CRSI

ANTI-CORROSION TIMES

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

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Grand Rapids S-curve completed early using CRCP with epoxy-coated rebar

On Saturday, January 15, 2000, the Michigan DOT undertook the biggest challenge in Michigan road construction history. Known as the S-curve, the one-mile stretch of US 131 in downtown Grand Rapids was closed completely for the first time since it was built 39 years ago, putting an unprecedented pinch on the region's transportation system. Over that January weekend, the ramp from westbound Interstate 196 to southbound US 131 was closed, followed by lane closures in both directions and finally, all remaining access ramps were blockaded.

© Grand Rapids Press

The project specifications included maintaining the S-curve, but making the roadway much easier to drive especially with wider shoulders on each side.

The time line plan for this $145 million dollar project incorporated fast-track construction methods. The northbound lanes were to be completed by September; final completion in December 2000. And, the project was actually completed early and opened by October 26, 2000. Bonuses of $3 million were paid to the contractors. If the project was not completed on time, $50,000-a-day late fees would have been levied.

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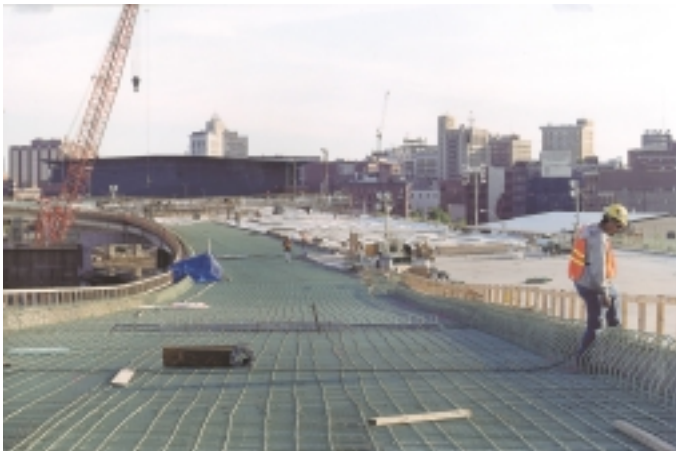
Grand Rapids S-curve . . . *continued from page 1*

However, the one-mile stretch of highway was not completed without a number of unforeseen obstacles, including fish reproduction and an archeological dig.

About 50 fish species live in the Grand River. During spawning season, many swim up and downstream under the US 131 bridge site. Because of this wildlife concern, both the Department of Environmental Quality and the Department of Natural Resources were involved. Their direction and management plan ensured that construction activity did not jeopardize the mating of salmon, steelhead, bass and other fish. The construction site along the river had to be kept clean and free of gravel and other construction debris, especially during the cycles of March 1 – July 15 and September 15 – November 30. The contractor was required to build two haul roads, one on each side of the river, into the Grand River before spawning began in March. The roads did not connect allowing constant river water flow. Both were removed after construction was completed.



Preconstruction Archaeology

Because the US 131 S-curve project was funded primarily (80%) by the federal government, MDOT ordered testing where the piers for the S-curve were to be erected. Researchers found what appeared to be the remnants of a village 2,300 years old. This find prompted MDOT to hire a team of four archaeologists to scour the area. Working at break-neck speed, they found 42,000 ceramic fragments, animal bones, stone tools and artifacts from Indian groups and from early settlers, an area covered and preserved by a cobblestone foundry floor built in the 1800's. The team of archeologists finished just one day before US 131 was closed. The collection cost MDOT over $800,000.

Construction Materials

The S-curve required two miles of pavement reconstruction, one mile in each direction as well as a new bridge, new piers and support beams. Steel beams and large concrete piers were constructed into distinctive arches. The new pavement was continuously reinforced concrete pavement (CRCP) using epoxy-coated reinforcement. Including the road, bridge, pier and beams 5,000 tons of epoxy-coated rebar were used in the project.

Ninety-five percent of the original materials was recycled. This included 175,000 tons of concrete crushed into lemon and pea-sized pieces. In addition, 7,000 tons of structural steel were recycled. These recycled materials were used throughout reconstruction.

In the past, the complication in recycling concrete was separating the reinforcing steel from the concrete. Today, recyclers find that a jackhammer can be used to separate most steel while the remainder is separated by magnets along conveyor belts.

