CRSI

ANTI-CORROSION TIMES

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REPORTING ON INDUSTRY NEWS, NOTEWORTHY APPLICATIONS & NEW DEVELOPMENTS ON FUSION BONDED EPOXY COATINGS FOR CORROSION PROTECTION OF REINFORCING STEEL

In this issue

Anti-Corrosion Times is a publication of the Concrete Reinforcing Steel Institute, a not-for-profit trade association providing valuable resources for the design and construction of quality cast-in-place reinforced concrete. Published biannually, the *Anti-Corrosion Times* is produced to help specifiers, engineers, architects, fabricators and end-users receive the most recent information about how and where epoxy-coated reinforcing steel is used, recent technical changes and information resources. Send any questions or comments regarding the *Anti-Corrosion Times* to Scott R. Humphreys, Manager of Corrosion Protection.

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New National World War II Memorial Dedicated May 2004

In 1993, Congress passed legislation authorizing the building of a National World War II Memorial in Washington, D.C. The authorizing legislation was signed into law by President Clinton on May 25, 1993. This is the first national memorial dedicated to honor all who served during World War II and acknowledges the commitment and achievement of the entire nation. It is estimated that 16 million people served in the armed forces; more than 400,000 died and a nation of 132 million supported the war effort.

After site selection, The American Battle Monuments Commission (ABMC) and the General Services Administration (GSA) announced a design competition in 1996 to kick off this project. The final design was chosen using a two-stage design competition. Over 400 entries were submitted in the first phase of the competition; six were chosen as finalists. Both the Design Jury and the Evaluation Board, independent of each other, unanimously recommended the design submitted by the Leo A. Daly team and Fredrich St. Florian.

After design evaluation and public hearings, the GSA awarded construction contracts in 2001 for a September start. Initial activity was devoted to site preparation and utility relocation. Next a slurry wall, along with 600 steel piles driven into bedrock, provided support for the plaza, the vertical structures and the water elements.

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(continued from page 1)

Major construction phases included:

1. Site mobilization and preparatory work
2. Utility relocation and preliminary foundation activity
3. Excavation and foundation construction
4. Slab on grade construction, plumbing and electrical
5. Stone setting and erection
6. Ancillary structures

The $110-million memorial is built of bronze and granite on a reinforced concrete foundation. It is located on the National Mall between the Lincoln Memorial and the Washington Monument. On the 7.5 acre site there are two 43-foot memorial arches joined in an oval ring by the fifty-six 17 foot high pillars. The arches represent the Atlantic and Pacific war theaters. The pillars encircle a sunken plaza and pool and represent each state and territory and the District of Columbia. Opened to the public during the last week of April 2004, the memorial was formally dedicated to a sell-out crowd of over 150,000 on May 29, 2004.

Total construction costs were estimated at $67.5 million, primarily covered by private contributions. Built to last for generations, the monument used 1400 tons of epoxy-coated steel reinforcing bars in the in the foundation and slabs throughout the memorial. This corrosion resistant reinforcement was chosen because it met the criteria of: esthetic appeal, superior strength and durability in a damp site. While epoxy-coated steel reinforcing bars are usually used in bridges, parking garages, and other transportation structures, it was the material of choice in this memorial to ensure a corrosion-free structure for for years to come. ■

Photos © Rick Latoff

The $110-million memorial is built of bronze and granite on a reinforced concrete foundation.

Epoxy-coated reinforcement was chosen because it met the criteria of: esthetic appeal, superior strength and durability in a damp site.

Project Team:	
Epoxy Coater:	Harris Rebar Atlantic Inc.
Owner:	American Battle Monuments Commission
Architectural Firm:	Leo A. Daly & Associates
Design Architect:	Fredrich St. Florian
Contractor:	Tompkins Builders & Gunley-Walsh

