

**Informational Hearing
Addressing Safety Concerns
Related to State Bridges**

**Senate Transportation and Housing Committee
August 14, 2012**

BACKGROUND PAPER

When a 250-ton section of the upper deck of the Bay Bridge collapsed during the 7.1-magnitude Loma Prieta earthquake in 1989, it served as a wake-up call for the entire Bay Area. It became clear that, because the area was so vulnerable to major seismic events, California needed to make its bridges seismically sound. Through the following decade, the state either replaced or seismically retrofitted nearly all of the Bay Area bridges.

While the Bay Bridge reopened less than a month after the Loma Prieta quake, a critical question lingered: How could this bridge - a vital regional lifeline structure – be strengthened to withstand the next major earthquake? Seismic experts from around the world determined that to make each separate element seismically safe on a bridge of this size, the work must be divided into numerous projects.

The state completed the west span retrofit work, including adding massive amounts of steel and concrete along with new seismic shock absorbers and bracing, in 2004. By fall of 2009, the state completed seismic safety retrofit work on the west approach which involved completely removing and replacing a one-mile stretch of Interstate 80, as well as six on and off-ramps. Rather than a seismic retrofit, experts concluded that the two-mile long east span needs to be completely rebuilt. The new span will feature the world's longest self-anchored suspension bridge, connected to a skyway that gradually slopes down toward the Oakland shoreline. The Department of Transportation (Caltrans) expects to complete and open the east span by September of 2013.

Recent media reports have raised a variety of concerns about the safety of the eastern span of the Bay Bridge, as well as some of the other Bay Area bridges. Specifically, articles in the *Sacramento Bee* have identified safety inspection falsifications by a Caltrans technician and the consequent cover-up, raised questions about the independence of a review panel, and suggested there may be problems with the concrete in the foundation of the Bay Bridge's main tower. More recently, the *Bee* reported that Caltrans may have identified additional safety concerns around the state that may need to be addressed.

The purpose of the August 14th hearing is two-fold. First, this hearing will give Caltrans and others the chance to respond to and describe actions taken which address these safety concerns related to the Bay

Bridge. Second, the committee looks to explore options available to the Legislature to confirm further the safety of the state's bridges, and begin to get to the bottom of what could be a systemic problem with safety tests within Caltrans. This background report first presents a summary of the history of the Bay Area bridge seismic retrofit program. Then, it reviews the safety concerns raised about the bridges and their construction.

History of the Seismic Retrofit Program

On October 17, 1989, the Loma Prieta Earthquake struck the San Francisco Bay Area, resulting in 62 deaths and leaving 8,000 people homeless. The epicenter, Loma Prieta, is approximately 60 miles south of the San Francisco- Oakland Bay Bridge. The damage this moderate earthquake caused highlighted the seismic vulnerabilities of all the state-owned toll bridges, especially the Bay Bridge. Caltrans initiated research projects soon after the Loma Prieta Earthquake to understand better the vulnerabilities of the state-owned toll bridges because of their structural complexity and uniqueness.

In 1990, Governor Deukmejian, through an executive order, created the Seismic Advisory Board (SAB) consisting of preeminent experts in seismology and geotechnical and structural engineering from the earthquake community and academia. The Seismic Advisory Board advises Caltrans on seismic safety policies, standards, and technical practices. This board of experts and other peer review panels has advised Caltrans to continue addressing the seismic vulnerability of the Bay Area bridges as quickly as possible since another destructive event could strike at any moment.

The Bay Area bridges are the largest and most complicated bridges in the state. Nowhere in the world have bridges as complex as these been seismically retrofitted. Variable soil types and foundations, seismic forces ten times the original design forces, aged structures, heavy traffic volumes, conflicts with utilities, air space concerns, handling of hazardous waste, and care to protect sensitive aquatic, cultural, and historical resources all contribute to the difficulty in retrofitting these structures. Based upon the hazard and vulnerability studies and input from SAB, Caltrans determined to seismically retrofit seven of the nine state-owned toll bridges in the Bay Area. In addition, Caltrans deemed replacement to be the most cost-effective, long-term retrofit strategy for the San Francisco-Oakland Bay Bridge east span and the westbound Carquinez Bridge.

Caltrans moved forward with an aggressive program to ensure that all bridges in California are seismically retrofitted, including the state-owned toll bridges, but by fall of 2004 it became apparent that project funding was insufficient to cover expected costs. In response, Governor Schwarzenegger signed into law AB 144 (Hancock), Chapter 71, Statutes of 2005, and thereby created the Toll Bridge Program Oversight Committee (TBPOC) to provide project oversight and project control for the Toll Bridge Seismic Retrofit Program in California.

The TBPOC is composed of the Director of Caltrans, the Executive Director of the Bay Area Toll Authority, and the Executive Director of the California Transportation Commission. The Legislature

assigned program oversight and control activities to the TBPOC, including review and approval of contract bid documents, review and resolution of project issues, evaluation and approval of project change orders and claims, and the issuance of monthly and quarterly program progress reports.