With the S-curve now in use and completed about two months early, contractor, Kiewet Western, Inc. and Chicago and Whaley Steel, Detroit are proud of their joint venture. ABC Coating Co., Grand Rapids, Michigan coated and fabricated the entire 5,000 tons of epoxy-coated rebar. ♦

Epoxy-coated reinforcement used to rebuild Stevenson Expressway in Chicago, Illinois

On October 23, 2000, ahead of its scheduled October 31st completion date, George Ryan, Governor of Illinois officially opened the newly rebuilt Stevenson Expressway.

The two-year project, 15 miles long, from the Dan Ryan Expressway to the Tri-State Tollway was completed in record time–less than 16 months.

The new pavement is continuously reinforced concrete pavement (CRCP) with epoxy-coated reinforcement throughout. A portion of the original elevated expressway was virtually reengineered. This portion was reconstructed on solid earth and stone, which according to IDOT will be easier and less expensive to maintain than an elevated structure. The rebuilt expressway also features new continuous concrete barrier walls, columns, pier caps, pier stems, bridge decks and parapet walls. During the second phase, a total of 9,000 tons of epoxy-coated rebar, supplied by ABC Coating, Michigan, was required. Approximately 8,000 tons of epoxy-coated rebar was used in the initial phase of reconstruction.

Along with epoxy-coated rebar, the actual pavement structure is twice as thick, at 28 inches, than the old roadway. Much of the material used was recycled from the old roadway. More concrete depth and structure was needed for the continuing increase in this expressway's traffic. When first opened in 1964 the average daily traffic was about 22,000 vehicles. In 2000, the daily traffic level has reached 160,000 vehicles including 24,000 heavy trucks.

Highlights of the project include:

- State-of-the-art bridge design with a 50-year life expectancy for the new bridge portion from east of California Avenue to east of Ashland Avenue. The bridge deck is engineered for a 25-year service life with regular maintenance.
- Grooved pavement to prevent hydroplaning
- Wider and safer shoulders
- Improved lighting
- Continuous concrete barrier walls

Completed for a cost of $567 million, the project is part of the overall Illinois FIRST program, a five-year, $12 billion program designed to build, repair and upgrade Illinois' critical infrastructure.

Additional information about construction projects in the Chicago area can be found at: www.chicagolandconstruction.com. ♦

Epoxy-Coated Rebar on Continuously Reinforced Pavement Roadway in Tulsa

The Tulsa-area expressway expansion of the Creek Turnpike from the Turner Turnpike to the west and through south Broken Arrow to the Will Rogers Turnpike east of Catoosa will create a building boom along the new roadway system, according to area economic and real estate experts. Because the project will greatly impact the areas surrounding its construction, it was very important that it has a long life and be cost effective. That is the reason that an epoxy-coated reinforced concrete structure and pavement was chosen over alternative construction types.

The Tulsa Creek Turnpike Extension proposal completes the "great arc" around south and east Tulsa, connecting the Turner Turnpike at Sapulpa, U.S. 75 at Jenks, Mingo Expressway, Broken Arrow Expressway, U.S. 412, and the Will Rogers Turnpike at Catoosa. Adding 26 miles to the turnpike creates the continuity intended in the 1989 plan, and includes a south loop around Broken Arrow relieving congestion on the Broken Arrow Expressway.

Creek Expressway Extension © Tulsa World

Some observers think that the town of Broken Arrow may blossom in a way similar to that of Plano, Texas, once a small town north of Dallas. Plano today has become a major economic hub with its own skyline and major corporations. There is not any question about what happened to Broken Arrow when the Broken Arrow Expressway was opened and to Owasso when Highway 169 was expanded, both in the 1960s. Expressway and roadway development has enhanced growth in all directions.

It sometimes takes several years for growth to follow highway improvement as huge amounts of land are becoming available. Growth will take place as quickly as population and income expand to fill the space. For the first time in the past 35 to 40 years, huge masses of land that would not otherwise be developed are being opened. Retail, industrial, and commercial development goes along expressways. Opening this new south loop around Tulsa will also relieve congestion in traffic.

The new transportation system and the Broken Arrow Expressway enlargement to six and eight lanes will enhance housing construction on the east side. It will be easy to get there.

Creek Turnpike Bridge © Tulsa World

The Creek Turnpike Extension has an estimated cost of $355 million and was funded from the Oklahoma Turnpike bond issue. Actual construction has moved very quickly; construction should be completed within two years, with an actual completion date of 2001. The project uses epoxy-coated reinforcement on all bridge decks and in pavement.

The continuously reinforced concrete structure used epoxy-coated reinforcement throughout, much of it supplied by ABC Coating Company, Tulsa. ♦

Introducing the Epoxy-Coated Reinforcement CD-ROM

Just completed, the new Epoxy-Coated Reinforcement CD-ROM was developed to enable manufacturers, consultants, engineers, state agency personnel and others remain up-to-date and informed on epoxy-coated reinforcement for corrosion protection in concrete construction.

