Guidelines for Inspection and Acceptance of Epoxy-Coated Reinforcing Steel at the Jobsite

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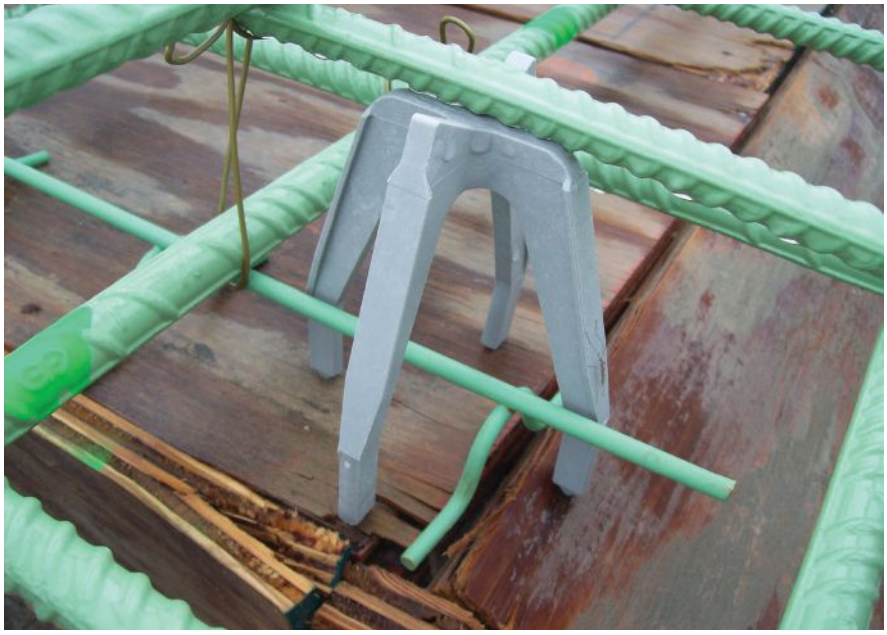
Inspection of epoxy-coated reinforcing steel prior to concrete placement is critical to ensure that optimum corrosion protection is provided to the structure. In particular, repair of coating damage on the reinforcing bars prior to concrete placement and the use of plastic-headed vibrators should be addressed. This article presents information on the inspection of epoxy-coated reinforcing steel and may be used to supplement state or other agency requirements for epoxy-coated reinforcement.



Epoxy-coated reinforcing steel placed on epoxy-coated wire and plastic bar supports. All Photos: EIG.

Handling

Just like any material used on a jobsite, epoxy-coated reinforcing steel requires appropriate handling. These steps are aimed at reducing damage to the coating that could reduce its corrosion-protection performance. Handling and storage requirements for epoxy-coated reinforcing steel may be included in contract documents or individual agency specifications by reference to many different sources including ASTM A775, A934, A1055, A1078, and D3963,[1–5] as well as ACI 301.[6] The following summarizes the main requirements found in these specifications:

- Epoxy-coated reinforcing steel should be lifted using a spreader bar or strongback with multiple pickup points to minimize sag. During sagging, steel reinforcing bars may rub against each other, causing damage to the coating.
- At no time should epoxy-coated reinforcing steel be dragged.
- Nylon or padded slings should be used, and at no time should bare chains or cables be permitted.
- Epoxy-coated reinforcing steel should be unloaded as close as possible to the point of concrete placement to minimize rehandling.
- Bundles of epoxy-coated reinforcing steel should be stored on suitable material, such as timber cribbing. At no time should reinforcing steel be stored directly on the ground.
- If the epoxy-coated reinforcing steel is to be exposed outdoors for more than 30 days, it should be covered with a suitable opaque material that blocks ultraviolet light and minimizes condensation.
- Epoxy-coated reinforcing steel and uncoated steel should be stored separately.

Placement

To protect epoxy-coated reinforcing from oil contamination, steel forms should be oiled prior to placement of the reinforcing bars. Bars should not be dragged or placed directly on the forms, as this may result in oil contamination of the bar surface. Bars should be placed on supports coated with or made of nonconductive material, such as epoxy-coated or plastic bar supports, and these should meet Class 1A requirements, as defined in the CRSI *Manual of Standard Practice*.[7] Bars should be tied using coated tie wire. This wire is typically 16.5 gauge or heavier and black annealed. When used with epoxy-coated reinforcing bars, tie wire is typically coated with polyvinyl chloride (PVC). Coated bars may be cut using power shears, chop saws, or bandsaws; the cut ends should be patched using a two-part epoxy. Bars must not be flame cut. Bars may be bent at the jobsite, but only with the permission of the engineer responsible for the project, and this should be documented. If bending is to be conducted on site, it should be conducted at ambient temperatures.

Coating Damage

If the epoxy-coated reinforcing steel has more than 2% of its area damaged in any given 1 ft section of coated reinforcement,

With proper inspection and handling, epoxy-coated reinforcing steel effectively protects against corrosion in reinforced concrete applications such as this bottom mat of reinforcement for a bridge approach slab.

it may be rejected. ASTM D3963[5] further requires that the total bar surface area covered by patching material shall not exceed 5% in any given 1 ft section of coated reinforcement. These limits on damaged and repaired areas do not include sheared or cut ends.