The New San Francisco-Oakland Bay Bridge Scheduled for Completion in 2012

A Bridge to Yesterday

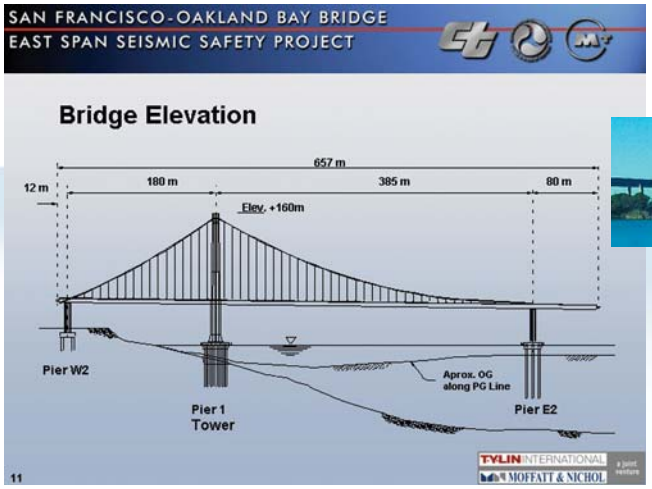
At its groundbreaking, President Herbert Hoover called it "the greatest bridge ever erected by the human race."

When it opened in 1936, it was the largest and most expensive bridge in the world at a cost of $77 million, a significant sum for the Depression-era.

In 1956, it was named one of the seven engineering wonders of the world.

And in the summer of 2007, it is scheduled to be demolished.

The end is coming for the San Francisco-Oakland Bay Bridge, which for more than 65 years has borne more traffic and superlatives than most bridges on Earth. The double-deck structure — a hybrid of two suspension spans, a cantilever section and a truss bridge — remains the busiest bridge in the nation, carrying more than 270,000 vehicles per day.



The new bridge concept

The new bridge will have the world's first self-anchored "suspension" span.

The New Bay Bridge

It will have the world's first single-tower self-anchored suspension span and some of the largest and heaviest components ever seen in bridge building, assembled by the biggest equipment ever seen on the bay. One section alone, the $2.18-billion Skyway, is by far the largest single construction contract ever awarded by the State of California.

The new East Span incorporates several state-of-the-art seismic safety features. As a "lifeline" bridge, the East Span has been designed to provide service within 48 hours of a damaging earthquake.

The 2.18 mile long span is not one bridge, but a combination of bridges: A signature "suspension" bridge, an elegant "Skyway" viaduct, an Oakland Touchdown and the Yerba Buena Transition structure. Construction for the East Span is estimated at ten years. The East Span's lean, graceful design was created to compliment the beauty of the bay and mirror the grace of the Golden Gate and West Bay bridges. The signature element, the "suspension" tower, has an asymmetrical cable design, destined to become a landmark.

The New East Span will provide a safer, more efficient transportation route across the bay. The bridge will not have more lane capacity than the existing bridge, but its husky emergency shoulders will produce a smother flow since accidents and stalls can be moved to the side.

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Copy platform and photographs courtesy of www.newbaybridge.org

(continued from page 3)

The Suspension Bridge

The building of the foundation for the "suspension" section tower and the construction of the eastern most support structure for the "suspension" roadway have been combined by Caltrans into one marine foundation contract. The foundation for the 530-foot steel tower is called the T1 footing. It entails the construction of a reinforced concrete pilecap supported by 13 piles set deep into underlying rock. In building the T1 foundation for the "suspension" section tower, crews will bore holes for 13 supporting piles 196 feet through the thin mud layer into the bedrock that forms the Bay bottom east of Yerba Buena Island.

The T1 piles will be constructed of reinforced cast-in-place concrete. The upper portion of the piles, roughly the top 107 feet, will be encased in a permanent steel casing, 8 feet in diameter. The lower portion of the piles, roughly the lower 98 feet, is a "rock socket" with the steel-cage-reinforced concrete extending down into the bedrock without a steel casing. The entire footing will be encased in concrete and will form a final foundation structure 85 feet long, 73 feet wide and 21 feet thick.

