The gloomy gate

The San Francisco-Oakland Bay Bridge, which sits in the shadow of the golden one, suffers string of setbacks with the old and the new.

By the fourth time, with the San Francisco Bay rippling underneath, shoulders had reached ankle depth.

Morale really could not get any lower, but Caltrans and MCM Construction Inc. knew it had a lead on a solution following a potential deadly break in the 73-year-old San Francisco-Oakland Bay Bridge in late October.

After a tie rod snapped and dropped a 5,000-lb chunk of debris onto rush-hour traffic, the idea was to install a ball-and-socket-type configuration to avoid metal-on-metal contact with the bridge’s tie rods and saddle plates, which were installed over Labor Day weekend when crews discovered cracks in one of the eyebars.

The installation of the new system, however, required hours of pulling, milling and shifting to assure all components were rub-free.

“Whenever we pulled a bar out everybody’s shoulders just kind of sagged,” Rick Land, Caltrans’ chief engineer, told a press conference on Nov. 2 that ROADS & BRIDGES participated in via phone. “It was like, here we go again, because every time we did...
that it was several hours of pulling it back, grinding, putting the bar back in, tensioning it up, locking it up and then doing measurements again. It was very, very tedious work.

“We probably pulled the bars out four or five times . . . probably more than that.”

For much of the second half of 2009, the San Francisco-Oakland Bay Bridge kept on returning back to square one in the game of setbacks, but at the tip of it all was the tie rod dropping—one that even Caltrans admitted could have been prevented.

**Hard labor days**

The first sign of smoke came during that Labor Day weekend, when workers conducting a routine maintenance bridge closure noticed cracks in one of the span’s eyebars. C.C. Myers Inc. was called in to execute the fix, which involved fabricating a steel saddle brace wrapped around the fractured eyebar. The system was supposed to redistribute tension away from the damaged area, stunting the growth of the cracks.

A series of follow-ups and inspections revealed no further damage to the eyebar. The repair was working.

A few weeks later, Caltrans was walking the site during a day of high winds and noticed that the bars were “moving around quite a bit,” said Land. The decision to close the bridge was never scooped out of the think tank. But on Oct. 27 the wind went on a steroid-like rage, and Caltrans’ low-grade concern was put on high in an instant when the San Francisco-Oakland Bay Bridge lost a part of its steel splint.

“[The bar movement due to the wind conditions] is something that we did not expect,” said Land during the press conference.

Land was then quickly asked why the closure did not take place.

“Nothing had failed. It was really easy to look back, but at the time we noticed the movement our understanding was, OK, they are moving here. We had no idea at that point that that may be causing something we hadn’t anticipated.”

That something was the steel-on-steel contact involving the tie rods and saddle plates. The metallic grinding was hard enough to snap the tie rod, sending a portion of the damaged section down on the roadway and another end in the San Francisco Bay.

Land admitted that having the other end of that rod would help define the exact cause of the accident, but Caltrans believed it could be narrowed down to the Labor Day repair and vibration caused by the high winds.

As soon as Caltrans surveyed the wreckage it developed five key objectives. One was to replace all four of the tie rods that formed the Labor Day brace and wrap to make sure everything was safe. Second, Caltrans wanted to make sure that the tie rods all remained in place and were well-centered. Third, the agency wanted to modify the holes in the saddle support brackets to make sure the risk of steel contact was minimized. Fourth, vibration-dampening devices needed to be installed to keep the tie rods securely in place even under high winds. Finally, Caltrans wanted to strengthen the welds on the entire system to make sure the unit as a whole was much stronger than what was previously in place.

There are a total of 1,680 eyebars on the San Francisco-Oakland Bay Bridge, and Caltrans believed what happened in late October was an isolated incident. Still, it assured the press and the public that it was following a regular basis looking for any kind of possibility of imperfection in the eyebars. At press time, Caltrans had successfully completed the inspection. No further problems were reported.

However, the sharpest eyes and the strongest of repairs can still fall victim to accidents, which created another opportunity of prevention that Caltrans failed to recognize.

“In hindsight we did think the tie rods and other components could have and should have been secured to prevent them from falling down on the deck when the failure occurred,” said Land. “It is a very important lesson that has been learned.”