Information is segmented into major topics much like the epoxy section of the CRSI web site and allows clickable access to the live site at www.crsi.org.

New to the CD-ROM, are three videos produced by the Epoxy Marketing Group.

1. *The Manufacturing Process.* This new 5-minute video was created and produced especially for the CD-ROM. The action shows the process from incoming material, through the coating line, to bundling for shipment and includes both in-line and laboratory quality control tests.

2. *Fabrication of Epoxy-Coated Reinforcement.* This 8-minute video was produced for the inspectors, manufacturers, consultants and others involved in the manufacturing and fabrication of epoxy-coated rebar quality work ensures quality in concrete structures.

Subject matter covered includes receipt of epoxy-coated bars at the fabrication plant, storage procedures, shearing, internal procedures and material inspection. Bending equipment usage, product verification and the actual bending process are reviewed. Finally, this video shows how to repair coated material, as well as relevant information on lifting equipment, material handling, securing loads and final inspection prior to shipping.

3. *Field Handling of ECR.* This 7-minute video provides current guidelines for handling epoxy-coated rebar at the job site.

Epoxy-Coated Reinforcement CD-ROM

Included is an overview of the CRSI Plant Certification Program. Subject matter includes: Material receipt and inspection, truck loading, job site handling, storage, placing bars, use of bar supports and tie wires, splicing and coupling devices. Also, final inspection, field repair and the concrete pour.

For easy reading and printing, the field handling and fabrication videos are also available in brochure format on the CD.

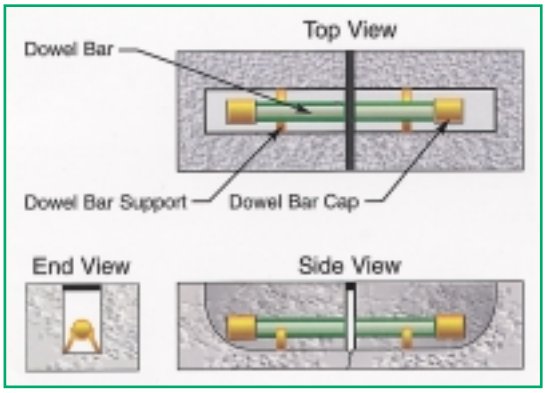
Other areas of interest covered on include:

- History of corrosion and the use of epoxy-coated rebar
- Material economics including detailed life cycle cost examples for parking garages and bridges
- The CRSI Plant Certification program and material performance
- Industry information about standards, with links to their respective web sites
- A clickable link to the CRSI web site from the CD-ROM
- Publications from the CRSI Series, including Research Reports from industry experts

For your personal copy of the Epoxy-Coated Reinforcement CD-ROM, contact CRSI. ◆

Epoxy-coated dowel rods used for pavement retrofit

Load transfer is the ability of a joint or crack in concrete pavement to transfer load from one slab to the next through shear action. The dowel bar retrofit system is a rehabilitation technique for increasing the load transfer capability of existing jointed portland cement concrete (PCC) pavement. This is accomplished by placing dowel bars where none previously existed across joints and/or cracks that exhibit poor load transfer.



The dowel bar retrofit system is suited for jointed concrete pavements with poor load transfer at joints and/or cracks, but have significant remaining structural life. A number of reasons including erosion, loss of load transfer, poor aggregate interlock in older pavement and lack of concrete thickness, joint spacing, etc. in newer panels make pavements candidates for retrofit.

Dowel bar retrofit started in the 1960s and has continued to grow. The program is now in use by many state DOTs.

For protection from corrosion, the dowel bars are epoxy-coated. When installed they are mounted on plastic chairs, so that the retrofit mortar can flow around and support the dowel. The properly installed epoxy-coated dowel bar allows the opening and closing of the joint or crack in response to both seasonal and daily temperature fluctuations.

Materials used along with the smooth round dowel bars that are epoxy-coated for long-term performance and cost-effectiveness, include: curing materials, plastic chairs and caps, joint filler and retrofit mortar.

