

Questions raised on Bay Bridge structural tests

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The spire of the new San Francisco-Oakland Bay Bridge eastern span majestically climbs hundreds of feet above the bay, an emerging icon of California's engineering and aesthetic prowess.

Scheduled for completion and public use in 2013 at a projected cost of \$6.3 billion, the bridge is the largest public works project in state history. Its designers placed one quality above all others: the strength to withstand the strongest anticipated earthquake.

Yet a Bee investigation has found that the state Department of Transportation technician who conducted key testing to ensure structural integrity of the span's foundation was later disciplined for fabricating test results on other projects. The technician, Duane Wiles, also failed to verify that his testing gauge was operating properly, as required by Caltrans to ensure the gauge's accuracy, before he examined parts of the Bay Bridge tower foundation.

When Caltrans officials became aware of the problems with Wiles they did not thoroughly investigate his earlier work - despite public safety concerns raised by other test employees and an anonymous whistleblower.

Until contacted by The Bee for comment, Caltrans had not assessed Wiles' work on the Bay Bridge tower.

Although Caltrans says the bridge is safe, The Bee's findings raise questions about its structural integrity that are not easy to answer. Outside experts say the bridge tower foundation probably is reliable but suggest further review.

Questions about Caltrans' testing extend to other projects. A Bee examination of nearly 50,000 test documents regarding foundations for bridges, overpasses and other freeway features showed that structures across the state were approved after questionable work by Wiles. In three confirmed cases, Caltrans documents show that he fabricated results.

Wiles also routinely discarded raw data files that provide the best information to detect fabrications.

Federal Highway Administration investigators have launched a detailed investigation of past tests, Caltrans chief engineer Robert Pieplow acknowledged in a recent interview. He said the U.S. Department of Transportation had completed a separate investigation of fraud, waste and abuse in the Caltrans Foundation Testing Branch, where Wiles worked, and that Caltrans was conducting a similar probe. Caltrans would not release any findings.

In a written statement, Pieplow said that for legal reasons he "cannot confirm or deny the identities of employees," but that Caltrans "has identified the full extent of this technician's actions (and) taken appropriate remedial measures."

On Nov. 8, three years after Wiles' fabrications were discovered and three weeks after The Bee contacted Caltrans about them, Wiles and his supervisor were placed on administrative leave, according to a Caltrans spokeswoman.

Wiles declined to comment.

In an interview, Pieplow called the type of tests conducted by Wiles one aspect of the agency's quality assurance program.

"As for the Bay Bridge," Pieplow said in a written response to questions, "the (tower foundations) are safe and it would be highly misleading and irresponsible to suggest otherwise."

Nor, so far, had federal investigators found falsified test data for the Bay Bridge in their ongoing investigation, he said. The Federal Highway Administration declined to discuss its investigation or findings with The Bee.

But Caltrans data and engineering diagrams cast doubt on the adequacy of testing of the foundation for the span's signature feature, the tower, and raise questions about its structural integrity.

In 2006 and 2007, Wiles tested seven of the 13 concrete and steel shafts, or "piles," buried deep in the bedrock beneath the bay to support the new Bay Bridge tower.

Wiles' tests, meant to confirm pile strength, showed results roughly the opposite of those captured by other technicians. In all but one case, Wiles' data showed no significant problems, while his colleagues detected many areas of questionable concrete density that required further scrutiny or repair.

Two internationally known bridge-foundation experts who examined hundreds of Caltrans data files, engineering diagrams and reports at The Bee's request, have questioned whether any of the 13 piles were tested adequately before their approval and the tower's construction atop them. Part of the problem, they said, was that the pile design made the structures extraordinarily difficult to cast and test.

The experts agreed that the bridge tower piles probably are reliable even with undetected weaknesses, because they were "overbuilt" to withstand a quake stronger than scientists believe will occur on the nearby San Andreas or Hayward faults. They disagreed on the degree of uncertainty introduced by testing irregularities and design concerns.

"The pile foundations for that structure would be categorized as highly redundant," said Dan Brown, who runs a small but influential foundation design and testing firm and has received numerous national and international honors for his deep-foundation work. "A structural defect in one or two of them would not really be a game changer."

But Bernard Hertlein, a principal scientist at Aecom Technology Corp., a global engineering and construction firm, and co-author of a reference text on foundation testing, said the adequacy of Caltrans tests and of the pile design raise significant questions with no clear answers.

Defects under the main tower would be nearly impossible to detect now, Brown and Hertlein agreed.

"Fixing the foundation in any significant way is pretty much impossible," said Hertlein, who has tested thousands of foundation piles. "Replacing the piles is not a viable alternative. Trying to beef up those existing foundations, which are already so massive," he added, "is probably not economically viable under any realistic circumstances."

Asked how he would address uncertainties about the bridge tower, Hertlein suggested a formal review of Caltrans engineering and test procedures by top bridge-building experts, "to come up with new procedures that at the very least would prevent this level of doubt on any future project."

He allowed that such a plan, combined with Caltrans' assumption that the completed bridge will be reliable, might not soothe wary drivers who would make about 100 million trips over the span annually.

"That's where the problem gets thorny," Hertlein said. "The only way to reassure the public is to do a complete review, with top-notch bridge designers. To look at the design, to assume you do have as much as a 40 percent-flawed foundation, and try and make an educated guess about how the structure would behave in a worst-case scenario."

Fail-safe design?

The 1989 Loma Prieta earthquake killed 63 people as it pancaked double-deck roadways in the Bay Area, flattened buildings and interrupted the World Series. It collapsed a section of the upper deck of the Bay Bridge, killing one motorist.

Lessons from the disaster transformed road and bridge building. Billions of dollars were spent on seismic upgrades.

State officials determined that the Bay Bridge eastern span, which resembles a giant Erector Set toy, must be replaced. It would be impractical, they concluded, to retrofit the structure to withstand a far more powerful temblor expected to hit eventually.

The centerpiece of the chosen design, a "self-anchored" suspension bridge, connects Yerba Buena Island with the elevated roadway leading to Oakland. Self-anchored refers to a single tower that supports roadways with cables tied to the roadways themselves. It would be the largest such span ever built.

Massive piles up to more than 8 feet in diameter, cast in concrete reinforced with rebar,

underpin the main tower. Each one reaches 196 feet below the waterline into the bedrock below. Their upper portions, surrounded by mud and water, are jacketed in steel and welded to the bridge footing.

To build the piles, boreholes were drilled and steel jackets set in place. Rebar reinforcing cages were then lowered into the holes, along with thin steel and plastic pipes set near the edge of each pile. Then the concrete was poured into the boreholes, casting the rebar and pipes in place.

The pipes allow tests of concrete density using two methods - gamma-gamma logging and cross-hole sonic logging.

In the first, Caltrans technicians, including Wiles, passed a radiation source down the length of the hollow tubes. The process can find changes in density that reflect structural defects within a few inches of a tube. Typically, about one in five piles shows anomalies that require further examination and possible repair, according to Caltrans.

Sonic tests, conducted in this case by a contractor, transmit compression waves "cross-hole," between steel pipes, to check average concrete density in the interior of a pile. But for most of the piles tested by Wiles, apparently no sonic tests were conducted.

Builders repair major defects to ensure that piles can withstand extreme stress.

James LoCoco, sales manager for the manufacturer of the gamma-gamma loggers, Denver-based Mount Sopris Instrument Co., called the gauges precision devices if used properly and verified for accuracy. But they go wrong periodically. Caltrans has returned devices to Mount Sopris for repair half a dozen times in the last decade, LoCoco said.

Records show that Wiles was responsible for verifying the accuracy of devices he used. That simple exercise involves examining a concrete block of known density. Expected results mean the device is fine, while unanticipated results suggest a malfunction. Wiles failed to verify the devices, according to Caltrans logs and memos.

For the Bay Bridge tower, six of the seven piles Wiles tested were found to be fine; five of the other six piles tested by different technicians showed significant anomalies.

Likewise, Wiles neglected to verify his devices during nearly all of 2006 and 2007. For some of the structures, Wiles recorded the required verifications, according to a Caltrans memo, but the results showed obvious accuracy problems that he ignored.

A Bee review of Wiles' work records shows that he failed to verify the testing devices for work on at least 25 structures, including several portions of the Bay Bridge, as well as bridges, freeway ramps, pedestrian walkways and large road signs in San Diego, San Jose, Anaheim, Oroville, Placerville and Los Angeles.

In his written comments, Pieplow, Caltrans' chief engineer, downplayed the importance of verifying the equipment. "If it were not functioning, the engineer conducting subsequent data analysis would readily notice" readings that fall outside the expected range, he said.

Brown, the geotechnical expert, viewed the failure to verify as far less troubling than the basic design of the Bay Bridge tower piles. It includes an extraordinary volume of rebar, ostensibly to increase pile strength, but he said that causes unintended effects.

"They put so much steel in it that there is no way in hell for all that concrete to get though" without trapping voids or weak pockets of contaminated concrete, particularly at the edge of the pile, Brown said, calling one section "ridiculous" in its congestion. "It's like trying to squeeze concrete through a screen door."

Other elements of the design made detecting such defects difficult. Each pile alternated steel and plastic pipes, because plastic is necessary for gamma tests and steel offers greater accuracy for cross-hole sonic logging.

Although the tower piles were cast after Caltrans issued rules in 2005 to ensure adequate testing of structural integrity, they were designed earlier.

That design violated key elements of the 2005 rules. For example, gaps between gamma-test pipes should not exceed 33 inches. In these piles, the pipes were cast 37 inches apart, so less of the pile was tested than required. The rules also call for at least 3 inches of clearance between the test pipe and adjacent rebar, which can alter readings. In this congested design, average clearance was about 2 inches; some testing pipes were surrounded by rebar supports as little as a half-inch away.

Pieplow said that the pile design did not contradict current test requirements, noting that Caltrans expects the engineer who evaluates test data to consider the unique character of each pile.

Hertlein, the other testing expert, identified another design problem: The pipes were about 8 inches from the edge of the pile, but the maximum range of gamma testing is about 4 inches.

The point of gamma-gamma tests is to detect casting problems that often occur at the periphery, particularly where rebar congestion occurs. The periphery of a pile performs a crucial role in load bearing and lateral stabilization during a major earthquake. If such flaws were present, they would likely have been missed. (In other structures, such as a large freeway interchange in Southern California, test pipes were placed up to 16 inches from the pile edge.)

More important, Caltrans said it had no records of sonic logging to supplement gamma tests for six shafts examined by Wiles. Therefore, apparently just 5 percent of the volume of those piles was examined for structural soundness - and that small portion was impeded by rebar congestion and examined by Wiles with a device that was not verified for accuracy.

Again, the independent experts' conclusions varied. Brown said that the foundation's redundancy - deploying more piles than absolutely required - would protect against undetected defects, which probably are minor.

Hertlein was less sanguine.

"They slipped up quite badly in their quality control," he said.

Falsification revealed

Caltrans memos show that Wiles' falsification of test data first came to light in September 2008. It involved an examination of a freeway overpass in Riverside. Jason Wahleithner, an engineer, found the deception while evaluating the data for a report, according to an internal Caltrans email obtained by The Bee. Foundation Testing Branch engineers were troubled by the fabrication and how the branch chief, Brian Liebich, responded.

The following month, Michael Morgan, a Caltrans foundation test engineer at the time, expressed concern to Liebich, in a memo obtained by The Bee, about a meeting soon after the fabrication came to light, in which Liebich told engineers to distribute test assignments evenly among the group's technicians. This included Wiles. Morgan urged Liebich to bar Wiles from testing duties, at least until after other falsifications had been ruled out.

"We are putting the reputation and integrity of the (testing branch) at stake..." Morgan wrote. "We are a public agency and the data and conclusions contained in our reports can end up costing contractors thousands to millions of dollars. Our work also can be linked to the safety of the traveling public." He said that he refused to "participate in a charade" about Wiles' work.

