able to accommodate large movements along not only the X and Y axes (longitudinal and vertical displacement), but also vertical movement along the Z axis.

A total of four hinges, along with 25-30 feet of structural box girders on the 53' wide bridge, were scheduled to be completely removed and replaced. The work included demolition of the concrete around the old bridge hinge, removal of the hinge, installation of a new bridge hinge and the placement of new rapid strength concrete.

This stretch of I-280 handles heavy commuter traffic, carrying 65,000 vehicles per day. It also serves the new AT&T Park (home of the San Francisco Giants), increasing traffic volume further. While the scope of repair work prohibited standard night closures, long term lane closures were avoided by establishing three 100-hourlong weekend (holiday) closures. On the closed portions of the viaduct, entire hinges were replaced during consecutive shifts.



Strength development for the new concrete became a focal issue of this project due to the short lane closure times, so for the first time on a full bridge project, rapid strength concrete was used in a structural application. A south-bound stretch of highway was the first job to be performed, with work being completed during Memorial Day weekend in 2014. Highway closure was scheduled to occur between 9 p.m. Thursday before the holiday and continue through 5 a.m. Tuesday. Reopening of the highway at the scheduled time depended upon the concrete gaining strength.

Prior to using the rapid strength concrete, the contractor constructed a full section mock-up of a bridge hinge and Rapid Set® concrete was pumped in using a volumetric mobile concrete truck to accurately replicate jobsite practices. A series of tests was performed, verifying that rapid strength concrete would have the necessary strength and durability to perform well in the I-280 application. All results were favorable; the concrete maintained its uniformity in the joint and shrinkage levels were very low. Caltrans strength requirements (a minimum of 1200 psi at 3 hours and 3600 psi ultimate strength that was achieved in 4 hours) were

TEAM MEMBERS

- California Department of Transportation (Project owner)
- Golden State Bridge Inc. (Construction contractor)
- Precision Concrete Materials LLC (Rapid strength concrete supplier)
- CTS Cement Manufacturing Corp. (Fast setting cement supplier)

met. The Rapid Set® concrete also remained workable long enough to accommodate the work being done on-site.

Concrete test results on the jobsite were just as favorable as they had been on the mock-up. The entire section of concrete that was removed from the joint location was replaced with Rapid Set® concrete, proving that structural repairs can be completed with rapid strength concretes. Furthermore, set times were more than adequate to accommodate short lane closure times: the I-280 bridge opened three hours ahead of schedule after the use of Rapid Set® concrete.