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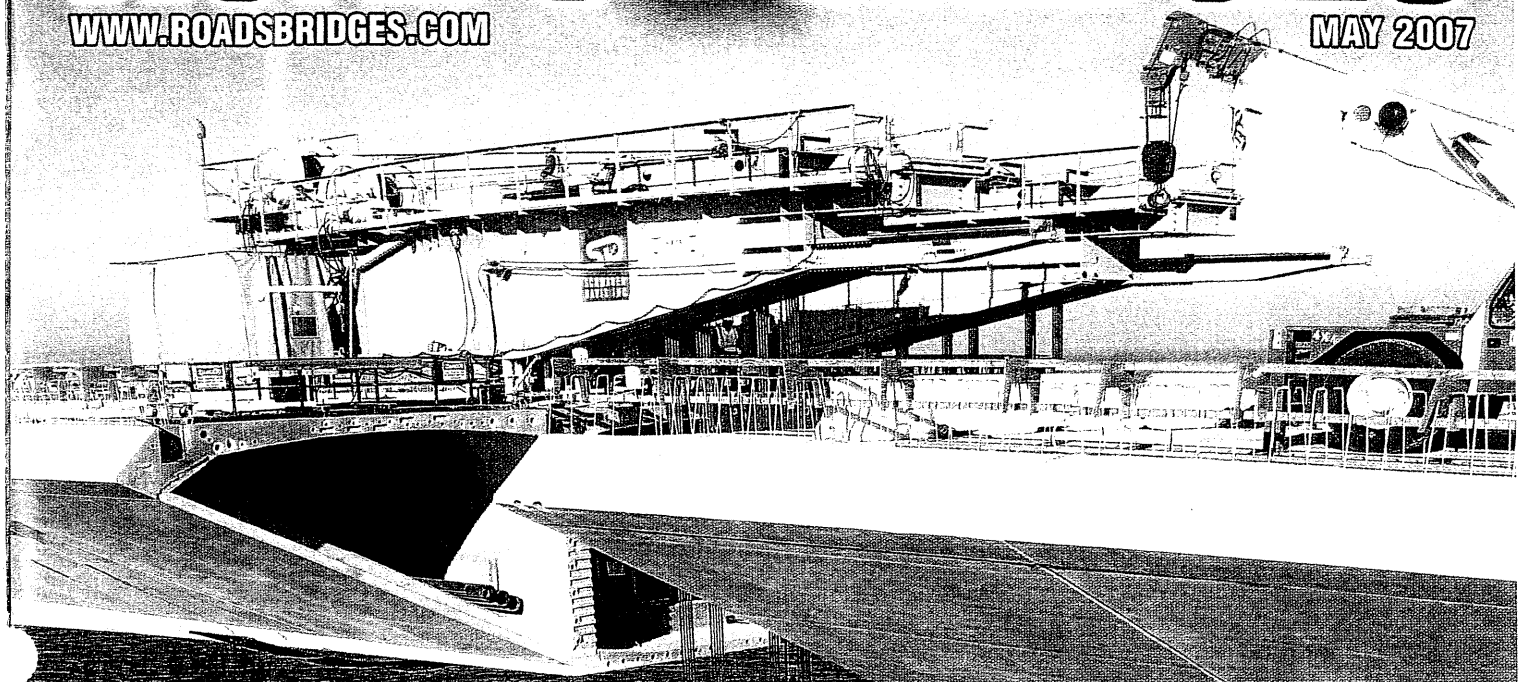