Tethers and straps have since been installed around the tie rod ends and saddles to keep everything suspended after a failure.

As for the repair, MCM Construction Inc. used two cranes to rig up 100-ft-long tie rods. Once in place, the rods were partially stressed to make sure
there was no metal-on-metal contact. If there was, or if the fitting did not meet Caltrans standards, crews would grind or cut the rod, the cranes would re-insert them and the process would start all over again.

“What we did is we added some attenuator straps to cut down the free length of the bar so if it had any vibration it would not oscillate as far,” Ed Puchi, spokesman for MCM Construction Inc., told ROADS & BRIDGES. “We also put attenuators in there so that the bridge structure itself would take most of the vibration.”

The complete fix went as follows:

• Workers installed a turnbuckle system that lashed the tie rods and eyebars together;
• Radiused nuts were put in place to secure the tie rods, which keeps them centered in their holes to minimize any metal-on-metal contact;
• Protective sleeves were wrapped around the tie rods to prevent them from rubbing against the eyebars; and
• Enhanced welding was executed to connect the cross bars to the saddles.

Once the repair was in place, Caltrans applied 320,000 lb of tension on the four tie rods, and before the bridge was officially put back in service, the agency had trucks run over the area while it watched strain gauges on the rods to check live-load readings.

“We saw very little change in the numbers,” remarked Land. The strain gauges will remain in place as inspections continue to mount. Caltrans planned on making daily inspections for two weeks. The everyday checks were supposed go on even longer if it was determined there was still a need for it.

Caltrans also made it clear that the fix was only a temporary one, but could not elaborate on a more long-term solution. Of course, once the new Bay Bridge is up and running in 2013 the current span will be demolished.

“We are looking for something that may be completely different than what we have that does not require the daily maintenance,” said Land.

**Throwing in a curve**

Vehicle speed, not wind speed, hit the San Francisco-Oakland Bay Bridge with another safety issue less than a week later. On Nov. 10, a semi-truck carrying a load of pears rammed into guardrail while attempting to manipulate around the new S-curve and plummeted 200 ft before

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landing on Yerba Buena Island below. The driver did not survive, but questions regarding the safety of the bridge were quickly resurrected.

Bart Ney, spokesman for the new San Francisco-Oakland Bay Bridge, vehemently defended the safety of the S-curve, referring to a stiffl and stern approval process before the project even broke ground. However, since it opened to traffic after Labor Day a total of 44 accidents have occurred.

“It went through a public process with the environmental impact report,” he told ROADS & BRIDGES. “So the final design is not only the best safety-wise for traffic navigation, but also the best for the environment we have here at Buena Island by putting both eastbound and westbound traffic on the southern side of the island.”

The S-curve is part of a half-mile-long detour that Caltrans put in place to literally take traffic out of the way so that crews could demolish the old approach to the Yerba Buena Island tunnel and place the new bridge over the same footprint as the current span. Alternative alignments were explored. One put eastbound and westbound traffic on either side of the island and another put both directions of traffic on the north side. However, it was concluded that the south side was the best spot.

But speed dangles temptation in front of drivers on the San Francisco-Oakland Bay Bridge. According to Ney, because the span is an open structure with five lanes of traffic, many choose to fly over it when traffic is light. The California Highway Patrol estimated that the pear truck was traveling 50 mph in a 40-mph zone.

Caltrans recently enhanced the safety throughout the S-curve during the Labor Day weekend closing that revealed the eyebars cracks, adding more arrow markings and flashing lights in the area where the speed limit changes. Raised reflectors also have been installed along the lane lines, and an epoxy grit has been applied to steel plates for better traction.

“Since the time we have opened, over 16 million vehicles have made it through [the S-curve] with no problem obeying traffic laws,” said Ney.

In the future, Caltrans is looking to install speed-display signs and other signs and flashing lights along different points of the bridge.