About a month later, he emailed Liebich and Liebich's boss Mark Willian to say that he had taken a cursory look at thousands of data files created over two years to check for obvious falsifications. Morgan wrote that he found suspicious data - "duplicate time or out of time sequence files" that imply someone changed or created files after tests ostensibly were conducted. He suggested a methodical examination to see if the data were falsified.

"The work that has been done so far is inconclusive and barely scratches the surface of what could reasonably be called a thorough or comprehensive search for falsified data," Morgan wrote, noting that he lacked the time to complete the forensic task.

Yet, in a January 2009 memo, Liebich told Willian, who oversaw various geotechnical services for Caltrans, that Morgan's review proved Wiles' had falsified just once, on the Riverside freeway overpass. Caltrans retested before completion of the structure.

Liebich described Morgan's work as a definitive validation of not just Wiles' other work, but "all of the Gamma-Gamma Logging data collected by the Branch."

He also cited an "intensive analysis" by Tejinderjit Singh, another engineer whom Liebich assigned to examine 18 months of Wiles' prior work. Singh found no evidence of other fabrications, Liebich wrote, apparently validating Wiles' claim that he falsified data only once.

Based on the review cited by Liebich, in April 2009 Willian issued a written reprimand to Wiles, obtained by The Bee, calling the fabrication "a critical and inexcusable breach of ethics." He directed Wiles to behave in an ethical manner in the future.

Pieplow said "the individual" who falsified data refused to say why he did so.

Other falsifications

Caltrans memos show that less than two months after Wiles was reprimanded, Wahleithner, apparently on his own initiative, found two other falsifications on a freeway sign in Oakland and a heavily traveled I-405 freeway bridge over Braddock Drive on the west side of Los Angeles.

Liebich told Willian in a memo that the additional falsifications had been missed in the first review because they fell outside the time frame examined. But the incidents occurred in April 2007 and March 2008, during the period scrutinized.

In both cases, Liebich wrote, the "pile in question needs to be evaluated for potential safety concerns to the traveling public."

Liebich did not return calls seeking comment, and Willian referred questions to Caltrans public affairs officials. Last week, Liebich was placed on administrative leave and Willian was reassigned to head drilling services, one of the 11 units he previously supervised.

Brown, the foundation expert, said that the significance of false data would depend on considerations unique to each structure, but only severe defects could create life-threatening dangers.

"Systematic flaws ... that's where you would worry," he said. "That could make the thing fall down."

As of last year, the Federal Highway Administration had deemed more than 7,000 California bridges "structurally deficient." Few fall down, even in earthquakes, said Bengt H. Fellenius, a foundation consultant and former engineering professor at the University of Ottawa in Ottawa, Canada, although most were built before today's tests were required. Fellenius and other experts said that designers build in a margin for error that usually compensates for construction or testing lapses.

But uncertainty rises when tests are deliberately fabricated, which he called "a rare thing," adding: "It's like murder."

James Davis, Caltrans acting director for engineering services, said in an interview that the agency assessed the Oakland sign, assuming serious defects in the portion of the pile for which data was falsified. Even so, it would hold during a maximum anticipated earthquake on the nearby Hayward fault, the agency concluded. So no repairs were made.

Davis said falsifications for the I-405 bridge pile were detected before the bridge was completed, and the pile was replaced.

Caltrans memos, logs and test reports about the structure, obtained by The Bee, tell a different story - that long after the structure was built, testing branch chief Liebich warned that it was a safety wild card.

In response to written questions about Davis' account, Pieplow said the I-405 pile "was found safe during multiple analyses over several years. ... Upon learning of the falsified data, another analysis was conducted, and the pile was yet again found to be safe."

Caltrans declined to release documents showing its analyses.

'Well-crafted misrepresentation'

Pieplow defended the review ordered by Liebich shortly after the first case of falsified data was found as "thorough," and said it confirmed "the safety of all structures."

Morgan, the engineer who conducted much of that review, disagreed.

About a year after Wiles was reprimanded, Morgan contacted Dolores Valls, then deputy division chief for geotechnical services and Willian's boss. In an email obtained by The Bee, he wrote that no genuine analysis of Wiles' work had been performed.

Morgan branded Liebich's exoneration of the Foundation Testing Branch - based largely on Morgan's own cursory analysis - "a well-crafted misrepresentation" with conclusions "unsupported by the facts."

Morgan added: "There has never been a comprehensive organized effort to analyze past gamma-gamma data and discover falsification."

Part of the problem involved missing data.

Wahleithner, the engineer who detected the fabrications, asked the manufacturer how to examine suspicious data, and he learned that the key was a special "RD" file, he told a colleague in a June 2009 email obtained by The Bee.

RD refers to unalterable raw data files generated by the test device. If data were in doubt, an RD file could be used to generate complete and accurate results for comparison against dubious data. In other words, if a technician falsified data, deleting RD files would be advisable to avoid getting caught.

Wiles routinely kept only "LAS" files - simple text files that anyone can change or edit - to display the results. He nearly always discarded the RD files.

Caltrans records show that other technicians retained RD files irregularly at best.

The manufacturer "pretty much read me the riot act when I told them we don't save the RD files," Wahleithner continued in his email.

Pieplow said that in 2008, after the first falsification was detected, Caltrans began to require that all RD files be retained - and that all test employees complied. But Caltrans archives indicate that only a small fraction of RD files were retained until July 2009. Records also show that in at least 30 cases, tests took place but no files - RD or LAS - were saved. In 85 other cases, no files were retained, but it's unclear whether testing took place.

Pieplow said that federal investigators delivered a progress report that their probe has not uncovered other falsified data so far.

Wiles kept on the job

In January 2009, an anonymous whistle-blower sent a detailed explanation of Wiles' fabrication problem, along with hundreds of pages of background files from testing logs and other Caltrans files, to the State Bureau of Audits. The Bee obtained a copy of the materials recently.

After the first falsification became known, the whistle-blower noted, other testing branch employees recalled that Wiles earlier had spoken openly "about his ability to change the data or make up for missing data by opening up and modifying the data files" created by the gamma-gamma software.

The whistle-blower added: "Wiles' past statement, combined with the speed and dexterity with which he was able to falsify the data on a recent job where he was caught, would lead a reasonable person to believe that he probably has falsified/modified (gamma) data in the past."

The whistle-blower also documented Wiles' failures to verify his devices to ensure accuracy and urged a full investigation to safeguard "the integrity of bridge foundations traveled over by the public."

A spokeswoman from the State Bureau of Audits said the agency does not comment on unpublished work.

"There generally seems to be no interest in finding out about problems with testing," the whistle-blower wrote to Will Kempton, then Caltrans director, a few months later. The author reiterated comments made to state auditors and warned that if no formal investigation ensued, concerns would be directed to the Association of Drilled Shaft Contractors trade group and to the Federal Highway Administration, because federal funds support many California projects.

Several members of the trade group declined to comment.

Asked whether fabricating bridge data and misrepresenting the extent of the fabrications is a firing offense at Caltrans, Pieplow, the chief engineer, called it "a human resources matter," handled case by case.

Even after falsifications came to light, Wiles kept his job testing piles. Later he was moved into collecting data on rock and soil conditions, and recently was moved out of technician work pending a personnel evaluation. Wiles was placed on administrative leave only after The Bee raised questions about his work.

Although Liebich no longer manages foundation testing, the unit's slogan remains the same: "One test is worth a thousand expert opinions."

Bay Bridge

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Panel that reviewed Bay Bridge foundations has ties to Caltrans

BY CHARLES PILLER - CPILLER@SACBEE.COM

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Frieder Seible, a panelist, is dean of the UC San Diego engineering school.

Leading engineering advisers, who met in secret to assess the testing and safety of the new San Francisco-Oakland Bay Bridge, maintain numerous financial and professional ties to the agency whose work they evaluate.

Transportation officials described the panel as independent, and late Friday it released its findings declaring work by the California Department of Transportation as correct and the bridge safe and sound.

But three of its four members have had financial ties with Caltrans or its contractors, and three helped select the Bay Bridge design – conflicts of interest that affected the panel's judgment, according to ethics experts contacted before the report's release.

The Toll Bridge Seismic Safety Peer Review Panel drew nearly all of its conclusions from material prepared or managed by Caltrans, even though the panel was asked to do the assessment because of possible malfeasance by the agency.

Experts on government ethics said the panel lacks the impartiality necessary to be perceived by the public as unbiased. Paula A. Franzese, a law and ethics professor at Seton Hall University in Newark, NJ, advises state and local governments on such matters. She described the panel's practices as "a significant departure from standard ethical canons."

"One central tenet of good governance," Franzese said, "is that those who act in the public trust must not be perceived as amassing some sort of personal gain as a product of that work."

The panel's Bay Bridge efforts were sparked by a Bee report last fall that a state employee had fabricated integrity tests on other structures, and failed to ensure accuracy while examining the foundation of the new span's main tower. Since December, panel members have studied testing issues related to the new \$6.5 billion eastern span of the Bay Bridge, scheduled to open by Labor Day next year.

Joseph Nicoletti, chairman of the four-member panel, said in the report that the foundation piles for the main tower were "designed, constructed, and tested in a way that meets or exceeds the state-of-practice and will result in a safe and reliable performance of the bridge." The panel, created and appointed by Caltrans in 1997, had been assessing the adequacy of certain tests on the tower foundation, according to Caltrans.

Its meetings were held in private despite requests from The Bee to open them.

State Sen. Mark DeSaulnier, D-Concord, transportation committee chairman, said the panel's meetings should have been open. If needed, he said, the Legislature would work to ensure such practices.

"We have to fix it. The whole idea of building a new bridge is for public safety," DeSaulnier said about the panel. "It would be awful to have that impaired in any way due to a conflict of interest or lack of transparency."

The four highly regarded engineers, whom Caltrans collectively paid about \$143,000 in the most recent fiscal year for which complete records were available, are:

Nicoletti, 90, a structural engineer who has served on the panel since its inception in 1997. He has nearly 70 years experience in coastal, seismic and structural engineering.

Izzat M. Idriss, 76, a geotechnical engineer and member of the National Academy of Engineering, is professor emeritus at UC Davis. A leading expert on geotechnical earthquake engineering, Idriss has served since 1997.

John Fisher, 81, a structural engineer and National Academy of Engineering member, is professor emeritus at Lehigh University and a private consultant. An expert on metal fatigue, he has been on the panel since 2008.

Frieder Seible, 62, a structural engineer and NAE member, is author of more than 500 technical reports. Dean of the UC San Diego Jacobs School of Engineering, he has served since 1997.

Outside of their panel work, two members have had financial ties to Caltrans.

The agency gave contracts worth nearly \$19 million to UC San Diego to fund work by Seible or professors under his purview for studies of the Bay Bridge and other seismic issues since 2003. Caltrans has paid Seible more than \$1.4 million more for his advice.

"My motivation, both professionally and personally, is to ensure that my expertise in seismic retrofit and seismic design for bridges and other transportation structures benefits the people of California," Seible said via email. He follows university and Caltrans disclosure rules, the professor said, and otherwise declined to comment.

Fisher consults for key contractors on the Bay Bridge and Benicia-Martinez Bridge, subjects of the panel's work, but said the business relationships did not influence his judgment.

Caltrans spokeswoman Tamie McGowen said the two panelists faced no conflict because the panel's current "issue under consideration" concerned a specific radiation test, called gamma-gamma logging, that was unconnected to Seible's research or Fisher's consulting.

Research conflicts

Caltrans formed the panel after the Loma Prieta earthquake prompted a decision to replace the Bay Bridge eastern span.

Steve Heminger heads the Metropolitan Transportation Commission for the nine Bay Area counties and chairs the Toll Bridge Program Oversight Committee, which manages funds for Bay Area bridges. The committee requested the panel's assistance on the Caltrans tests.