The total process consists of:

- Cutting the slots
- Material removal from the slots
- Placement of the epoxy-coated dowel bars, caps, chairs and joint filler
- Backfilling the slots
- Concrete cure
- Grinding the surface

This information was furnished by American Highway Technology, Kankakee, Illinois. For additional information contact them at: Phone: 815-936-3300; Fax: 815-936-3306. ♦

Box girder segmental bridge on I-895 uses ECR throughout

The new I-895 bypass project around Richmond, Virginia includes not only a new highway. Slated for completion in late 2001 or early 2002, the project started in the first quarter of 1999. The I-895 Bypass will terminate at Chippenham Parkway on the east side of Richmond.

The centerpiece of the project is a toll bridge being built over the James River and the new highway. Built by private enterprises, plans are to turn the toll bridge over to the State of Virginia in the future.

The bridge is a segmental box girder design and uses epoxy-coated rebar (ECR) in both the side walls and the mats. In order to protect the bridge from the effects of corrosion, any area that comes in contact with the top slab uses epoxy-coated reinforcement. Approximately 4 to 5 tons of epoxy-coated rebar will be used in construction of the bridge.

All decks use ECR, as do both mats on the top slab of the box girder. In addition, all vertical reinforcement in the side walls is epoxy-coated. Epoxy-coated reinforcement for this project was supplied by Ameristeel, Raleigh. ♦

Continuing series in Anti-Corrosion Times, Frequently Asked Questions about epoxy-coated rebar

The following questions are often asked of CRSI staff. These questions and answers plus more can be found on the CRSI website. To have your questions answered, visit the epoxy-coated rebar section of www.crsi.org or contact us.

COAT BOTTOM MAT

Question:

Should the bottom mat of steel on a bridge deck or a parking garage be epoxy-coated as well as the top layer?

Answer:

The answer to this question will depend primarily on two factors: the specified service life and the desired level of corrosion protection. Clearly, the best corrosion protection is provided when all of the reinforcement in the structure is epoxy-coated. Several research studies have confirmed this finding. For example, the recent FHWA study of Corrosion Resistant Reinforcement showed that the best performance was achieved when all of the reinforcement was coated — even bars that had large damaged areas. The researchers concluded that coating the bottom mat reduces the area of steel that is available to serve as a cathode in a corrosion reaction, thus slowing the rate of corrosion even further.

In the past, many engineers were not particularly concerned about the corrosion of the bottom layer of steel in a bridge deck or parking garage slab. Often times, the unprotected steel in the top mat corroded so quickly and caused so much distress that total rehabilitation was often needed before chlorides could reach the bottom steel. However, as better protection strategies are employed to protect the top steel and as structures are being designed for longer service lives, it is becoming increasingly important to protect all of the embedded steel to assure maximum structure serviceability.

Another reason to consider coating the bottom mat of steel is the potential for concrete cracking. As has been shown in numerous field studies, chlorides can quickly penetrate a cracked slab, even when high quality concrete is used.

In the final analysis, the decision to coat bottom steel is a trade-off between cost and performance. For all but short-term designs, it is usually cost effective to provide the improved corrosion protection by coating all of the embedded steel. ◆

Plant Certification Program continues to grow

With more than 90% of epoxy plants participating, the CRSI Epoxy Plant Certification Program continues to guarantee the production of quality epoxy-coated steel reinforcement bars required by state highway agencies and Canadian provinces.

Because the industry continues to improve its manufacturing performance, outside agencies including ASTM and AASHTO have rewritten specifications with higher standards.

The Plant Certification Program continues to change and grow as user needs change. Since its inception in 1991, 250 plant inspections have taken place; they include both scheduled and random inspections. For more information about the Certification Program, a Certification Brochure or other material, contact Scott Humphreys, Certification Program Administrator at CRSI. ♦

States/Provinces Requiring Certified Plants

Arkansas	North Carolina
Idaho	Oregon
Indiana	Utah
Kansas	West Virginia
Minnesota	Wisconsin
Nevada	Alberta
New Hampshire	Ontario

Comparison of ECR standard specifications available

Now available from CRSI is a 4-page specification brochure. In its easy to read 4-column format, the CRSI Comparison of Standard Specifications reviews the standards set by ASSHTO and ASTM for epoxy-coated reinforcement. These specifications are recommended for use on projects where corrosion of reinforced concrete is a concern.

The summary of specifications was prepared in January 2000. However, it will be regularly updated on the epoxy section of the CRSI website, www.crsi.org.

The three tables that make the comparisons of AASHTO and ASTM are:

Table 1 - Comparison of Standard Epoxy Coating Application Specifications

Table 2 - Comparison of Standard Epoxy Coating Fabrication Specifications

Table 3 - Comparison of Standard Epoxy Coating Field Specifications

For your free copy of the brochure, contact CRSI. ♦

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