Coating Repair

All damage to epoxy-coated steel reinforcement should be repaired to ensure maximum corrosion-protection performance. The areas to be repaired should be prepared for patching by using a wire brush to remove any rust or other contaminants. It is recommended for all epoxy repairs to use a two-part patch material that has been recommended by the powder-coating manufacturer. This material should be mixed according to the manufacturer's recommendations and should be used within the specified pot life. Patch repair materials should be provided enough time to cure prior to concrete placement, which may be up to 8 hours for some patch materials. All repairs should be conducted in strict accordance with the written instructions furnished by the patch material manufacturer. For epoxy-coated reinforcing steel to comply with ASTM A775,[1] the patch material must meet all of the requirements in Annex A2 of ASTM A775.

Inspection

Inspection prior to concrete placement is critical as this is the final opportunity to document that the coated reinforcing steel is installed according to the structural design and that the coating will provide optimum durability. Prior to concrete placement, the following should be inspected and appropriately documented:

- *Bar spacing, size, and type*: Bars should be placed in accordance with the structural drawings for the particular project, and conformance to the required specifications should be documented. Current practice often uses photographic documentation for recording mill and bar strength information, which is stamped onto the bar. Information obtained from the mill and fabrication reports may also be obtained.
- *Bends*: The coating at bends should not exhibit any cracking or fractures. Particular care should be taken to inspect the condition of the coating in these regions because damage may occur during fabrication.
- *Lap lengths*: Lap lengths approved by the structural engineer should be measured and documented. Laps are only permitted at locations approved by the structural engineer.
- *Mechanical splices*: Where mechanical splices are used, they should be epoxy-coated. Any damage to the coating after the bars are connected should be repaired.
- *Tolerances and clear cover*: Concrete cover should be measured. Additional information on placing tolerances is provided by ACI Committee 117[8] and CRSI.[7] If concrete cover on the reinforcing steel is inadequate, force is sometimes used to move the reinforcement. When such methods are employed, damage to the coatings must be avoided.
- *Repair of all damage*: All damage should be repaired.
- *Bar supports*: Epoxy-coated reinforcing steel should be placed on supports coated with or made of nonconductive material, such as epoxy-coated or plastic bar supports.
- *Tie wire*: Epoxy-coated reinforcing steel should be tied using a coated tie wire.
- *Bar samples*: Some agencies require inspectors to collect coated steel samples from the jobsite. These samples should be clearly identified prior to submittal to the appropriate laboratory for testing.
- *Welding*: Welding should only occur with the permission of the engineer. Any welded surfaces should be cleaned and repaired with patch material.

Protection of Coated Reinforcement Before, During, and After Concrete Placement

A meeting with the concrete contractor prior to concrete placement may be beneficial to discuss precautions that should be taken to protect coated reinforcement. After placement of epoxy-coated reinforcing steel, minimize traffic over it. At no time should stands or rails used for concrete placement machines be welded to the epoxy-coated reinforcing steel. Care should be used to ensure that activities during the concrete placement do not result in damage to the epoxy-coated reinforcing steel. Avoid placing concrete hoses on installed reinforcing steel; they may damage the coating as they are moved. Care should also be taken to ensure that items such as unprotected couplers for concrete delivery hoses are not dragged across the steel; these actions may result in coating damage. Consider a runway if necessary. Concrete pumps should be fitted with an "S" bend to prevent free fall of concrete

directly onto the coating. Plastic-headed vibrators should be used to consolidate concrete; steel vibrators may cause coating damage. Bars that are partially cast in concrete and then exposed for extended periods, should be protected against exposure to ultraviolet light, salts, and condensation. Wrapping bars with plastic or individual tubing is suitable for providing long-term protection.

Conclusion

Epoxy-coated reinforcing steel has been successfully applied to concrete bridge construction since the 1970s. As materials and processes have been improved through the years, bridges using epoxy-coated reinforcement have consistently demonstrated good field performance. Following the recommendations in this article helps ensure that the highest quality of corrosion resistance is provided for every project.

References

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3. ASTM International. 2016. *ASTM A1055/A1055M-16 Standard Specification for Zinc and Epoxy Dual-Coated Steel Reinforcing Bars*. West Conshohocken, PA: ASTM International.
4. ASTM International. 2019. *ASTM A1078/A1078M-19 Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement*. West Conshohocken, PA: ASTM International.
5. ASTM International. 2015. *ASTM D3963/D3963-15 Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars*. West Conshohocken, PA: ASTM International.
6. American Concrete Institute (ACI) Committee 301. 2016. *Specifications for Structural Concrete* (ACI 301-16). Farmington Hills, MI: ACI.
7. Concrete Reinforcing Steel Institute (CRSI). 2018. *Manual of Standard Practice*, 29th ed. Schaumburg, IL: CRSI.
8. ACI. 2010. *Specification for Tolerances for Concrete Construction and Materials* (ACI 117-10). Farmington Hills, MI: ACI.

About the Epoxy Interest Group

The Epoxy Interest Group (EIG) of the Concrete Reinforcing Steel Institute (CRSI) is a not-for-profit trade association providing an authoritative resource for information related to the use of epoxy-coated reinforcing steel in reinforced concrete applications. Epoxy-coated reinforcing steel is also known as epoxy-coated rebar (ECR), as well as fusion-bonded epoxy-coated rebar (FBECR).

The association serves the needs of specifiers, engineers, architects, fabricators, and end users with the most recent information about how and where epoxy-coated reinforcing steel is used, as well as recent technical changes, educational seminars, and promotional activities.

EIG serves the construction market in the United States, Canada, and Mexico.

Our Mission

The mission of the EIG is to promote the use and advance the quality of epoxy-coated reinforcing steel. Epoxy-coated reinforcing steel is used instead of conventional reinforcing bars to strengthen the concrete and protect against corrosion. The epoxy coating is applied to the steel in a factory prior to shipping.