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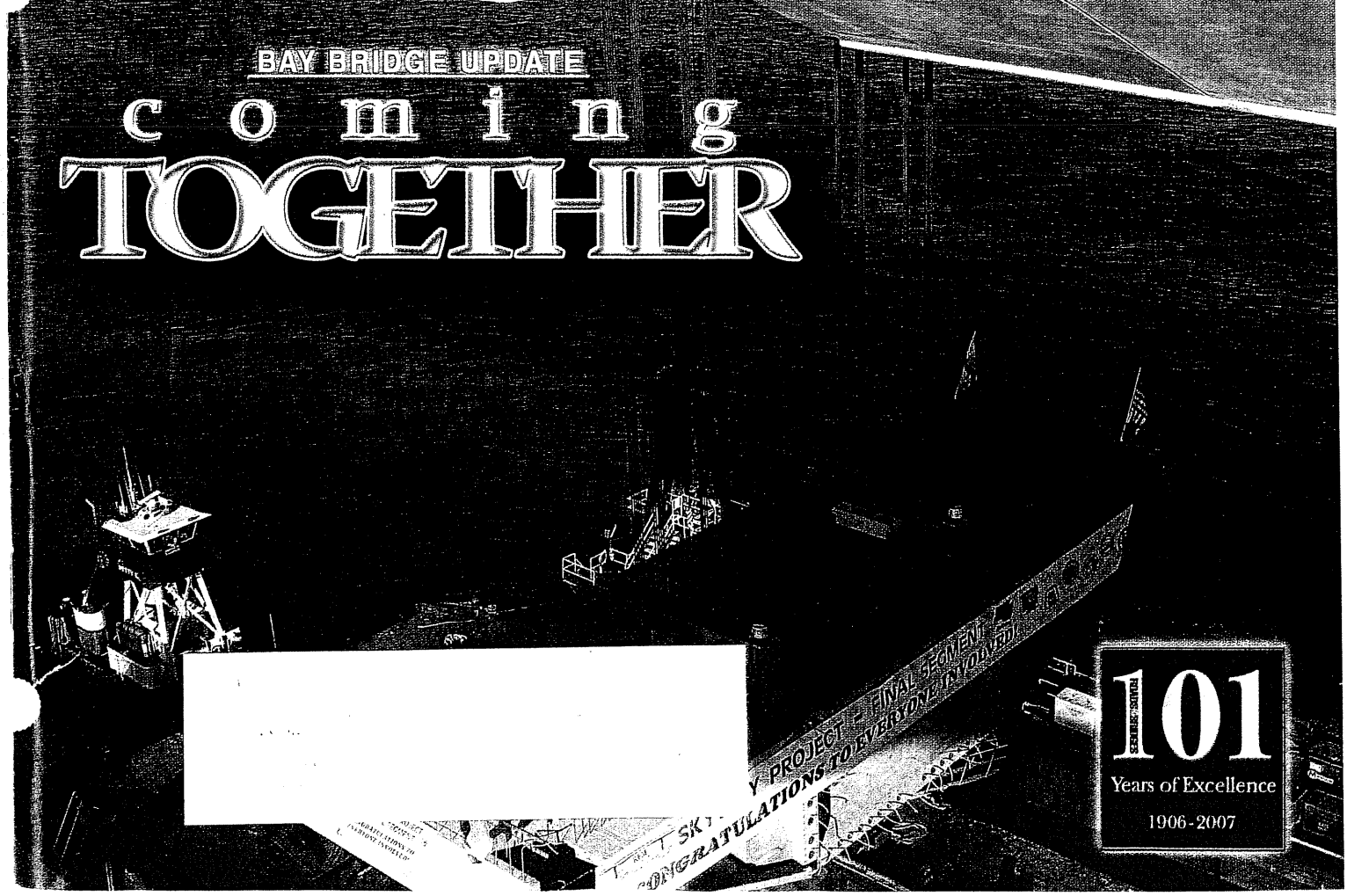

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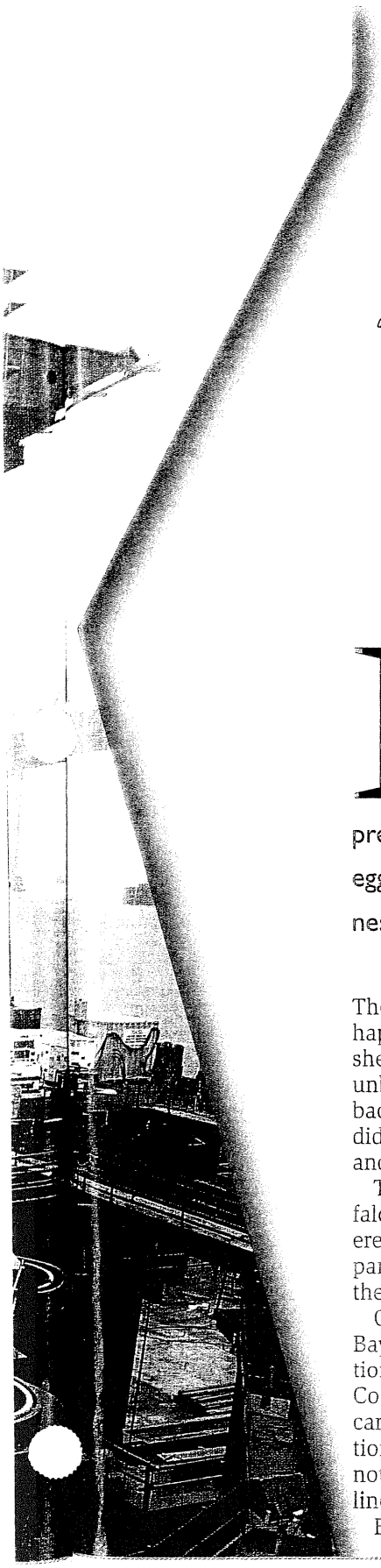
BRIDGE CONSTRUCTION