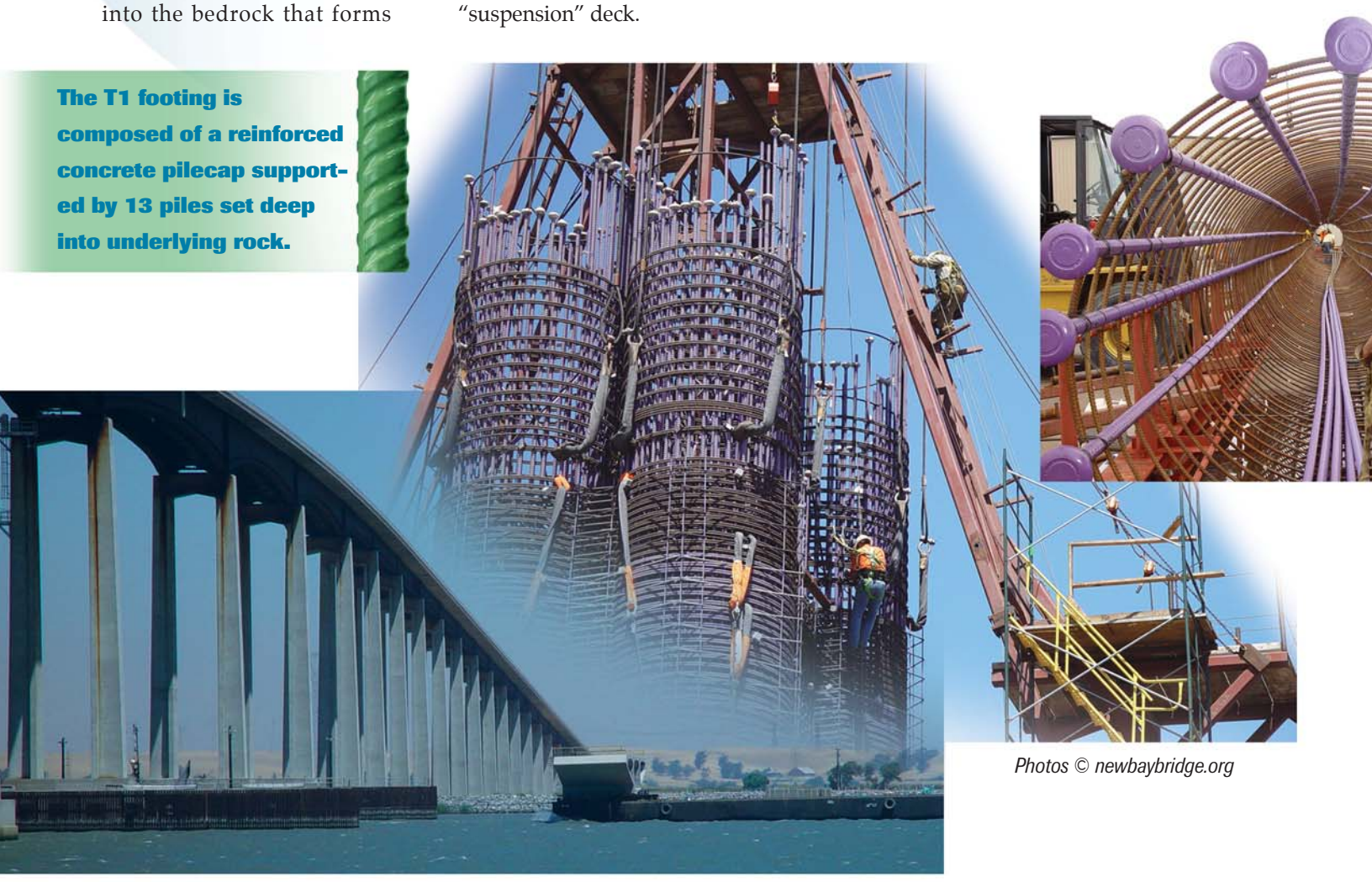
The eastern support is referred to as E2. It features two pile-supported footings linked by a reinforced concrete box and topped by pier columns that support the bridge's twin road decks. A 52-foot-long concrete box section will connect the two footings. The dimensions of the three-part structure will be 220 feet long by 80 feet wide. Crews will then construct two reinforced-concrete pier-columns, roughly 120 feet tall.

W2 Project

The W2 project entails the construction of two massive pier structures 170 feet apart on Yerba Buena Island to support the western end of the "suspension" section. The pier foundations will extend 70 feet into the ground; their columns will rise as much as 89 feet from the ground to the "suspension" deck.

The Skyway features 452 separate roadway box segments, most 25 feet long, three stories high, 90 feet wide and weighing between 480 and 780 tons.

The T1 footing is composed of a reinforced concrete pilecap supported by 13 piles set deep into underlying rock.