Specifically, one of the main responsibilities the Legislature delegated to the TBPOC is to investigate and respond to safety concerns involving the Seismic Retrofit Program. For example, when Caltrans employees informed the TBPOC of concerns involving welds on the main bridge girders being assembled in China, TBPOC formed an expert panel in November 2010 to assess the quality of workmanship. Caltrans received the panel's recommendations and quickly implemented changes in order to resolve the issue. By November 2011, TBPOC's expert panel reported that, after reviewing all data for welds of interest, Caltrans' implementation of its recommendations achieved the expected weld quality improvement. In other words, the problem was resolved to the experts' satisfaction.

Bay Bridge Safety Concerns Recently Raised

A November 2011 *Sacramento Bee* article raised concerns regarding the adequacy of Caltrans' technicians' construction inspections of the foundations of bridges, including the foundation for the new east span of the Bay Bridge. In brief, the article alleged that a Caltrans inspection engineer discovered that an inspection technician, Duane Wiles, had falsified inspection data, destroyed raw data from inspections, and not properly checked the calibration of instruments used to perform the test. The article further alleges that when Brian Liebich, a transportation engineer who until recently was responsible for managing foundation testing, was told that Wiles had falsified data, he embarked upon a cover up. Seven months after the report of data falsification, Mark Willian, Liebich's supervisor, wrote a letter of reprimand to Wiles.

TBPOC Response

In response to the reports calling into question foundation testing results and the safety of the new east span, the TBPOC commissioned the Seismic Safety Peer Review Panel in November 2011 to review records and answer questions regarding the design, quality assurance, and safety of the Bay Bridge east span's main tower foundation. Structural engineer Joseph Nicoletti chaired the four-member panel. He had previously served as chair of the Engineering and Design Advisory Panel for the Bay Bridge East Span replacement project. Other panel members included Dr. Frieder Seible, who is dean of the Jacobs School of Engineering at the University of California at San Diego; Dr. I.M. Idriss, an independent consulting geotechnical engineer and emeritus professor of civil engineering at the University of California at Davis; and Dr. John Fisher, professor emeritus of civil engineering at Lehigh University and director emeritus of the ATLSS Engineering Research Center. Three of the four panel members are also members of the prestigious National Academy of Engineering.

The evaluation, which covered construction methods, equipment, and quality testing related to the foundation of the main tower of the new east span, concluded that no data falsifications occurred at the

tower foundations and that the structure is safe. The Federal Highway Administration (FHWA) came to a similar conclusion after analyzing the foundation test data.

Further Concerns Raised

After the Seismic Safety Peer Review Panel released its report concluding that the tower foundation piles were safe, a *Sacramento Bee* article on March 25, 2012, raised concerns about the panelists' independence. According to the *Bee*, three of the four members of the panel have had financial ties with Caltrans or its contractors, and three helped select the Bay Bridge design. According to an ethics expert quoted in the article, these conflicts of interest could have affected the panel's judgment. Further, the panel met behind closed doors and relied almost entirely on materials prepared or managed by Caltrans, although the panel was asked to convene after evidence of malfeasance by Caltrans employees came to light.

Both Caltrans and the panelists vociferously defended the panel's independence and its conclusions. Caltrans chose the panel members based on their knowledge and expertise. The panel members indicated that, with their professional integrity at stake, they in no way let any relationship with Caltrans influence their review of the issue.

Questions about Foundation Concrete

On May 26, 2012, a *Sacramento Bee* article raised concerns about the concrete in the main tower's foundation of the Bay Bridge's eastern span. Based on records provided by Caltrans to reassure the public about the overall stability of the bridge, the *Bee* concluded that a contractor failed to disclose that a 19-foot section of concrete in the foundation had not hardened before it was tested. According to the *Bee*, experts said this failure to allow the concrete to harden properly, combined with other construction and testing lapses by Caltrans, raised new questions about the structural integrity of the bridge. Beyond the large area of suspicious concrete in one of the foundation piles, the *Bee* investigation found numerous other problems with the piles as well as gaps in essential data. Experts questioned the ability of the main tower foundation to withstand an extreme earthquake.

Specifically, the *Bee* found:

- Two of thirteen piles that rise out of the bay to hold up the tower contain suspect and inadequately tested concrete. Sonic-wave tests revealed a 19-foot section of poor concrete in Pile 3, in a location subject to profound seismic forces. When tested, the concrete had not hardened to the required strength. It was not retested. Further, for unclear reasons, Pile 8 either received no sonic test or builders could not locate the test report. Job-site inspection diaries also show construction abnormalities in that pile.

- Sonic test reports contained more than 20 errors. Among other slips, they misstated which piles were tested, test dates, and pile measurements. Experts said the unusual volume of mistakes casts doubt on the reliability of testing for both the problem pile – Pile 3 – and others deemed free of defects.
- Builders treated the piles with an additive meant to increase concrete strength, but known to cause soft or poor quality concrete when overused – one possible explanation for the 19-foot anomaly. Although computer programs used to effectively create concrete should ensure mixing precision, records for a different pile show unexplained mixing errors by a concrete plant computer.
- Caltrans and its experts said the bridge is safe, but Caltrans’ own documents contradict many of their supporting assertions. For example, a Caltrans panel asked to review the work said sonic tests proved that the piles were of sound construction, despite the Pile 3 problem and the lack of testing for Pile 8. Panelists relied heavily on tests of what they called "full scale" mock-ups. Those models actually were a small fraction of the bridge piles' size. Independent experts said the mock-ups offered invalid comparisons.