BY ALLEN ZEYHER
MANAGING EDITOR



ALL the state's horses

California builders reach major milestone in putting together Bay Bridge east span

Reading the news story, someone might think: There's got to be a Humpty Dumpty joke here somewhere. (Humpty Peregrine sat on a bridge . . .) Recent newspaper accounts reported that rescuers had snatched a group of peregrine falcon eggs from their precarious perch on the San Francisco-Oakland Bay Bridge. The rescuers said the eggs were in a dangerous location, where an egg or a chick might tumble out of the nest and into the bay far below or into traffic zooming along the bridge deck.

The scientists looking after the falcons perhaps could not have put the broken egg shells back together, but they could nurture unbroken baby falcons and then release them back into the wild. After all, that is what they did for the celebrity falcon parents, George and Gracie.

The same ingenuity that can save peregrine falcons—applied to a different pursuit—can erect a bridge to carry travelers across an expanse of open water and land them safely on the other shore.

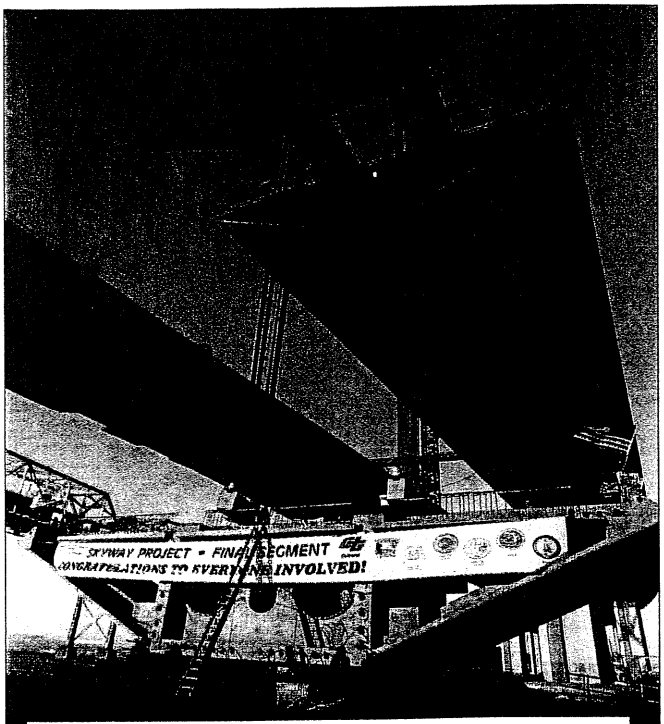
Construction of the new east span of the Bay Bridge is at a sort of turning point. Erection of the skyway structure is complete. Construction of the temporary steel truss to carry interim traffic is about half built. Erection of the self-anchored suspension span has not yet begun . . . at least not above the water line.

Both the skyway and the suspension sections had recent big events to report. The suspension bridge celebrated the completion of the foundation of its single tower in mid-March. The 2,100-ton, basketball-court-size footing box arrived by barge and was lowered onto the tower's piles. It will be filled with concrete to complete the connection between the tower and its foundation.

The footing box left Corpus Christi, Texas, about a month earlier and floated through the Panama Canal and up the Pacific coast of California to reach the San Francisco Bay.

Stabbing up from the footing will be a 525-ft-tall steel tower, which will cradle the 0.78-m-diam. (30.7 in.) suspension cables.

In all, the new east span will run 11,525 ft (2.2 miles) from Oakland to Yerba Buena Island and cost $6.3 billion. The suspension span by itself will cost $1.4 billion. The total length of the bridge from Oakland to San Francisco is 8.25 miles.



Fitting the 750-ton segment into place was the culmination of three years of work by the joint venture contractor Kiewit-FCI-Manson. (Photo courtesy of Caltrans)

Skyway crown

Like a tooth into a row of dentures, the last segment of the east span skyway deck was raised into place a few months ago. The precast concrete segment was the last of 452 that were cast at a fabrication yard in Stockton, Calif.

The workers who were raising the segment into place 100 ft above the bay knew it would fit precisely because the skyway segments were "match-cast." The segments fit in the field because adjoining segments were cast alongside each other at the fabrication yard.