Heminger said the panelists often "tell Caltrans officials what they don't want to hear." They successfully argued against a Caltrans plan for retrofitting the Dumbarton and Antioch bridges, he said. Caltrans normally follows the advice of the panel, but in at least two other cases, the agency overrode panelists' suggestions.

In its Friday report, the panel validated all of Caltrans' previous assertions about the bridge foundations after relying almost exclusively on Caltrans officials to manage or conduct research for its report.

The background materials for that report were provided to The Bee. They included analyses of radiation-based tests of the bridge foundation by Caltrans; a report by Fountain Valley-based Earth Mechanics Inc., a geotechnical engineering firm; and a report on tests of demonstration piles built by Caltrans to reproduce the conditions of the bridge piles. They also cited a Federal Highway Administration computer analysis, not yet publicly released, which concluded that Caltrans employees had not fabricated Bay Bridge test data.

Asked about the Caltrans pile demonstration analysis, Nicoletti said in an email Saturday that he was unaware of that report, although the panel's findings relied on its conclusions.

Earth Mechanics was directed by Caltrans, according to Nicoletti. The company has often worked for the agency and as a subcontractor for builders of projects funded by Caltrans. It had a major role in pile design and geological considerations for the foundation of the new Bay Bridge eastern span, and cited its own prior work in materials provided to the panel.

The demonstration pile testing was conducted by the Foundation Testing Branch of Caltrans – the division implicated in data fabrication, other lapses and a cover-up of those problems.

'Group think'

Several panel members have served – often with pay – on other Caltrans advisory groups or efforts integral to Caltrans projects.

Nicoletti and Idriss were members of a related review panel, the Caltrans Seismic Advisory Board, which counsels the agency more broadly. Seible has been a member of that board since 1990, and its chairman since 2005. All three also served on an engineering advisory board, chaired by Nicoletti, that was instrumental in selecting the design of the new Bay Bridge. Seible has claimed credit for a key design concept behind the new span's main tower.

Franzese said Nicoletti, Idriss and Seible, who participated in the highly contentious design selection process, might "have a vested interest" in seeing that the chosen plan remains untainted in the face of uncertainties created by testing lapses and design questions.

"To avoid any untoward appearance, a completely new panel of impartial arbiters" should have been appointed to review the current problems, she said.

Judy Nadler, former mayor of Santa Clara, now a senior fellow at the Markkula Center for Applied Ethics at Santa Clara University, said the panelists' participation on powerful, overlapping boards could bias them to favor past decisions – a particular

weakness when weighing possible wrongdoing by Caltrans.

She called it "group think" – a failure of independent analysis – which often occurs within small groups that operate privately for long periods.

The panel, according to its chairman, has a casual, informal approach to its work.

The engineers influence bridge safety for millions of people and the spending of billions of public dollars, yet operate without bylaws, terms of office or a prescribed appointment process. Caltrans said it does not maintain a list of who served on the Seismic Safety Peer Review Panel other than its current members.

In an email before the panel released its report, Nicoletti described panel meetings as "intentionally more like workshops than formal meetings." The group and Caltrans bar the public from those sessions. Caltrans said the panel is not subject to the state Open Meeting Act.

Legal or not, Franzese called such informality and secrecy in a group with authority concerning profound and costly public safety issues "aberrational."

Heminger, of the Metropolitan Transportation Commission, defended private meetings as proper "as long as the advice ultimately makes its way to an accountable decision maker" – in this case, Caltrans.

"The public is extraordinarily well served" by the current peer review process, he said.

Max H. Bazerman, a business ethics professor at Harvard University, also defended closed meetings as sometimes more effective. Some advisory groups work more efficiently and are "more capable of being skeptical and critical in secret than in public," Bazerman said.

But the relative merits of efficiency and openness depend on the context of the task, he said. Last fall, The Bee reported that Caltrans didn't reveal serious bridge-testing problems – including fraud – to the public, elected officials, Heminger and the peer review panel itself.

"The less trust there is," Bazerman said, "the more effort we need to recreate trust in the process."

Lucrative research

Panel members never have been obligated to report economic interests, such as business clients, investments and corporate board memberships, so a comprehensive examination of possible conflicts has not been possible. After a recent inquiry from The Bee, the California Fair Political Practices Commission acted to require such reporting by the four panelists beginning in April. Heminger said he supports the move.

Panelists' earnings from Caltrans or bridge builders might particularly affect their independence, experts said.

Since 1991, Seible's contracts for providing advice to Caltrans as a member of this panel and similar boards averaged about \$70,000 annually.

Public records, although incomplete, show that he has benefited financially and professionally from work on Caltrans projects beyond those fees. He has received Caltrans funding for at least 42 seismic research projects related to the Bay Bridge and other structures since 1991.

In some cases, Caltrans funded Seible's work via contracts with his private consulting companies; in others, contracts with UCSD specifically supported his work.

Among those funded projects, at least 30 came after his appointment to the Seismic Safety Peer Review Panel. Seible received Caltrans funds for numerous other projects while serving as a member of the separate Seismic Advisory Board. Professors in his school have been funded for at least 23 additional projects since he became dean in 2003.

Caltrans said it had no comprehensive records about the number of such contracts or their value, but 26 of the most recent agreements for Seible or members of his faculty totaled nearly \$19 million, including Seible's \$4.1 million "seismic research proof testing" project for the new Bay Bridge.

In addition to the financial benefits to Seible and UCSD, he and his professors wrote scholarly papers and gained professional honors for work underwritten by Caltrans.

"Even presuming the high-mindedness of everyone serving on this board, the body itself is fraught with, at a minimum, significant concerns for the appearance of untoward conflicts of interest," Franzese said. In most states, she added, given a situation like that of Seible, "recusal would be warranted."

Fisher, meanwhile, consults for Wiss, Janney, Elstner and Associates Inc., a Chicago-based architectural and engineering firm that has worked for Caltrans on several projects. The firm also worked as a subcontractor for Kiewit Corp., a prime contractor for Caltrans on the Benicia-Martinez Bridge. Omaha-based Kiewit was also a member of the joint venture that built the Bay Bridge tower foundations – central to the panel's latest report.

"I seek the truth for any problem that I am confronted with," Fisher wrote in an email. Commercial relationships with his many other clients have no influence on his judgments, he said.

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Engineers Spotted ‘Hundreds’ of Cracks in San Francisco Bridge

By James Nash January 23, 2014

Engineers spotted “hundreds” of cracks in welds on parts produced for the San Francisco-Oakland Bay Bridge in 2008 and were encouraged to stay quiet rather than delay the \$6.4 billion project, according to a California Senate committee report.

James Merrill, then a senior engineer with a quality assurance company known as Mactec, told Senate investigators that his complaints about work done at Shanghai Zhenhua Heavy Industry Co. Ltd. (900947), known as ZPMC, were rebuffed by managers of the California Department of Transportation as “too rigorous,” according to the report released yesterday.

A new eastern span of the Bay Bridge, the state’s busiest structure, carrying Interstate 80 between San Francisco and Oakland, opened in September. The replacement of the section damaged in the 1989 Loma Prieta earthquake was more than six years behind schedule and almost \$5 billion over budget. The most recent delay occurred in March 2013 when 32 steel anchor bolts fractured as they were tightened.

Attempts to contact Shanghai Zhenhua, based in Shanghai, by telephone and e-mail were unsuccessful.

“This is the first time in my career the engineering wasn’t allowed to be done right,” said Douglas Coe, a former civil engineer for the California Department of Transportation, known as Caltrans, according to the report. “Engineering decisions were made by non-engineers.”

Merrill and Coe said they don’t think the bridge is unsafe, according to the report, though they suggested that the structure may require retrofitting throughout its life and may last less than the 150 years state officials projected.

Andrew Gordon, a spokesman for the Bay Area Toll Authority, the financing agency for the Oakland-based Metropolitan Transportation Commission and Caltrans, declined to comment on the findings.

“The report just came out and the toll bridge program oversight committee is still reviewing it,” Gordon said by telephone.

The state Senate Transportation and Housing Committee plans to discuss the report’s findings tomorrow.

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Caltrans says criticism of report on broken bolts has merit

BY CHARLES PILLER - CPILLER@SACBEE.COM

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California Department of Transportation officials acknowledged Wednesday, for the first time, the validity of some concerns raised by critics of the department's evaluation of broken and suspect anchor bolts and rods on the new San Francisco-Oakland Bay Bridge.

At a technical briefing at the bridge offices in Oakland, Caltrans engineers said that ongoing tests looked promising, but they would address some of the outside objections as research continues on the 2,306 parts that secure the span's main cable and tower.

The briefing was held to provide details on testing and address doubts raised by two local metallurgists about an official report on the rod problem. Retired Bechtel Corp. engineer Yun Chung and Lisa K. Thomas, a materials engineer at Berkeley Research Company, a consulting and test lab, analyzed transportation officials' approach to evaluating the high-strength anchor rods for the tower and main cable of the suspension span. Their concerns were first detailed in December by The Sacramento Bee.

Steve Heminger, executive director of the Metropolitan Transportation Commission, headed the committee that produced the report. Last month he called their complaints "inconsequential" and "unsupported assertions."

But at the briefing Wednesday, Caltrans Director Malcolm Dougherty said the testing is about half done, and that his department remains open to new ideas before deciding if any rods and bolts must be replaced or other changes made. Those decisions are

expected by this summer.

“What else do we need to take into consideration before that final decision is made?” he said.

The Chung-Thomas critique, peer reviewed by leading engineers, concluded that the Toll Bridge Program Oversight Committee, which supervises the new span, overemphasized manufacturing flaws as the cause of 32 massive rods snapping last March. Chung and Thomas blamed the failure primarily on corrosion that occurred after construction errors exposed the bottom of the rods – where all the breaks occurred – to water off and on for five years.

The oversight group’s conclusion glossed over the odds of 1 in 4 billion against all the rods failing in the same location without the environmental corrosion, Chung said in prepared remarks. The mistake has significant implications on plans for evaluating other suspect rods, he said.

Chung compared the oversight group’s analysis to a postmortem medical report after 32 people died from snakebites. It was as if the death certificate failed to mention that all the bites were “in the ankles, not in the neck or arms,” Chung said.

Citing numerous technical errors and misconceptions in the oversight report, he called it “unintelligible” and “not acceptable as an engineering report and as a public document I am ashamed of the state officials who let it out.”

Chung and Thomas asked for samples of the suspect anchor rods to conduct independent testing.

Thomas said that scientists from the National Institute of Standards and Technology also have offered to conduct neutron tomography and gamma ray activation tests that might determine the presence of hydrogen in the broken and suspect parts. Such data could offer new insights on the vulnerability of the rods to future cracking. She urged Caltrans to take the agency up on the offer.

Moisture in the bay’s marine environment could corrode other suspect anchor rods. Chung and Thomas questioned the adequacy of Caltrans’ efforts to dehumidify chambers in which some critical rods are housed to prevent that possibility. Caltrans

has defended those protections, despite recent concerns raised by leaks of rainwater inside most of the suspension span roadway through 800 bolt holes.

Ongoing tests to mimic long-term environmental corrosion also suggest that the rods will be reliable for the span's 150-year service life, according to bridge spokesman Andrew Gordon. Those tests involve soaking large anchor rods in salt water, then stressing them to the breaking point.

Caltrans corrosion consultant Herbert Townsend Jr., a noted expert in stress corrosion cracking, called these full-scale tests unprecedented, and a "truly a remarkable achievement." The first of four phases of tests showed that the rods did not crack until well beyond the stress level they would be exposed to in normal use on the bridge. But he acknowledged that considerable uncertainty – and much additional testing – remains.

Chung said in his prepared remarks that those "Townsend Tests" could prompt a false sense of security, because they don't predict the long-term performance of rods that secure the suspension span's main cable and support its tower.

