Improving Durability Through Certification of Epoxy-coated Reinforcing Steel

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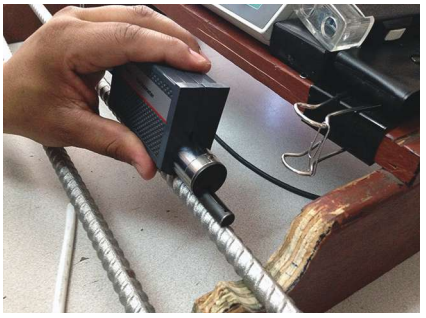
In 2012, the Concrete Reinforcing Steel Institute (CRSI) was approved by the American National Standards Institute (ANSI) as a Standards Development Organization (SDO). The hallmarks of the American National Standards process include

- consensus by representatives from materially affected and interested parties,
- broad-based public review and comment on draft standards,
- consideration of, and response to, comments from voting members as well as public review commenters,
- incorporation of approved changes into a draft standard, and
- right to appeal by any participant that believes that due process principles were not sufficiently respected during the standards development.

History of Epoxy-coated Bars

Epoxy-coated reinforcing steel was introduced in 1973, in response to significant bridge deck corrosion concerns in the 1960s.[1] The increased use of epoxy-coated reinforcing steel was rapid and by 2014, over 82,000 bridge decks and many other structures contained epoxy-coated reinforcing steel.

The early history of epoxy-coated reinforcing steel was marred by a few notable failures, including corrosion of coated reinforcing steel in piers of bridges in the Florida Keys observed in 1986.[2] This corrosion—exacerbated by porous concrete, thin concrete cover, and inadequate manufacture and protection of the coated steel—led many research programs to question the value of the epoxy-coating system.



Measurement of steel surface roughness to ensure adequate surface area for coating bonding. Photo: Western Coating Co.

Placing of epoxy-coated reinforcing steel. Photo: Epoxy Interest Group of CRSI.

One of these research programs involved testing of bent, coated reinforcing steel from seven manufacturers.[3] After approximately two years of testing, five of the systems exhibited poor performance, while two of the systems exhibited excellent performance. It was concluded that the performance was based directly on the application of the coatings and manufacturing procedures.

Initial Certification Programs

In 1991, CRSI launched a voluntary epoxy-coated reinforcing steel certification program. This program required independent review of plant procedures using unannounced inspection. Improvements in epoxy-coated bar consistency between plants was dramatic. For example, prior to the certification program, certain plants were coating products that had 50 to 70% dust contamination, which was termed backside contamination. Currently, this value averages 15%.

The CRSI program has worked synergistically with the ASTM specifications, leading to changes that improved product quality. Such changes to the requirements include:

- Increased coating thickness
- Introduction of required steel roughness prior to coating
- Requirements for clean substrates (backside contamination)
- No cracking allowed during bending
- Improved storage and handling

Cracking of the coating during bending is considered unacceptable now; however, in 1983 certain agencies permitted unrepaired hairline cracking in the coating and did not require repairs, nor did damage repair, if the damaged area was less than 25 mm^2 (0.04 $in.^2$).[4]

Development of National Standards

During 2014 and 2015, CRSI produced three national standards relating to epoxy-coated reinforcing steel:

- CRSI Standard for Epoxy Coating Plant: Straight Bar Lines
- CRSI Standard for Epoxy Coating Facilities: Custom Lines
- CRSI Standard for Epoxy-Coated Steel Reinforcing Bar Fabrication Facilities

To develop these standards, the documents underwent rigorous and open consensus-balloting procedures. Balloting occurred within a task group, the standards committee, and through public comment. These standards are the basis for future plant inspections.

Process Certification

CRSI is currently pursuing accreditation from ANSI under International Organization for Standardization (ISO) 17065, *Conformity Assessment — Requirements for bodies certifying products, processes and services*.[5] This program requires CRSI to maintain an Independent Manufacturing Certification Committee (IMCC) that is responsible for all items related to certification within CRSI. This committee is made up from industry experts, department of transportation officials, university academics, and others that have significant knowledge of ISO processes. The program is independent of the rest of the CRSI operations and follows written rules.

The adoption of ISO 17065 requires all steps in any CRSI certification program to be documented and audited. Thus plants, inspectors, and CRSI are all audited for conformance with their quality control procedures and they must address nonconformances. The program also requires certified plants to address any customer complaints.

Summary and Benefits

The adoption of ISO 17065 along with the development of national standards by CRSI has led to a more transparent certification program for epoxy-coated reinforcing steel. The programs provide a clear method for improving processes.

The benefits of CRSI certification programs to the final customer of epoxy-coated reinforcing steel is clearly found with products that are more robust and durable than the product used in the 1980s. The program provides a clear and open method for customers to provide their input into the programs and all concerns must be addressed.

References

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Measurement of coating thickness as part of the plant quality-control procedures. Photo: Epoxy Interest Group of CRSI.

Background

The Concrete Reinforcing Steel Institute (CRSI) has been developing programs and processes to seek accreditation by the American National Standards Institute (ANSI) for its epoxy-coating plant and fabrication certification programs. ANSI accreditation signifies that the procedures used by CRSI meet essential requirements for openness, balance, consensus, and due process. The move toward ANSI accreditation strengthens the CRSI certification programs relating to epoxy-coated reinforcing steel.

A typical example of epoxy coating flexibility. This No. 4 bar is bent around a 1.5-in.-diameter pin. No cracking of the coating is observed. Photo: David McDonald.

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