Fitting the 750-ton segment into place was the culmination of three years of work by the joint venture contractor Kiewit-FCI-Manson, which along with Caltrans employed about 260 people at the Stockton yard. The skyway deck segments consumed about 130,000 cu yd of concrete and 31 million lb of steel.

The only work left on the twin parallel decks of the skyway is to pave the decks with high-strength polyester concrete, install electrical and mechanical systems and finish the pedestrian and bike path. The expected completion date for the skyway is the end of this year.

The precast concrete skyway segments are the world's largest at three stories tall, according to a Caltrans District 4 newsletter, *East Span News*.

The skyway segments are not the only components of monumental size on the east span.

The battered piles under the skyway weigh 365 tons

each and were driven by one of the largest hydraulic hammers in the world. The hammer generated 1.2 million lb of force, producing such powerful shock waves that the builders had to create dense curtains of air bubbles around the piles underwater. The air bubbles help absorb the shock waves and protect fish and other wildlife in the vicinity.

The skyway, like the suspension span, was designed by a collaboration of T.Y. Lin and Moffatt & Nichol.

Caltrans and contractor American Bridge Co. plan to begin major construction operations on the suspension bridge in 2009. When the suspension span is finished, it will be the world's longest single-tower, self-anchored suspension bridge. Caltrans expects to be able to open the new east span to traffic in 2013.

An earlier fall

The impetus—or driving force, you might say—for constructing a new east Bay Bridge span was the damage done to the old bridge by the 1989 Loma Prieta earthquake.

As a result, the new east span was designed and is being built with more extensive seismic features to resist future earthquake damage.

The new Bay Bridge is designed to "lifeline criteria," according to Bart Ney, Caltrans' chief public information officer for the Bay Bridge. To be a lifeline, the Bay Bridge must be immediately available for use by emergency vehicles after a large-scale seismic event. It must also be able to be put back into service for the public within a relatively short time.

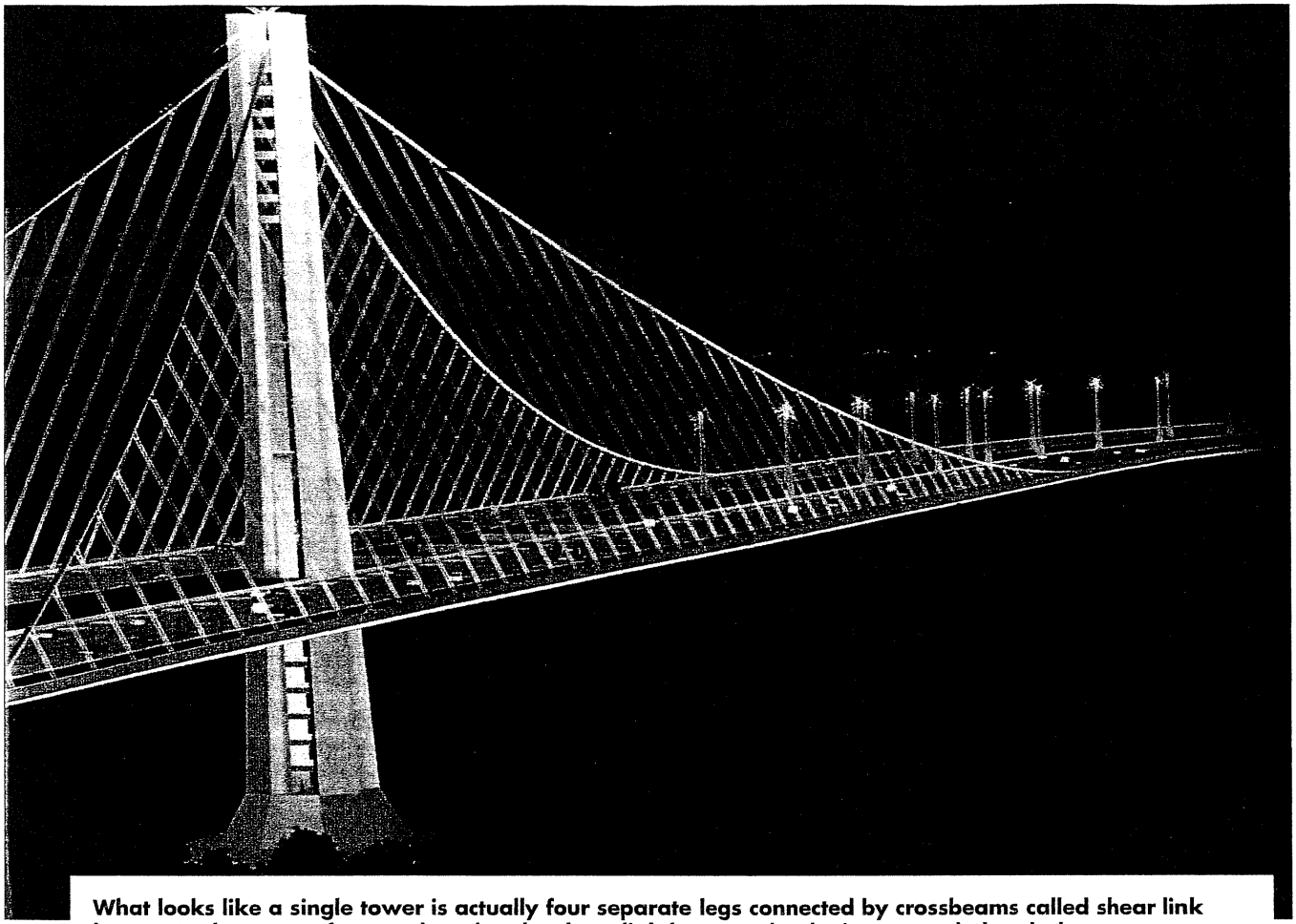
The skyway is protected from earthquake damage by several physical features. Starting at the bottom, the 160 piles for the 28 piers of the skyway are driven at an angle, what bridge engineers call "battered," for better stability. The arrangement is similar to the legs of a tripod, but a tripod stands on the ground and extends up in the air, and the 8-ft-diam. skyway piles are driven into the ground some 300 ft and never touch bedrock.