He also cited unusual, poorly understood hardness qualities, not raised in the oversight report, for many anchor rods that raise questions about their vulnerability to brittleness.

The rods and bolts in question generally are harder at the edges than in the interior of the parts. But many of the rods in question tested as harder internally – a factor that Chung and Thomas believe could increase brittleness and requires new research.

Caltrans materials engineer Bahjat Dager said that the department had begun to explore Chung's question, but so far had no explanation for the strange hardness profile.

Chung noted that threads on rods that secure the main cable at its eastern anchorage were fabricated with a "cold roll" process that increases hardness in the threaded areas compared to machine-cut threads.

Harder areas can be more susceptible to brittleness caused by hydrogen introduced into the steel during manufacturing or by environmental corrosion.

“To guarantee the 150-year life of this bridge, Caltrans engineers need to know all there is to know about the properties of these anchor rods, to the intimate details,” Chung said.

Karl Frank, a Caltrans consultant and professor emeritus of engineering at the University of Texas, told Chung and Thomas that extensive tests on the thread issues are in progress.

“Don’t think that we are ignoring these issues,” he said. “We are thinking about the same things you are We want to give good answers. We want a safe bridge.”

Bay Bridge's troubled China connection

How Caltrans' choice of an inexperienced company left structural doubts and cost taxpayers

BY CHARLES PILLER

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MANNY CRISOSTOMO / THE SACRAMENTO BEE

The new Bay Bridge suspension span. Part of the new \$6.5 billion structure, the suspension span, despite its innovative design, experienced construction problems that raised doubts about its durability. These include suspect concrete in the tower foundation, broken anchor bolts, rust on the main cable, and cracked roadway welds.

The Chinese company hired to build key parts of the San Francisco-Oakland Bay

The Chinese company hired to build key parts of the San Francisco-Oakland Bay Bridge had never built a bridge.

Shanghai Zhenhua Port Machinery Co. Ltd., after all, was a manufacturer of giant cranes for container ports.

The California Department of Transportation agreed to contract the company known as ZPMC in 2006 because it had established a reputation as fast and cost-effective, offering savings of about \$250 million compared to the competing bidder.

Bridge officials were racing to finish the span, pushed years behind schedule and billions of dollars over budget by political squabbles and construction delays. Fearful that the old bridge might not survive a major quake, they wanted speed and savings.

Caltrans asked an outside expert to assess whether ZPMC could do the job, and Jim Merrill, a senior materials contractor for the bridge project, gave the company a “contingent pass.” He also labeled it “high risk.” Among other problems, ZPMC didn’t have enough qualified welders or inspectors, the audit noted, and routinely welded in the rain, a basic error that often causes defects.

Undeterred, Caltrans signed off.

The company later boasted of “zero defects” in a news release. Brian Maroney, chief engineer for the bridge, said in a recent interview the audit’s “contingent pass” heightened vigilance to head off problems.

Key findings

- Caltrans approved a Chinese firm to build the roadway and iconic tower. When the company ignored quality requirements and fell behind schedule, Caltrans paid hundreds of millions of dollars to induce faster work.
- Caltrans permitted an unknown number of cracked or suspect welds in the suspension span. After two senior engineers challenged quality assurance practices, Caltrans reassigned one and let the other’s contract lapse.
- The Bay Bridge oversight committee pressured Caltrans to speed up the job despite signs that quality control had broken down.
- Tony Anziano, chief executive for toll-bridge work, made at least 64 visits to Shanghai, stayed in one of the city’s most luxurious hotels and spent more than \$300,000 on travel during construction.

But Caltrans' decision to hire an inexperienced Chinese company, unaccustomed to the rigor of American construction rules, to fabricate the suspension span's signature tower and roadway partly explains why costs ballooned to \$6.5 billion and misgivings persist about the quality of the bridge. Caltrans continued to bet on ZPMC by relaxing U.S. standards when the firm couldn't finish fast enough.

Caltrans overrode bridge welding codes and near-universal requirements for new bridge construction when it deemed many cracks in welds produced by ZPMC inconsequential and left them in place to hurry construction along, Caltrans documents show.



HECTOR AMEZCUA / THE SACRAMENTO BEE

Key Players

Tony Anziano (pictured) – Toll Bridge Program Manager, Caltrans; top executive for the project; defended welding quality controls.

Douglas Coe – Supervising Bridge Engineer, Caltrans; criticized handling of welds.

Keith Devonport – High-level consultant on fabrication for work in China; left job after developing concerns that work was not managed properly.

John Fisher – Professor Emeritus of civil engineering, Lehigh University, expert on how metal

Maroney said ZPMC's automated welding process produced excellent results. Caltrans documents show that it also paid hundreds of millions of dollars to fix problems of ZPMC's making, even as it delivered a bridge riddled with cracked welds.

If ZPMC couldn't build the bridge to the required quality, "it should have been taken away from them and built someplace else," Doug Coe, a high-level Caltrans engineer in China during much of the job, said at a California Senate committee hearing in January.

"The race for time" created overwhelming pressure to keep moving as planned, he said. "But there's no excuse for building something defective like that

because we are in a race for time "

fractures, consultant to Caltrans; suggested leaving some weld cracks in place.

Steve Heminger – Executive Director, Metropolitan Transportation Commission; chairs oversight panel for Bay Bridge; defended welding quality.

Brian Maroney – Caltrans chief engineer for new Bay Bridge; oversaw engineering reports that accepted possible or actual cracks in some welds.

Jim Merrill – Contract welding expert who oversaw welding in China from 2006-2008; warned that hazardous cracks were ignored.

Rick Morrow – Supervising bridge engineer, Caltrans; voiced concerns about poor workmanship.

Gary Pursell – Principal Transportation Engineer, Caltrans, and a manager for the suspension bridge contract that included the work in China; expressed concerns that contractors were not fixing cracked welds.

Peter Siegenthaler – Executive Vice President, Alta Vista Solutions; former Principle Transportation Engineer, Caltrans, and overall head of the work in China until 2011; allegedly told inspectors to ignore some weld cracks.

Senate hearing.

The state Senate Transportation and Housing Committee and the California Highway Patrol are investigating how the weld problems were handled. (In a written statement, Caltrans declined to comment on the CHP probe.)

At the Senate hearing, bridge officials dismissed quality concerns as baseless. “It has been a winding road to get here, but we are here. We have achieved seismic safety for the bridge,” said Caltrans Director Malcolm Dougherty.

But committee chair Sen. Mark DeSaulnier, D-Concord, suggested that Caltrans had tried to cover up serious problems with “a deliberate and willful ... attempt to obfuscate.”

His comments were echoed by experts inside and outside Caltrans – some of whom supervised the welding and warned of serious flaws. They said the state bought a

time.

The litany of Bay Bridge problems exposed in recent years by The Sacramento Bee and others includes suspect foundation concrete, broken anchor rods and rust on the suspension span’s main cable. Yet beyond those investigative findings, bridge engineers say, the decision to hire ZPMC will haunt the new span and the traveling public for generations to come.

In an investigation of the welding issues, The Bee reviewed more than 100,000 pages of construction records and emails by bridge officials, interviewed technical experts and examined testimony at the

bridge likely to require extraordinary and costly maintenance.

“If you have to go up on the decks and start taking lane closures and scrape off all the asphalt and do deck repairs for months and months and months, that certainly could affect public welfare,” Coe said at the Senate hearing.

Professional engineers, he said, must report “any irregularities that could affect public welfare.” That’s what Coe and his colleagues did.

“But (Caltrans) has the prerogative to accept these (cracked or suspect parts), ‘fit for purpose,’ ” Coe said. That’s what Caltrans managers did.



MANNY CRISOSTOMO / THE SACRAMENTO BEE

Caltrans engineer Bill Casey (left), inside a Bay Bridge roadway girder. The Chinese builder of the new span’s roadway had trouble welding the complex roadway girders, leaving many cracks that some engineers fear could cause structural problems.

2006-07: Lapses from start

Shortly before ZPMC was hired, the Legislature empowered a new group, the Toll Bridge Program Oversight Committee – the heads of Caltrans, the California Transportation Commission and the Bay Area Toll Authority – to supervise construction on the troubled project. In October 2006, in what would become a refrain, the committee called accelerating construction “Job One.”

Caltrans’ prime contractor on this part of the bridge was ABF, a joint venture of American Bridge Co. and Fluor Enterprises Inc. ABF, with Caltrans’ approval, hired ZPMC as a subcontractor. In choosing a Chinese firm, Caltrans gave up federal money and angered U.S. labor advocates and steel-makers. Maroney said no U.S. firm could have built as quickly a bridge so innovative and complex. ZPMC, with its vast capacity and ultra-modern equipment, was the right choice, he said.

In December 2006, ZPMC began making roadway “box girders.” These box shells, flat on top for the roadway, weigh up to 1,669 tons each. ZPMC would weld thick steel panels together to create the boxes. The finished girders would be shipped to Oakland and welded together there to form the suspension span’s 2,047-foot roadway.

But after a month, the work already was going sideways. A Caltrans inspector caught ZPMC employees using the wrong radiation source from the wrong direction to check steel plates for flaws. ABF didn’t catch the lapse.

Caltrans recorded the episode in a “nonconformance report,” a technical memo detailing

Key Players

American Bridge Co./Fluor Enterprises Inc.

Joint Venture – contractor for fabricating and erecting the suspension span roadway, tower and cables.

Alta Vista Solutions – Prime materials-quality contractor, 2011 to present (and subcontractor, 2009-2011); responsible for ensuring that welds in China met contract requirements.

Bay Area Toll Authority – Administers tolls for all Bay Area toll bridges except the Golden Gate; underwrites much of the Bay Bridge construction and maintenance.

California Department of Transportation – Manages construction of new Bay Bridge; owns and operates Bay Area toll bridges, except the Golden Gate.

Caltrop Corp. – Prime materials-quality contractor, 2009-2011, responsible for ensuring that weld operations in China met contract requirements.

MACTEC – Prime materials-quality contractor until 2009, responsible for ensuring that weld operations in China met contract requirements.

Toll Bridge Program Oversight Committee

Top authority over toll bridge construction; consists of the heads of Caltrans, Bay Area Toll Authority and California Transportation

contract violations and specifying corrections. The reports, many citing multiple errors, averaged one every day or two – adding up to 965 in less than five years. ZPMC welders made errors, and the firm’s inspectors overlooked those flaws day after day.

Authority, and California Transportation Commission.

Shanghai Zhenhua Port Machinery Co., Ltd. (ZPMC); recently renamed Shanghai Zhenhua Heavy Industry Co., Ltd. – Subcontractor that fabricated suspension span tower and roadway in Shanghai, China.

Months after ZPMC won the job, Gary Pursell, a high-level Caltrans engineering supervisor on the job, noted in his job diaries that the firm lacked basic quality control. The company hired for speed was soon behind schedule, Pursell wrote.

Caltrans diaries also indicated that ZPMC violated the job contract by delivering key documents in Chinese instead of English. ABF lacked sufficient quality-assurance staff to speak directly to its own subcontractor – also a contract violation. “Although I can jump in when misunderstanding between ABF and ZPMC developed,” Caltrans engineer Stanley Ku wrote in a report, “I do think ABF should have a (quality expert) who can speak Mandarin to reduce the ‘misunderstanding’ situation.”

Cracked welds appeared regularly, particularly in roadway box girders – parts that challenge even the best welders. Yet the oversight committee created by the Legislature, charged with watching the clock and budget as it protected public safety, knew that ZPMC welders lacked the required experience, according to the committee’s May 2007 meeting minutes.

Getting ZPMC to comply with the contract “was a real struggle,” Michael Forner, a retired Caltrans principal engineer who served as one of the job’s top officials, said in an interview. ZPMC subcontracted work out to other companies, he said, making it harder to ensure that welders had proper training.

