Research Notes

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Keeping Cathodic Protection Systems Operating

ODOT has historic reinforced concrete bridges at the Oregon Coast that employ impressed current cathodic protection (CP) to greatly reduce the corrosion of the embedded steel reinforcement. The CP systems rely on passing an electric current into the concrete through zinc metal that has been sprayed onto the surface of the concrete. For some bridges, the zinc metal coatings are nearing the end of their design lives at which time the bond between the coating and the concrete is expected to become too weak to keep the zinc metal attached. One bridge has a section in which the zinc coating has separated from the concrete prematurely possibly due to erratic current controllers or initial contractor inexperience during installation. Zinc metal sections that have debonded no longer protect the underlying steel reinforcement, which will eventually begin to corrode at its natural rate causing concrete spalling and steel section loss. ODOT expects to reapply the zinc metal coating to maintain corrosion protection; however, there was no procedure established by ODOT to remove the old coating, prepare the concrete surface, and install new zinc metal.

The critical concerns with removing the old zinc coating and replacing it with a new thermally sprayed zinc metal were the following:

- During CP operation, a reaction layer forms at the surface of the concrete. How much of the reaction layer should be removed to achieve good performance from the new zinc coating?
- What effect does the sandblasted concrete surface after zinc removal have on the bond strength of the new zinc metal?

Consequently, ODOT contracted with Montana State University to determine the most effective method to remove existing zinc coatings and to develop a protocol to prepare the concrete surface for the new coating. The researchers conducted laboratory testing on zinc-coated slabs and field experiments on a cathodic protection zone in which the zinc coating was replaced on small sections.

Enclosed field test site

The research showed that removing the old zinc coating effectively removed the reaction layer at the concrete surface. The research also showed the effect of surface roughness and exposed aggregate from surface preparation on the bond strength of the new coating. Recommendations were made for sandblasting parameters to achieve the best combination of surface roughness and exposed aggregate.

The research provides the basis for ODOT to rationally specify the level of surface preparation for replacing the zinc coatings on concrete in cathodic protection systems. The outcome will ensure that the ODOT CP systems installed on historic coastal structures continue to protect those structures and extend their service lives.

Thermal spraying zinc at test site

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