In the skyway deck itself, there are hinge pipe beams between segments. The hinge pipe beams are 60-ft-long, 4-6-ft-diam. steel tubes that extend longitudinally from one deck segment into the adjoining segment. They allow the segments to slide longitudinally in response to thermal expansion or contraction.

The end sections of each hinge pipe beam are made of strong 70W-grade high-performance steel (HPS). Holding the two ends together is a narrow "fuse" made of smaller-diameter and lower-strength HPS 50W steel. In the event of an earthquake, the skyway segments will give way at the fuse. The fuse will deform, absorbing the earthquake energy and preventing damage to the deck segments.

The piles the suspension tower rests on are not battered; they are driven straight down 200 ft and rest on bedrock.

The tower has its own version of the hinge pipe beams of the skyway. What looks like a single tower is actu-



What looks like a single tower is actually four separate legs connected by crossbeams called shear link beams. In the event of an earthquake, the shear link beams take the impact and absorb the energy, preventing damage to the tower legs. The shear links are relatively easily replaced. (Photo courtesy of Caltrans)

ally four separate legs connected by crossbeams called shear link beams. In the event of an earthquake, the shear link beams take the impact and absorb the energy, preventing damage to the tower legs. The shear links are relatively easily replaced.

Other seismic features of the bridge include a monitoring system that Caltrans is installing at key locations on the bridge to indicate forces and displacements caused by an earthquake. The information from the monitoring system should enable Caltrans to diagnose structural problems earlier.

Caltrans also has planned for inspection of some pier footings. According to *East Span News*, some of the piers that have footings below water level have special casings that allow inspectors to walk down into the pile cap to inspect the condition of the pile cap and pier connection after an earthquake.

Working around

Over Labor Day, the Bay Bridge will be closed for three or four days—as it was last year—in order to demolish 4,000 cu yd of material on the westbound approach to Yerba Buena Island and roll in a new upper deck viaduct. The new prefabricated viaduct structure is 300 ft long. Once the demolition of the old structure on the east side of Yerba Buena Island starts, the massive operation cannot stop until the new viaduct is in place and connected.

Over the next five months, a contractor, C.C. Myers, will construct the upper viaduct section just south of the existing section. Caltrans plans to tear down the existing viaduct in the first two days of the closure. Another contractor is scheduled to spend the next day pushing the new viaduct into place.

Caltrans announced the closure five months ahead of time to let people plan their detours. A similar closure last Labor Day allowed workers to demolish sections of the San Francisco approach to the Bay Bridge. With plenty of advance warning and a massive public relations campaign, traffic in the area flowed smoothly.

The new Bay Bridge east span is quite an international effort. The steel tower, steel deck sections and suspension cables for the suspension bridge are being fabricated in China near Shanghai. The temporary double-deck, steel-truss viaduct is being fabricated in South Korea.

Erection of the suspension bridge is scheduled to begin in 2009. The east span is scheduled to open to traffic in 2013. R&B