The damage to the S-curve following the accident was minimal. According to Ney, minor repairs were made to the guardrail, and reflectors and arrow signs were replaced. Caltrans now has a total of seven arrow signs at the scene of the accident.
Chinese crackers

Caltrans was hoping for a fresh start with the new San Francisco-Oakland Bay Bridge, but when it was reported that the Chinese steel fabricator—Zenhau Port Machine Co. (ZPMC)—was having difficulty producing pieces of the self-anchored suspension (SAS) bridge this summer something did not smell right for many in the bridge-building industry.

The National Steel Bridge Alliance was quick to call out the California transportation agency when it was reported that delivery of steel segments of the SAS deck was being delayed.

“We put out a press release and it pretty much said I told you so,” Bill McEleney, director of the NSBA, told ROADS & BRIDGES. “We complained four years ago about circumventing the Buy America process that led [Caltrans] to where it is today, and now they are getting what they paid for.”

The Buy America process McEleney was referring to rewards those projects that use fabricators and suppliers in the U.S. with federal funding.

“[Caltrans] said, ‘No, we are going to fund it ourselves.’ So they took it off the Buy America so they could go wherever they wanted,” said McEleney.

McEleney said Caltrans decided to bypass federal funding when it received just one bid for the new bridge. According to McEleney, an independent review team was then formed and recommended the original SAS design should be scrapped in favor of a cable-stayed design.

“At that time the independent review team was recommending their scheme would save [Caltrans] $600 million. We know what Caltrans decided to do. They certainly did not adopt that recommendation,” said McEleney.

Ney recalled the process differently. He said the Metropolitan Transportation Commission (MTC) developed an opinion based on recommendations of an advisory panel full of bridge experts. The panel offered guidance to a committee formed by the MTC to determine which span type would be the best moving forward. According to Ney, it came down to the SAS and a cable-stayed version, and the MTC went with the SAS.

Caltrans advertised the bid with the SAS and came up with the lone taker.

“The bidder was almost double the engineers’ estimates,” Ney said. “We could not afford it.”

Caltrans then went back and considered a concrete viaduct that was originally proposed and was quickly shot down by those in the Bay area that demanded a signature structure. That is when the state legislature stepped in and passed a funding package (Assembly Bill 144) that allowed Caltrans to look for bidders a second time.

“We did a couple of things that made it more enticing to get multiple bids,” said Ney. “We put a $5 million stipend for groups that put responsive bids in.”

American Bridge ultimately won the contract and, according to Caltrans, was the one that decided to go with a Chinese steel fabricator. According to Ney, American Bridge did not believe there was a facility in the U.S. that could handle the order. Caltrans audited the China facility to make sure ZPMC had the capacity to handle such a job.

McEleney said that in the original lone bid the U.S. steel fabricator proposed to build a new plant, which would take some time at the onset. However, McEleney believed that the new facility also would carry automated machinery which would speed up the process.

“I am sure many of [China’s] steel mills are not as up to date and modern as ours are,” he said.

ZPMC’s troubles surfaced as it was producing the first delivery of the steel deck and cracks were discovered in the floor panels.

“It was the worst place to find the crack in the process because it is one of the last steps and you have to start over in repairing it,” remarked Ney.

Ney added that the necessary adjustments have been made and the first delivery could ship in December, putting the project four months behind schedule.

Erecting an orthotropic deck, however, can be complex, which drew a concern from McEleney.

“The welding needs to be much more precise. For this type of bridge, underneath that wearing surface is a steel plate that goes the full length of the bridge, and that is stiffened by little stiffeners every 4 or 5 ft. I couldn’t even guess how to quantify the welding.”

The complexity puts a higher importance on quality control, which many argue would be better managed had a U.S. fabricator been used.

Ney, however, argued that Caltrans personnel live in Shanghai and are inspecting it daily to make sure the product is right.

The overall cost of the new San Francisco-Oakland Bay Bridge currently sits at $6.2 billion with a $900 million contingency. As of Nov. 10, Ney said funding had not been exceeded and that they still plan on opening the span to traffic in 2013.

McEleney questioned the project’s ability to stay on time and within budget.

“It appears it is going to be late and cost more than they thought. Could that happen on any project? Sure. Am I hesitant to say it would be less likely to happen on a domestic project? No.

“You can’t prove me right or wrong, but I am not embarrassed to say it probably would not have turned out this way on a domestic project.”