Photos © newbaybridge.org

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Each of the two structures will consist of these components:

1. *A solid, 62-foot wide and long by 33-foot deep foundation block*
2. *Retaining walls extending 35 feet from ground level to the top of the pile cap*
3. *Four columns reaching from the pile cap to the "suspension" section*

Once the columns are completed, they will be capped with concrete structures that will tie into the "suspension" section. In all, the W2 structure will require 5 million pounds of steel reinforcement and 430,132 cubic feet of concrete.

The Skyway

Construction of the Skyway begins below the Bay. Working amid the tides and dealing with deep layers of sediment, crews will use unique techniques and mammoth equipment to build the underpinnings of this new bridge section.

The substructure of the Skyway consists of three major components:

Piles.....Large steel tubes driven deep into the bay mud.

Footings.... Steel and concrete foundations through which the piles are driven.

Piers.....The concrete pillars atop the piers to support the roadway.

In all, 160 piles will be set, their sections welded in two long segments as they are driven in sequence. Crews will then clean out the forms for the piles, insert a rebar cage into each and fill them with concrete. When the pilings are placed, the forms will be dismantled and moved to the next location.

A 3-foot thick slab of concrete will then be poured on top of the footing to form a pile cap upon which the piers supporting the roadway can be built. In addition, a concrete sleeve will be poured atop the pile cap. Although the footing will be submerged in the bay shallows, the sleeve will be visible at the waterline. Within the sleeve, the footings will have two open sockets into which reinforcing steel will be set for the construction of the piers, which will be poured in stages called lifts. Concrete will be barged to the piers and pumped into the forms. Three to four lifts will be required for each pier. Each finished pier will consist of four connected columns with an opening in the middle where an access stairway will allow engineers and maintenance crews to inspect the pier interiors and pile caps.

The Skyway will have 452 roadway box segments, most of them 25 feet long, three stories high, 90 feet wide and weighing between 480 and 780 tons. The roadway construction starts at the top of each column. Above the water, the first road deck section, called pier tables, will be cast in place. To make the pier tables, crews will build forms, tie in

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reinforcing steel, then place concrete into the forms. The wings for the tables will be precast and installed in place.

Oakland Touchdown

The roadway connecting the Skyway section to the existing freeway lanes west of the Bay Bridge Toll Plaza is called the Oakland Touchdown. Two roadway sections and a new electrical substation will be constructed. Extensive relocation of the underground utilities will also be required. The Oakland Touchdown will be one of the last phases of the East Span project.

YBI Transition Project

The Yerba Buena Island (YBI) Transition project will connect the "suspension" section of the new East Span with the existing roadway on the east side of the Yerba Buena Tunnel. The challenge for the designers and engineers was to devise a strategy for building the connectors high above the island without impeding the flow of the 270,000 vehicles that cross the Bay Bridge every day.

The California Department of Transportation (Caltrans) is responsible for the design, construction, maintenance and operation of the East Span of the bridge. This $2.6 billion seismic safety project is scheduled for final completion in 2012. ■

Project Team:	
Epoxy Coater:	American Highway Technology & FBC Systems
Contractor:	KFM (a joint venture of Kiewit Pacific, FCI Constructors Northern Division and Manson Construction Company)
Skyway & Suspension Bridge:	T.Y. Lin
Oakland Touchdown & Yerba Transition:	Moffatt & Nichol Engineering
Rebar Supply & Installation:	Harris Salinas Bay Area Reinforcing

Marquette Interchange: Reconstruction Begins

The Marquette Interchange is an $810 million construction project in Milwaukee, Wisconsin. Originally known as the Central Exchange, the Marquette Interchange has a fifty-year history. Initial sketches and plans were presented in December 1952; the interchange was opened to traffic in December 1968. After 30 years of service, the DOT determined that it was time to reconstruct the Marquette Interchange, with the goal of building it better and at a lower cost. In its reconstruction, it will also be reconfigured. Consisting of six phases, the construction of the first phases began in April 2004, completion is scheduled for November 2008.