“They basically rented out the shop,” creating a chaotic job site, Forner said. Workers flooded the plant on Changxing Island at the mouth of the Yangtze River – then a 4-mile boat ride from Shanghai. “It was hard to get the bus from the dock to the shop, there were so many people riding bikes and walking.”

ZPMC had been working under the contingent pass from the 2006 audit while

moving to fix its operations. In August 2007, Caltrans auditors approved ZPMC outright, although the firm still lacked adequate quality control, even for “fracture critical” materials, according to the audit report. Fracture critical means the failure of such materials could “result in a partial or full collapse of the bridge,” according to the American Association of State Highway and Transportation Officials.

In October 2007, Caltrans told the oversight committee that ZPMC was well qualified and watched carefully by ABF, the oversight minutes noted.

But Caltrans documents state that ZPMC often ignored or defied the prime contractor and Caltrans alike – and got away with it.



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Beneath the suspension span. The bridge tower, seen through gaps between the roadway girders, holds up 28 girders and their connecting crossbeams, some of which suffered weld cracks during construction.

2008: ZPMC rebels

Incorporated in 1992, ZPMC is one of the world’s leading builders of port machinery. Although the firm’s stock trades publicly, it’s a subsidiary of

machinery. Although the firm's stock trades publicly, it is a subsidiary of government-controlled China Communication Construction Co. Ltd., among the world's largest companies. ZPMC officials did not respond to requests for comment.

The Bay Bridge project showed that it had joined the realm of ambitious Chinese enterprises that took on the most complex and high-profile jobs, according to ZPMC's website. A "strict and responsible spirit," it said, led U.S. partners to trust and admire ZPMC.

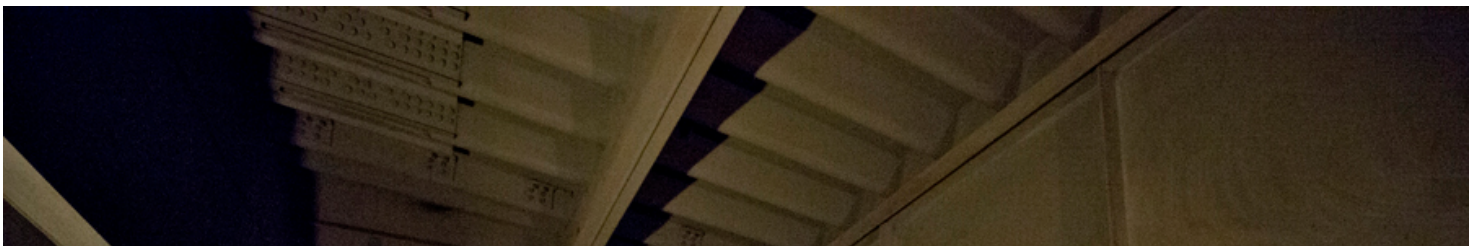
In early 2008, at a meeting with Caltrans and ABF, the Chinese firm showed open defiance, according to a Caltrans memo about welder performance. "ZPMC stated that they, as the fabricator, will decide whether or not they will adhere to the agreed upon (quality-test) procedures. To this date, ABF has not provided the Department with ZPMC's decision."

Rick Morrow, a supervising Caltrans engineer, wrote in his job diary, "Is ABF unable to control ZPMC or doesn't want to? No follow through on agreement and ZPMC ignored the ABF stop order. ..."

Philip Stolarski, head of Caltrans materials testing, testified at the January Senate hearing that ZPMC treated contract requirements as "suggestions."

Caltrans would not permit interviews with Morrow or Stolarski for this story.

Brian A. Petersen, project director for ABF, declined to comment. A written statement from ABF said, "While there were many unique challenges on a project of such complexity ... we were able to achieve Seismic Safety and successfully open the bridge to traffic this past Fall and accomplish this feat in a safe manner." The statement noted that ABF is cooperating with the CHP investigation.





MANNY CRISOSTOMO / THE SACRAMENTO BEE

Bay Bridge roadway girder. This box girder, near the east end of the suspension span, was built late in the process, after some quality control lapses at the Chinese builder of the new span's roadway had been corrected.

In March 2008, after more than a year of work, hundreds of weld cracks still appeared. Stolarski directed Merrill, the quality contractor, to alert Peter Siegenthaler, the most senior Caltrans manager for what the department called “Team China.” Merrill recommended that production on the bridge deck panels be halted until ZPMC could produce reliable parts.

“Very shortly after that I was told (by Siegenthaler that) I was no longer authorized to write recommendations on state letterhead,” Merrill said at the hearing.

Siegenthaler, who left Caltrans in 2011, declined to comment.

BAY BRIDGE INVESTIGATION

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Caltrans responded in a joint statement from many unnamed officials. It said that Merrill's memo to Siegenthaler “was

shared with the project team and it was the judgment of the project team that it was in the best interest of the project to

continue production.” Actual or possible flaws were repaired as required by the

contract, the statement noted.

Maroney, chief engineer for the bridge, said he held Merrill in high esteem, and still seeks his advice on engineering issues. Maroney never heard about Merrill's suggestion to halt production, he said. "There was a goal that 'Team China' made decisions in China."

Welding problems continued. "Transverse" cracks – crossing a weld rather than following its length – which can grow into adjacent base metal and cause a box girder to fail, had become common, according to a June 2008 Caltrans report. ZPMC's repairs regularly fell short, the report noted.

The same month, Tony Anziano, a Caltrans attorney who headed all toll bridge construction, told the bridge oversight group that the repair of the deck panels was close to resolution.

Anziano declined an interview request. In its written statement, Caltrans said Anziano's reference to "resolution" referred to an "agreed upon path forward involving the departments, the contractor, and fabricator."

Yet, hundreds more nonconformance reports were issued to ZPMC for faulty box-girder welds or related problems.

Those reports and others said that one of the serious problems cited in ZPMC's first audit – welding or testing welds in the rain or in wet conditions – continued on numerous occasions over years of production. Wet welds often mean contamination of the steel with hydrogen, a chief cause for cracks.

In several cases, bridge sections had been stored in the rain and filled with water. ABF said in a response to a nonconformance report on the matter, that the resulting, inaccessible corrosion inside the parts "would be insignificant and unmeasurable" – a conclusion Caltrans accepted without comment.

The oversight committee began to discuss financial sweeteners to induce ZPMC to recover time lost to fixing bad welds, according to the group's minutes. It also emphasized quality as "the main goal" – a rare caveat amid constant demands to move faster.

2008: Risky business

“Evening mtg with Anziano in China. Tony says ZPMC is on verge of stopping work on the job,” Morrow wrote in his diary in July 2008. “(Caltrans) needs to direct work to move forward even if it adds risk and cost.” In its written response to Sacramento Bee questions, Caltrans wrote that while it could not define “risk” without a close review of the context of such statements, the risk of an earthquake to public safety “has always been the driving factor” for the project.

“Nearly all staff below Pete (Siegenthaler) and Tony (Anziano) agree that SERIOUS problems exist in the fabrications and with ABF. Moral(e) is very low as concerns are not followed up on and poor workmanship is allowed to continue.”

Rick Morrow, Supervising bridge engineer, Caltrans, in diary

“Nearly all staff below Pete (Siegenthaler) and Tony (Anziano) agree that SERIOUS problems exist in the fabrications and with ABF,” Morrow wrote. “Moral(e) is very low as concerns are not followed up on and poor workmanship is allowed to continue.”

As delays dragged on, Caltrans approved paying the contractors an additional \$6.5 million to boost efficiency and quality, and to catalog the work.

The money didn’t fix ongoing problems with “tack welds,” a key concern for Merrill. Those preliminary welds for the box girders, about 3 inches long, hold in place steel parts in preparation for final welds.

Tack welds were cracking routinely and the cracks often remained underneath the final welds, according to Merrill’s testimony at the Senate hearing. John Fisher, an expert on metal fractures and emeritus professor at Lehigh University in Bethlehem, Pa., confirmed this observation for Caltrans soon after Merrill raised the issue in August 2008, according to Fisher’s report on the issue.

Merrill feared that the cracks could cause structural problems. But Siegenthaler directed Merrill “not to look in areas that I knew there were cracks,” Merrill said at the hearing.

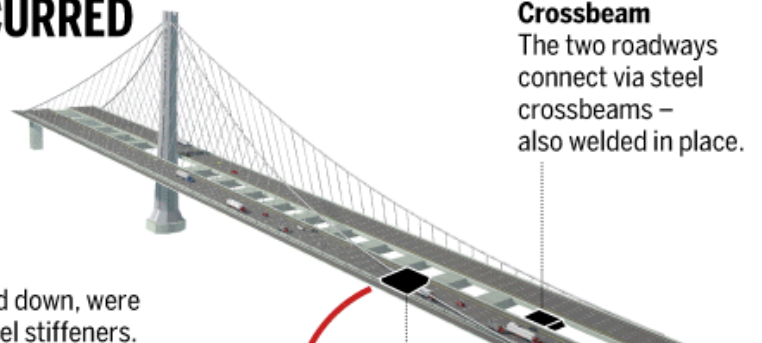
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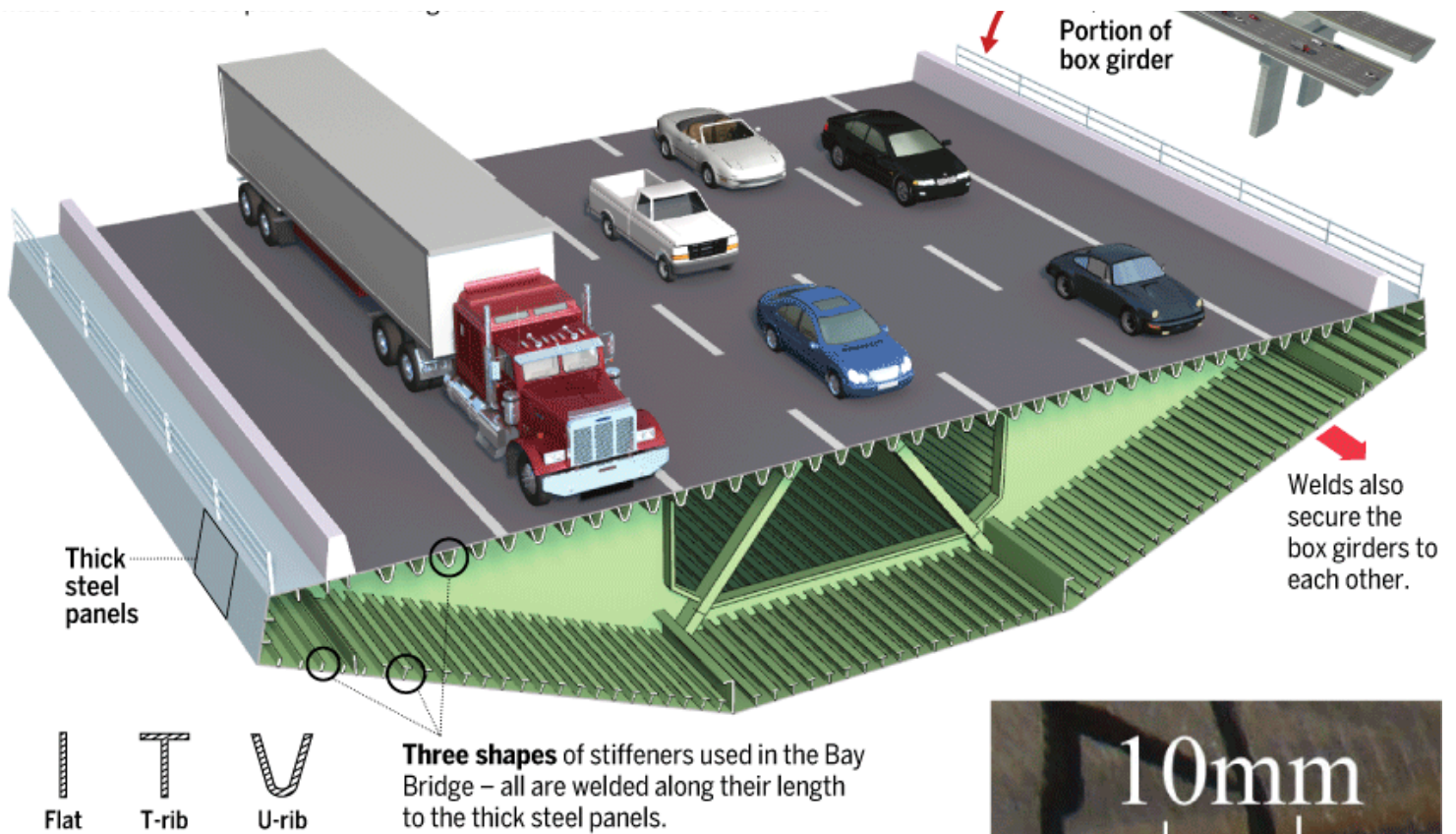
WHERE SOME WELDING CRACKS OCCURRED

The new Bay Bridge suspension span roadway, fabricated in China, comprises 28 box girders – steel shells weighing up to 1,669 tons each – 14 in each 2,047-foot-long parallel roadway, westbound and eastbound.