The *Bee* concluded that the combination of missing and undisclosed data, radiation’s inability to detect unset concrete, doubts about the piles’ design, uncertain testing reliability, and reliance on model piles creates uncertainties about how the foundation would behave in a worst-case scenario.

Caltrans’ Response

In response to what he termed a misleading and inaccurate representation of the facts, Caltrans Director Malcolm Dougherty called on the *Sacramento Bee* to retract the story raising questions about the bridge foundation concrete. A Caltrans review of the *Bee*’s assertions determined that the report was completely inaccurate and that it contained false information and a selective reading of records. In a letter to the *Bee*, Director Dougherty claimed the reporter was given voluminous evidence that contradicts the story’s conclusion that the bridge foundations were inadequately tested, and that the reporter failed to test the accuracy of his claims while omitting information that contradicted his conclusion.

In this letter, Caltrans raised the following specific examples of inaccurate and misleading reporting:

- The story claims that Caltrans was “prevented” from doing “further examination or repair” on Pile 3 because Caltrans did not see a subcontractor’s report identifying a 19-foot anomaly using “cross-hole sonic logging (CSL)” in Pile 3. According to Caltrans, this is false, as Caltrans did substantial further examination. The concrete in Pile 3, as in all the piles, was designed to meet certain strength requirements, not to set in a short period of time. Concrete for Pile 3 was tested 28 days after it was poured and met strength requirements. The contractor tested Pile 3

on day four – a full 24 days before the Caltrans test. Caltrans uses cylinder break tests to assess concrete strength, and checks this over extended intervals, sometimes in as little as 14 days after concrete is poured and in some cases as long as 56 days after concrete was poured.

- The story makes an unsubstantiated hypothesis that a concrete additive may have been overused, which is directly contradicted by certifications and factual records indicating consistent, correct concrete mix was produced. This was verified by a variety of tests.
- The story claims that the testing subcontractor, Olson Engineering, detected the “problem concrete” in Pile 3 in 2007 and “suggested new sonic tests.” Caltrans states that this is not accurate. Olson suggested new sonic tests or a gamma-gamma test. Caltrans performed the gamma-gamma tests, consistent with Olson’s suggestion, three days after the cross-hole sonic test and seven days after the concrete was poured. This test showed the concrete had no significant anomalies and had the required density. Caltrans claims that the reporter was given all this information but he omitted Olson’s suggestion that gamma-gamma tests could be performed in lieu of sonic tests, creating the false impression that Caltrans failed to verify the safety of the pile.
- According to Caltrans, the *Bee*’s reporting on Pile 8 similarly relies on conclusions invented by the reporter. The *Bee* asserts that Pile 8 had “inferior concrete,” was “plagued by test and construction problems” and was beset by “construction abnormalities” without providing any evidence to support these claims. Caltrans indicates that all tests – the “slump test” performed during the pour, the “break test,” the gamma-gamma tests performed after the pour, and the chipping – show no abnormalities. These test results give Caltrans confidence that Pile 8 is safe.

Finally, Caltrans concluded the letter to the *Bee* by pointing to a pattern of care and quality assurance at every stage of the Bay Bridge project. Caltrans recognizes that the safety of millions is dependent on the engineering work Caltrans does on structures like the Bay Bridge. Director Dougherty states that he believed the *Bee* reporter misled the public and on that ground requested a retraction. The *Bee* chose not to retract the story, stating that the paper’s investigative mission requires it to raise these questions.

Suspect Safety Tests

On August 5, 2012, the *Sacramento Bee* reported that a special team within Caltrans has uncovered problems with safety testing far broader than previously known. In response to concerns raised involving technician Duane Wiles fabricating test data, Caltrans formed a team last December to review test data from all over the state to determine if tampering with safety inspection data was widespread or limited to this particular technician. To encourage integrity of the results, the team includes the individual who discovered the initial fabrications and reported the issue to Caltrans as well as other concerned experts. Using computer algorithms to analyze roughly 90,000 files, the team has identified

roughly 1,000 files of testing data containing some type of anomaly. The team is now looking through each of these files to determine the significance of these anomalies. A final report will be issued by the team after its methods and findings have been vetted by a panel of outside experts being assembled by FHWA.

Caltrans indicates that the special team's work is still ongoing and the information included in the *Bee* report is preliminary. The department is awaiting the team's final determination and will resolve any real issues the team identifies.

Conclusion

The seismic retrofit or replacement of Bay bridges is some of Caltrans' most complicated, but critically important work. Caltrans must adequately resolve questions about the quality of that work and consequent inspections in order to confirm the safety of this critical work to both the Legislature and the public. The August 14th hearing will identify potential next steps toward that confirmation.