The reconstruction was necessary for several reasons, including deteriorating bridges, safety, traffic congestion and the economic well being of the state. The project connects most of the areas freeways, which link about one-third of the state's freeway traffic to the rest of the country. These highways, I-94, I-794 and I-43 are the cornerstone of the southeastern Wisconsin freeway system. The exchange serves approximately 300,000 vehicles a day, as well as 125,000 residents, 4,200 employers, 127,000 jobs, 3,600 hotel rooms, and over 7 million tourists a year. The importance of this stretch of interstate highway and its rapid deterioration was highlighted in December 2000 when two of the three structural steel plate girders of the Hoan Bridge failed from brittle fatigue fractures. The subsequent bridge closure disrupted both traffic and commerce. Wisconsin's Department of Transportation has rated approximately 1/3 of the bridges that will be replaced in this project as intolerable to minimally intolerable. Besides replacing these structures, the other goals of the Marquette Interchange project are to eliminate left hand side entrances and lessen the crash rate, which is currently so high that approximately 1/3 of the accidents in the entire Milwaukee County freeway system occur within this corridor.

The project has many unique constraints. Many of the highways are not at grade but elevated or below grade. The project will make extensive use of bridges, retaining walls and short tunnels. In total, 152 bridges will be reconstructed close to the existing maximum height of 120 feet. Other project constraints include the re-configuration within the existing footprint, reconstruction under traffic with the goal to keep two traffic lanes open in each direction at all times and an aggressive project schedule that requires construction during the winter season.

In some areas where a new retaining wall is needed, the existing interstate roadway and secondary roadway are so close to each other that a new style of retaining wall, called a secant pile retaining wall will be used. The secant pile retaining wall is constructed by placing a series of small diameter reinforced cast-in-place piles in an alternating pattern and then coming back and drilling in between these piles and placing another pile with higher strength concrete between the previously placed piles.

Originally, cost estimates reached $1.4 billion, but with fine-tuning of the design the total cost was reduced by $600 million. The project will require about 11,500 tons of steel reinforcing bars. In the first phase, 700 tons of reinforcing bars were used (150 epoxy-coated and 600 black bar). In the second phase, 3,100 tons were used (350 epoxy-coated, 2,750 black bar). Chosen for their ability to reduce corrosion, epoxy-coated reinforcing bars will be used in concrete piers, girders and decks. Originally these portions of the structure were to be built utilizing stainless steel clad reinforcing bars. However, due to the lack of availability and the tight construction schedule, epoxy-coated steel reinforcing bars became the material of choice. ■

Project Team:	
Epoxy Coater:	Toltec Steel Services
Owner:	Wisconsin DOT
Engineer:	HNTB, TBD
Contractor:	Walsh Construction

Scott Humphreys Promoted to Manager of Corrosion Protection at CRSI

Scott Humphreys, P.E., S.E., is the new Manager of Corrosion Protection at CRSI. For over 3 years, Scott has managed the CRSI Epoxy Plant Certification Program along with technical duties as a staff structural engineer.

He joined CRSI in 1999 and has worked extensively updating the CRSI Design Handbook and developing industry related software. In addition, he represented CRSI on many industry related committees including ACI 332 – Residential Concrete, ACI 360 Slab-on-Ground, ACI 551 Tilt-Up Construction, ASCE 7- Minimum Design Loads for Buildings and Other Structures, Building Safety Seismic Commission's National Earthquake Hazards Reduction Program and the Alliance for Concrete Codes and Standards.

In his new position, Scott is responsible for managing the technical, marketing and plant certification program activities of the CRSI Epoxy Coating Rebar Committees. He will coordinate the integration of all epoxy related initiative programs with CRSI bridge/pavement/parking structure marketing. Responsible for technical assistance, he will make visits or presentations to all interested parties, including engineers, state agencies, contractors, specifying agencies and CRSI members.

An engineering graduate of the University of Illinois, Champaign-Urbana, he received his Master of Science degree in Civil Engineering-Structures from Purdue University in 1987. A registered Structural Engineer in Illinois, Humphreys is also a registered Professional Engineer in Indiana and a Certified Building Official.

To arrange a presentation or visit from Scott, contact him at CRSI Headquarters in Schaumburg, IL. ■

"Progress with Epoxy-Coated Rebar" in New '30 Year' Milestone Brochure

This new 16-page, full color brochure celebrates the 30th anniversary of epoxy-coated rebar. The first specified application for epoxy-coated steel reinforcing bars was in bridges. Here's an outline of the brochure:

- Early years and the players
- Fusion-Bonded Coaters join CRSI
- Plant Certification
- Research Findings over the years
- Epoxy-Coating Economics
- Outstanding Projects

For your copy of the '30 Year' Milestone brochure, contact:
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