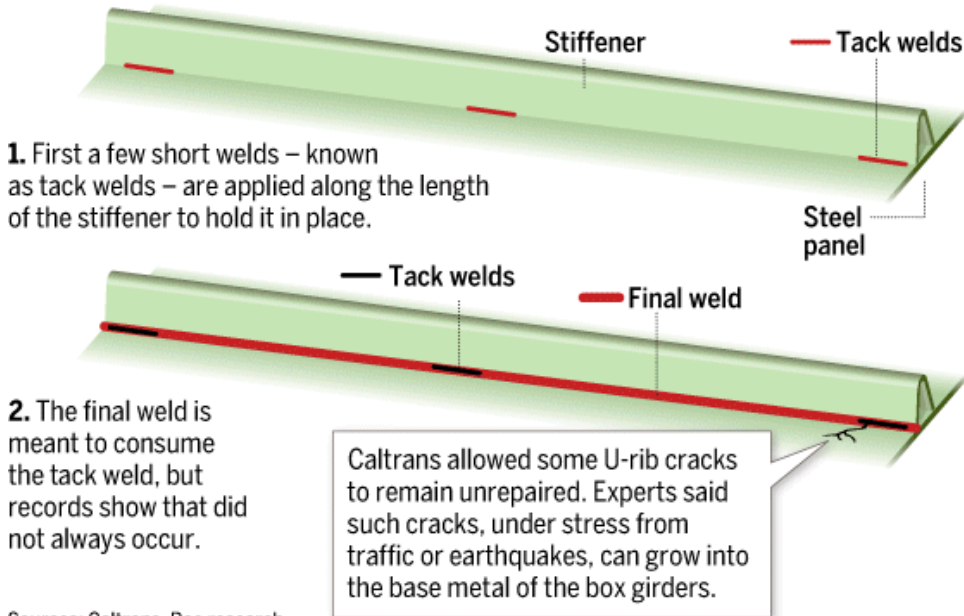
Box girders

The girders, flat at the top where the roadway pavement was laid down, were made from thick steel panels welded together and lined with steel stiffeners.

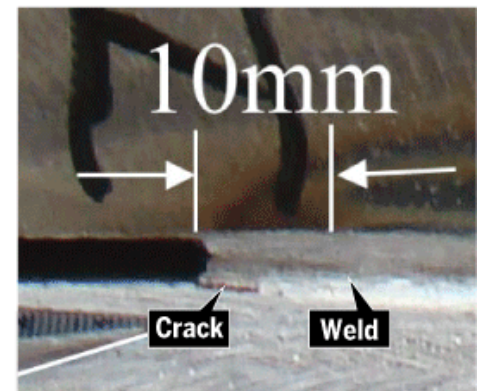




How the welds are done



Sources: Caltrans, Bee research



Cracked tack weld

A top Caltrans inspector in China told state senators that Caltrans' top manager told him to ignore many cracks. The inspector warned that the cracks, which violated the welding code, could harm the new span. He provided this photo to Caltrans to illustrate his concerns. It shows one kind of crack the inspector said he was told not to fix.

Nathaniel Levine nlevine@sacbee.com

In an email with photos to Siegenthaler, provided to The Bee by a state Senate investigator, Merrill alerted Siegenthaler to the problem. Siegenthaler did not change his orders, Merrill said at the hearing.

Maroney told The Bee that he never saw Merrill's memos or emails. "It was a Team China thing, but I knew there was fighting. And that's actually why I went there," to look into the matter with Fisher's help.

In a rebuttal to Merrill's Senate testimony, an official from Alta Vista Solutions, Siegenthaler's current employer, called Merrill's requests to fix cracks "a contentious issue" that "would further deteriorate the relationship between Caltrans and the fabricator/contractor, and that would not address the problem at its root. Mr. Siegenthaler instructed (Merrill) to follow the agreed upon inspection protocols," rather than directing him not to find cracks.

DeSaulnier, at the Senate hearing, asked Coe, the Caltrans engineer, if Merrill had been too rigorous.

"There's nothing rigorous about meeting the contract specifications," Coe said. " ... (Merrill's) recommendation to stop the process like that, because it was leaving problems in the work, is what we normally do."

Coe, drawing on decades of Caltrans experience, said at the hearing that he still warned Merrill to expect trouble: "Talking back to the ... project manager puts you in harm's way."

In an earlier interview with the Senate investigator, however, Coe said Anziano called the shots. "Anyone who went against Tony didn't stick around," Coe said, according to the Senate report. "This is the first time in my career the engineering wasn't allowed to be done right."

A few months after Merrill confronted Siegenthaler, Caltrans agreed to a major change in the contract to allow cracks in some tack welds to remain unrepaired.

In a recent interview, Keith Devonport, a consultant for one of the project's subcontractors who said he served as fabrication manager in China, confirmed that Siegenthaler ordered Merrill to ignore certain cracks. He said he agreed with Merrill's concerns "100 percent."

Devonport had managed similar box-girder fabrication for large companies since 1995. He worked in China on the Bay Bridge from 2006 until 2010. He quit in disappointment about project management, he said, after Caltrans moved him from China to California. "I didn't feel as though I could perform my role as fabrication manager 5,000 miles away from where it was taking place," he said.

In its written statement, Caltrans said that Devonport was not a fabrication manager, and was moved to California to assist on other aspects of the job.

Shortly after Merrill voiced concerns about welds, nearly nine months before the contract of his firm, MACTEC Engineering and Consulting Inc., expired, Caltrans put the contract out to bid. Caltrans ordered an independent audit of a competitor, Caltrop Corp. and its subcontractor, Alta Vista. The audit, obtained by The Bee from the Senate investigator, stated that they lacked skill or experience required for key welding supervision jobs. Yet before the audit was completed, Caltrans certified the firms as qualified and awarded them the contract.

“(T)he decision to advertise a new contract for inspection services ... was made by the Department’s CFO,” Caltrans said in its written statement. “Specific issues surrounding quality assurance contractors are the subject of an ongoing CHP investigation ... and questions about that should be directed to CHP.”





MANNY CRISOSTOMO / THE SACRAMENTO BEE

Inside a Bay Bridge roadway girder. Quality control problems at the Chinese builder of the new span's roadway led Caltrans to allow cracks where steel stiffeners (top), which resemble corrugated cardboard, were welded beneath the roadway deck.

2009: Shanghai showdown

In late 2008, Caltrans began payments of more than \$13 million more to build a database to track weld quality. (Caltrans refused to provide it to The Bee, saying that the data still had to be cross-checked for accuracy.)

With the schedule for delivery of the deck sections slipping, the oversight group called for “drastic measures,” meeting minutes noted early in 2009. It approved \$45 million for acceleration incentives.

But as the work sped up, quality problems worsened. On July 1, Pursell, one of the top engineering managers, told ABF that Caltrans had been finding more cracks on welds that ZPMC inspectors had approved.

“(Y)our data does not indicate the seriousness associated with the presence of transverse cracks,” the kind that can grow into the surrounding metal of the box girders and cause fractures, Pursell wrote to ABF executive Michael Flowers. Such cracks, he added, “are of great concern structurally.”

Worried that flaws were being missed, Coe ordered new tests using ultrahigh-frequency sound waves at a setting not previously tried. He found worrisome cracks in approved welds. On Sept. 15, 2009, Coe drafted a formal state letter requesting more such tests.

Anziano ordered Coe to rescind the letter, according to an email obtained by The Bee. Coe, who had managed box-girder projects at Caltrans for about 30 years, said at the Senate hearing that he had never been told before to overlook serious quality concerns.

The first shipment of girders were on a boat ready to go to Oakland. “It’s important for you guys to know that these segments that are coming over to Oakland may be full of defects,” Coe testified he told Kenneth Terpstra, a deputy to Anziano.

“It’s important for you guys to know that these segments that are coming over to Oakland may be full of defects.”

Douglas Coe, Supervising Bridge Engineer,
Caltrans

Coe said that in a conference call he told Anziano he intended to take the box girders off the boat and recheck them to protect public safety. Anziano became angry and ordered him not to do so, adding, “Do I make myself clear?” Coe said. “I was just flabbergasted.”

Soon after, Anziano came to China and removed Coe from the Bay Bridge job. At the hearing, Anziano said he reassigned Coe to reduce job-site tension.

“We’ve seen instances, time and time again, where we have, in effect, gone to war with the contractor,” Anziano said at the Senate hearing. “It will cost you time. It will cost you money. ... And it will not resolve the problems.” He denied compromising quality or overstepping his authority by making engineering decisions.

But Caltrans eventually took Coe’s advice, to a degree, ordering some of the new tests he proposed and some repairs, according to records recently made public.

As concerns about workmanship mounted, the ZPMC began to resist even standard quality assurance. According to a nonconformance report at the time, Caltrans employees came to the jobsite to test a box girder for possible cracks on heavily corroded welds. A ZPMC supervisor obstructed efforts to take photos, wiped away key markings from the test area and shouted “no UT,” a reference to ultrasonic

testing. The inspectors withdrew. Caltrans later agreed to conduct its quality checks on a schedule agreed to by ZPMC.

On Dec. 30, the first finished box girders were shipped to Oakland.

“Steel decks have cracks in ’em,” said Steve Heminger, executive director of the Metropolitan Transportation Commission and current chairman of the oversight group, at the January Senate hearing. “The issue is not whether there’s a crack there, it’s whether it matters.” Caltrans evaluations, reviewed by experts, found that the cracks didn’t matter, he said.

2010-2011: Epilogue

Over the next year, the oversight committee approved funds to train ZPMC welders, plus more than \$191 million in speed-up incentives and cost adjustments, according to contract change orders. With so much money flowing, the roadway box girders moved in a steady stream from Shanghai to Oakland. By early 2010, 12 of 28 had been lifted into place over the bay. By the end of that year, 19 had been installed.

Siegenthaler, who oversaw the work in Shanghai, retired from state service in September 2011, and a month later, just before the final bridge girders were set in place over the bay, he joined Alta Vista Solutions as executive vice president.

Siegenthaler had been a member of the Caltrans committee that in 2008 awarded the quality supervision contract to Caltrop and Alta Vista. His first-place ranking put them over the top to win the contract, according to the committee’s records, obtained by The Bee under the state Public Records Act. A couple of months after Siegenthaler left Caltrans, Alta

Vista won the \$21 million prime contract to oversee quality issues for the new span’s materials.

Records provided by the state Fair Political Practices Commission said that Siegenthaler contacted the agency in December 2011 to ask



whether he might risk violating conflict of interest laws if he worked on Caltrans projects. Based on the facts Siegenthaler presented, the agency saw no problem. The documents contain no mention of his role in awarding the Alta Vista-Caltrop contract.

As the project wound down, ZPMC reaped tangible rewards, sharing with ABF more than \$250 million in cost overruns and incentive payments.

Counting the money spent on travel and living costs for Caltrans and its contractors, the suspension span consumed much more than the \$250 million in ZPMC's assumed efficiencies that made the Chinese steel so cost-effective.

"We have traded money for time," said Heminger. "We never once traded quality for time."



MANNY CRISOSTOMO / THE SACRAMENTO BEE

Picturesque but problematic. A single cable hangs off the tower and attaches only to the bridge itself. Typical suspension bridge cables are anchored into bedrock. The self-anchored design holds up 28 steel box girders, which in some cases include cracked welds, contrary to the welding code.

Tony Anziano, Caltrans' top executive for the new Bay Bridge, visited Shanghai, where much of the span was made, at least 64 times during construction. He nearly always stayed at one of the city's most luxurious hotels – the JW Marriott Shanghai Tomorrow Square. Anziano's monthly travel expenses from June 2006 to August 2013:

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Overseas contract leads to high travel tab

By selecting a bridge-building neophyte in Shanghai to fabricate the iconic suspension span of the new Bay Bridge, Caltrans took on logistical complexity and escalating travel bills.

Caltrans employees and U.S. contractors who supervised the job lived fulltime in Shanghai, and top officials flew there often. Tony Anziano, toll bridge program manager, alone spent more than \$300,000 on travel.

Part of that cost was for Anziano's room at the five-star JW Marriott Shanghai Tomorrow Square for up to \$470 per night, according to his expense reports. One of the city's most luxurious hotels, it features a 60th floor library – the world's highest – marble bathrooms and a lavish Mandara Spa. Anziano, the top



Caltrans official on the bridge project, almost always stayed at Tomorrow Square, in the stylish Puxi shopping district, across the teeming metropolis from the bridge jobsite.

Kenneth Terpstra, a deputy to Anziano, often stayed at the same hotel, up to 27 days at a stretch, for as much as \$567 per night.



PHOTO COURTESY JW MARRIOTT SHANGHAI TOMORROW SQUARE
Caltrans paid as much as \$567 per night for a room at the five-star JW Marriott Shanghai Tomorrow Square.

Caltrans described the accommodations as "reasonable and appropriate" in a written statement. "The hotel provided a government rate that was comparable to rates at other western hotels," and followed bargaining agreements, based in part on providing adequate "safety and support for employees far from home."

Caltrans employees on long-term assignments in Shanghai stayed at the Marriott Executive Apartments – at the top end of the local long-stay hotel market, according to the leasing agency bizstay.com. For more than three years, Caltrans paid about \$50,000 annually per person to rent more than a dozen well-appointed rooms with access to a state-of-the-art fitness center and pool, according to lease agreements.

Anziano made at least 64 such visits over six years between 2006 and 2012, jetting from San Francisco to Shanghai as often as four times a month, often staying one or two days, according to travel records obtained under the California Public Records Act. For a two-day trip in 2011 he paid \$6,266 in plane fare, although a coach ticket at the time typically cost less than \$1,500.

"Real time on-site observations and conversation were (critical) to effective management of the program and project," Caltrans said about Anziano's trips.

Anziano usually billed his travel for the Bay Bridge to the Bay Area Toll Authority, funded mostly by bridge tolls. In the process, he accumulated about 400,000 frequent flyer miles for his personal use, as permitted by state law.

Call The Bee's Charles Piller, (916) 321-1113. Follow him on Twitter [@cpiller](https://twitter.com/cpillar).

A luxury hotel in Shanghai

PHOTOS COURTESY JW MARRIOTT SHANGHAI TOMORROW SQUARE

A look at the Marriott hotel where Caltrans Toll Bridge Program Manager Tony Anziano stayed.

open gallery





SFGATE<http://www.sfgate.com/bayarea/article/Rust-cracks-found-on-Bay-Bridge-tower-rod-6092734.php>

Rust, cracks found on Bay Bridge tower rod

By **Jaxon Van Derbeken** Updated 8:54 pm, Friday, February 20, 2015

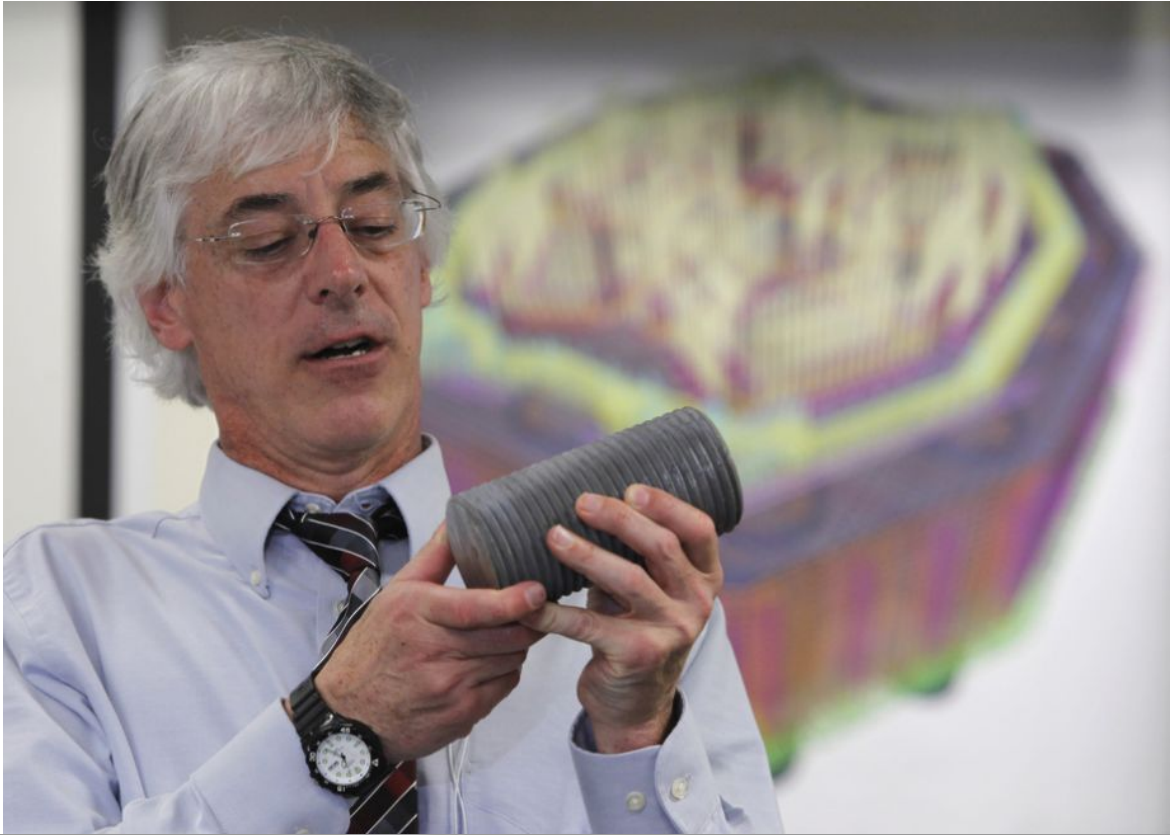


IMAGE 1 OF 4

Caltrans bridge engineer Brian Maroney explains how a section of a Bay Bridge steel anchor rod could rust and crack.

Tests on a steel anchor rod removed from the Bay Bridge eastern span's tower after being inadvertently submerged in water for years revealed rust and tiny cracks, bridge officials said Friday — a potentially worrisome sign for the long-term viability of the span.

The 25-foot-long rod is one of more than 400 galvanized-steel fasteners that became soaked in water because they sat in holes at the tower's foundation that were poorly grouted. The rods cannot be removed without being destroyed, and there is not enough room to maneuver replacement rods into position — so any evidence that the water has damaged the rods presents Caltrans with what could be an unsolvable dilemma.

“We did see some evidence of damage on the surface,” Caltrans bridge engineer Brian Maroney said at a news conference in Oakland, where officials announced the results of preliminary tests on the removed rod.

It’s the latest in a series of construction problems on the \$6.4 billion bridge, and potentially one of the most serious. Other steel rods that stewed in rainwater for several years snapped when they were tightened in 2013 on seismic-stability structures on the bridge, but Caltrans was able to engineer a replacement for them.

There is no obvious work-around for the rods that anchor the 525-foot tower to its foundation. They were essentially fixed in place when the tower was lowered atop them during construction in 2010.

Maroney said that even if other rods that remain at the tower base are cracked and rusted it is “not a safety issue.” He said even if many of the rods failed in a large earthquake, it would simply result in the tower suffering extra damage — but not catastrophic failure.

He has not yet decided what can be done to reduce the risk to the tower rods until he sees more test results. “I want to know what I’ve got down that hole to make a good decision,” Maroney said. “We’re still in the process of the science.”

Corrosion risk

Caltrans inspectors discovered the tower-rod problem last fall. The rods are galvanized, or coated in zinc, to guard against rust. The galvanization can make metal more vulnerable to another form of corrosion — hydrogen-induced cracking.

Maroney said the tests showed the galvanizing layer was gone on parts of the rod, an indication that hydrogen may have invaded the metal.

That was how 32 galvanized rods failed on seismic-stability structures on the bridge in March 2013. Bridge officials have downplayed that risk on the tower rods, saying they were under less tension, a key factor in causing sudden failure.

Two independent experts, however, said the rods are at risk of failing even at the lower levels of stress, because tiny cracks like those found on the tested rod can get worse over time.

“If it started, it will grow. It will continue to grow until reaching a critical size — then, bang,” said Yun Chung, a retired Bechtel engineer and expert on steel fasteners who has been critical of Caltrans.

Lisa Fulton, a metallurgical engineer and materials scientist who specializes in corrosion, said the discovery of rust and tiny cracks is alarming.

“This is bad news,” Fulton said. “It means other rods surely have cracks in them. We don’t know when those rods are going to snap.”

Fulton said the loss of the zinc galvanization coating is telltale evidence of the electrochemical reaction that drives hydrogen from standing water into high-strength steel. The presence of hydrogen can make the steel vulnerable to failing like the rods that failed in 2013 on the span.

Not to specifications

The tower rods sat in water because the main bridge contractor, a joint venture called American Bridge/Fluor, did not follow the contract specifications that the sleeves surrounding them be filled with moisture-resistant grout, Caltrans officials have said.

Many of the rods sat in only a few inches of moisture, but 60 or so were completely submerged in water that got into the tower during storms and power-washings, Caltrans said. Engineers cut apart and removed two of those for testing.

The first rod was tested for its material properties, not for cracking. The second rod removed and tested recently showed rust and cracking.

American Bridge/Fluor is removing standing water from the sleeves and putting in new grout, a process that is still under way.

Also Friday, Maroney revealed that Caltrans is seeking approval from environmental agencies to implode one of the old eastern span’s piers as part of the demolition project.

He said the method of setting off a series of small underwater explosions could take down the pier in about six seconds, allowing officials to save “a tremendous amount of money” over the year it would normally take to demolish the concrete and steel structure. At the same time, he said, it would limit damage to the environment that traditional demolition might inflict.

Maroney said he hopes the implosion could happen in November, when fish runs are limited.

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HEARST *newspapers*

Bay Bridge news gets worse: Tower rod fails key test

By **Jaxon Van Derbeken** Updated 8:04 am, Friday, May 8, 2015

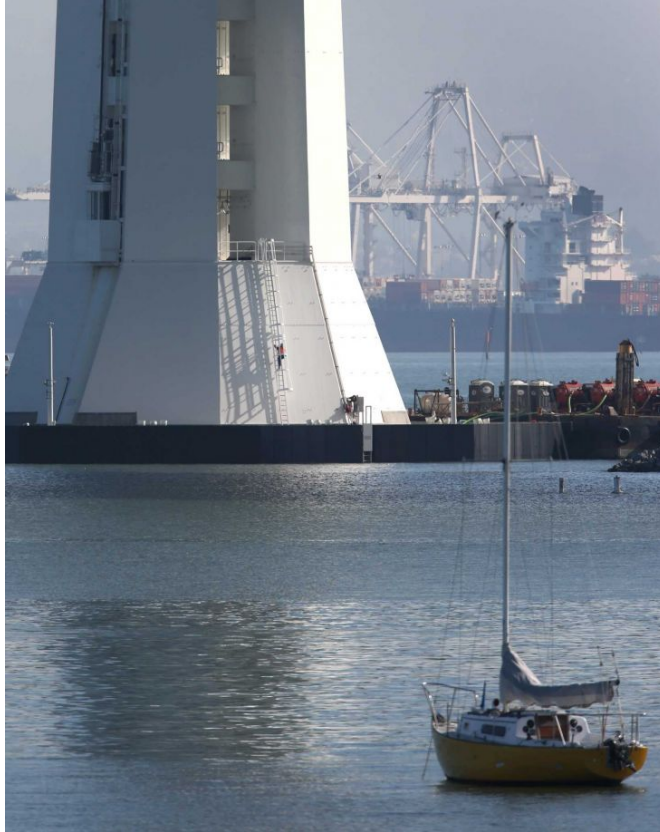


IMAGE 1 OF 31

A maintenance worker climbs a ladder to the base of the eastern Bay Bridge tower in February. New tests provide the strongest evidence yet that a steel rod that helps anchor the tower to its foundation is broken.

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One of the steel rods anchoring the tower of the new Bay Bridge eastern span has failed a key integrity test, suggesting it became corroded and broke during years when it was soaking in water, **The Chronicle** has learned.

The test result raises the possibility that hundreds of other rods that have been steeped in water in the bridge's foundation in recent years are in danger of cracking, which could reduce the stability of the 525-foot-tall tower in a major earthquake.

State officials remained optimistic Thursday that corrosion was not to blame, and stressed that Caltrans isn't certain of the rod's condition because workers have not removed the 25-foot-long

fastener from its sleeve.

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Ominous signs of problems with new Bay Bridge foundation

Gareth Lacy, a spokesman for the state **Transportation Agency**, confirmed that the rod had failed what is called a mechanical pull test, in which crews tug on the fastener to see if it moves. If everything is right with the rod, it should stay in place. This rod moved during Wednesday's test, Lacy said.

"They are investigating why one seismic rod at the base at the tower moved when it was pulled by the machine," Lacy said. "It did not carry the expected load, and the next step is to remove it to fully investigate its condition."

Downplaying corrosion

Dan McElhinney, the Caltrans district official overseeing the bridge project, downplayed the

possibility that corrosion was to blame.

"We don't believe it's corrosion — this bridge is not old enough for corrosion, not with these rods or under this level of loading," he said.

"We need to know what else is going on," McElhinney said. "It could take us one to two weeks to be able to remove it."

He added that nearly all the remaining rods will now be pull tested to determine their integrity.

"The bridge is safe," McElhinney said. "This is an important part of long-term maintenance of the bridge."

Stewing in water

Nearly all of the tower's 424 high-strength rods — intended to provide added seismic protection for the landmark structure — stewed in water for a prolonged period, exposing them to possible corrosion. A botched grouting and sealing job left hundreds of rod sleeves flooded, and recently Caltrans discovered signs indicating that salt water may be leaching into the foundation from the bay.

Although state officials hold out hope for an alternative explanation for the rod's test failure, one outside expert said there was little doubt what happened.

"The thing clearly cracked," said **Lisa Fulton**, a corrosion expert in Berkeley who has studied the problems on the span. "It means there's little doubt that others are cracked — they just don't know it. What are the odds this is the only one?"

Suspensions had centered on the rod after ultrasonic tests showed that it was 6 inches shorter than the others, a possible sign that it had broken at its base.

When workers for the bridge contractor pulled on the three rods, the shorter one gave way while the other two held fast, Lacy said.

Some bridge officials speculated that the rod was simply constructed shorter than other fasteners, for reasons unknown.

Bridge officials say they won't know for sure what happened until the entire rod is removed. The rod has to be cut apart in 2-foot sections as it is pulled up, because there is not enough room at the base of the tower to remove an intact rod.

String of bad news

This is the latest bad news for Caltrans, which was rocked last week when tests on water found in three rod sleeves turned up elevated chloride levels — possible evidence of saltwater intrusion into the foundation. The bridge project's oversight committee approved \$400,000 to test more rod sleeves to see how widespread the problem is.

The chloride levels were about half what is normally found in salt water, Caltrans says. But they also were 50 times higher than what Caltrans found in water removed from rod sleeves last fall when crews discovered that the bridge's lead contractor had done an incomplete grouting and sealing job.

Experts say that if the rod that Caltrans is removing this week is indeed fractured, many of the other rods could be in jeopardy. There is precedent for that: Thirty-two similar steel rods failed on the bridge's seismic-stabilizer structures in 2013 after they were exposed to rainwater for several years, forcing Caltrans to engineer a workaround that cost \$45 million.

Foundation at risk?

Experts also fear that more than the rods could be endangered by salt water: The tower foundation itself could be at risk.

Salt can attack structural rebar embedded in concrete, and the rust can cause the steel to expand up to six times its original volume. That in turn can cause much worse cracks in the concrete. The rebar is covered with epoxy coating, but even that might not provide long-term protection, experts said.

Concrete shrinkage cracks were evident at the bottom of the foundation during construction, and crews injected them with epoxy, bridge officials say. But one expert said such concrete cracks can never be fully filled to guard against saltwater intrusion.

'All bets are off'

“If you have cracks, all bets are off,” said **Russ Kane**, a corrosion expert in Texas who has advised the military and offshore oil industry on how to recognize and combat corrosion.

Kane said salt water “does nothing good,” and corrodes steel roughly twice as fast as freshwater does.

“You have a situation where the long-term viability of this system is in question,” Kane said. “You have everything working against you at this point, and all the safety factors have been removed.”

Kane added, “After seeing everything else that has happened, it seems like more of the same. It shows kind of a wanton disregard for good engineering design and practice.”

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HEARST *newspapers*

Fixing Bay Bridge tower's lean put crucial rods at risk

By **Jaxon Van Derbeken** Updated 6:32 am, Friday, March 6, 2015



IMAGE 1 OF 3

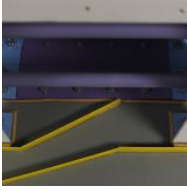
A crane removes a section of steel girder sliced from the old Bay Bridge span.

More than half the 400 steel rods that hold the new Bay Bridge eastern span's tower in place were put at significantly greater risk of cracking when engineers fixed a lean in the landmark tower by tugging it into its proper position, a bridge official revealed Thursday.

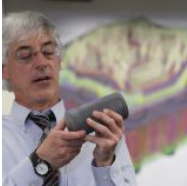
The problem was that when it was first installed, the top of the tower listed 18 inches closer to the East Bay shore than it should have, project chief engineer Brian Maroney told members of bridge oversight committee.

To pull the tower upright, workers attached high-tension cables on Yerba Buena Island to the 525-foot-tall structure for a full year in 2011 and 2012, Maroney said. One outside expert likened it to using a giant crowbar to pry the tower into place.

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That did the job — but it may have endangered the galvanized, high-strength steel rods that anchor the tower to its foundation, Maroney said.

The integrity of the 25-foot-long rods had already been thrown into doubt because of another construction problem: A botched grouting and caulking job had them stewing in water for years after they were installed. One rod that was removed for testing **was found to have rust and corrosion**, Caltrans said.

2013 failure

Before Thursday, Caltrans had downplayed the risk from the long-term soaking, saying the rods were under less stress than **32 similar steel**

fasteners that snapped when they were tightened on the bridge's seismic-stabilizer structures in 2013. Stress is a key factor in causing corrosion damage from hydrogen, the element that led to the sudden failure of those rods.

The tower was off-center after it was lifted into position in 2010 because the eastern half of the suspension span is longer than the western half, creating forces that pulled the structure eastward, Maroney said.

"Aesthetically, that's not a very good thing," he told the oversight committee at a meeting in Oakland. "We want the tower to be nice and vertical when it's done."

Maroney acknowledged that tugging the tower into its proper position could have put the water-soaked anchor rods at greater risk of cracking.

"We pulled them," Maroney said. "That was a pretty significant process. ... There was a lot of force involved there."

Tiny cracks

Maroney said the stress that the rods sustained during the year the tower was being pulled into position could account for microscopic cracks that were found on the rod that was removed from the foundation and tested. He said more tests need to be done to be certain.

The rod was taken from eastern side of the tower base, where the tension was greatest as the structure was being pulled toward Yerba Buena, Maroney said.

“When we pulled the tower back, we introduced some tension,” he said. “It was sustained for a long time, and (while the rods were) in standing water.”

Maroney said there is no immediate safety threat to the bridge, but that there could be a problem during a large earthquake — the kind the \$6.4 billion bridge was designed to withstand after the 1989 Loma Prieta earthquake revealed the vulnerability of the old eastern span, a section of which collapsed.

The rods are supposed to keep the tower from heaving during a quake and possibly listing. If many rods fail, Maroney said, “it’s not going to be the Leaning Tower of Pisa, but it will be perturbed.”

No obvious sign

Steve Heminger, executive director of the Metropolitan Transportation Commission and chairman of the oversight panel, asked whether some rods may have already failed in their sleeves at the base of the tower. Because of the way they were installed, they would not pop out of position like the ones that failed on the seismic-stabilizer structures in 2013.

Maroney acknowledged it was a possibility and said checking for any significant cracks would not be difficult.

But it is impossible to replace any damaged rods. The fasteners were installed before the tower was put on top of them, and now there is no room to maneuver new ones into place.

Heminger said he would be more comfortable if he knew that no rods had actually failed. “I hate to say this, but for some of us it feels like a trip down memory lane,” he said, referring to the 2013 failure.

Bernard Cuzzillo, a Berkeley-based mechanical engineer who investigates material failures, said the process of yanking the tower into place may indeed account for the tiny cracks that Caltrans has identified.

‘500-foot crowbar’

“This would provide additional loading on the rods, during the time they were the most vulnerable — a high hydrogen environment in water,” Cuzzillo said. “This could have put cyclic stresses on the rods, which may have resulted in crack growth or crack initiation.

“By pulling on a tower like that, it’s like a 500-foot crowbar creating a massive pulling force on these rods, which are basically like nails,” Cuzzillo said. “The material responded by cracking instead of stretching.”

The fact that Caltrans does not know whether any rods have failed is troubling, Cuzzillo said.

“If you are unable to verify the clamping force, you would basically have no information on what the tower would do in a quake,” Cuzzillo said. “It’s in a quake that you need the clamping force the most.”

Charles McMahon, a metallurgist and professor emeritus at the University of Pennsylvania, said Caltrans now faces a “big question mark.”

‘It’s an unknown’

“If you have evidence of cracking, you have high stress and you have water, you have a problem and there is no way to rationally judge whether these cracks are going to propagate,” McMahon said. “It’s an unknown.”

He said any cracks caused by the tower-pulling operation could get worse over time.

“When you put it in bending, you can get pretty high stresses,” McMahon said. “That should raise a lot of concerns, particularly with steel that is so susceptible to hydrogen cracking.”

Noting the litany of problems on the bridge, which have also included a **leaking road-deck support structure** and **questionable welding work**, McMahon added, “Wow. This has gone from one calamity to the next. At some point, a rational person would basically condemn the thing and redo it — if it weren’t so expensive.”

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