Protecting Piers of Overhead Structures from Degradation Due to Snow and Ice Chemical and Material Usage Phase II

<table>
<thead>
<tr>
<th>Researcher(s)</th>
<th>Richard Miller, PE; Norbert Delatte, PE; Prateek Nepal; Abdullah Haroon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency</td>
<td>University of Cincinnati; Oklahoma State University</td>
</tr>
<tr>
<td>Report Date</td>
<td>April 2021</td>
</tr>
<tr>
<td>Project Number</td>
<td>106177</td>
</tr>
</tbody>
</table>

The Problem

Ohio Department of Transportation (ODOT) and the various Ohio local governments use over one million tons of road salt each year. Plow trucks throw salt laden snow and ice onto bridge pier columns where it adheres. With long exposures, chlorides from the salt can migrate to the reinforcing steel especially in cases where the reinforcing steel has been placed without proper cover. This leads to corrosion of the steel and spalling of the concrete.

Research Approach

In Phase I of the research, two possible solutions were identified. One was the use of polyethylene shields marketed under the brand name of PolySaltArmor™. The other was use of polysaspartic polyureas.

The polyethylene shields are wrapped around the columns to act as a barrier to ice and snow. An air gap between the shield and the column allows for air flow to dry the column in case any moisture gets under the shields.

In this research several columns were covered with the polyshields while other columns in the same area were not. Small mortar and reinforcing bar specimens were placed on the protected and unprotected columns to check for chloride intrusion and corrosion. Corrosion probes were also used.

Polyasparic polyureas are coatings that provide a tough, rubber like surface. They are often used as a protectants on industrial concrete floors. Columns were coated with two different polysaspartic coatings and then checked using the ASTM D6677-07 “V notch test”.

The study lasted 2.5 years to allow for 2 winters of exposure.

To access copies of the final report, visit: www.dot.state.oh.us/research

This research was sponsored by the Ohio Department of Transportation and the Federal Highway Administration.
Findings

The main conclusions for the polyethylene shields are:

1) They are very easy to install and require very little skill or training. A single column can be shielded in about 30-40 minutes by a 3 person crew.
2) The cost for the shields is approximately $11/square foot including labor for ODOT personnel. The standard epoxy-urethane coating was found to cost $20/sq foot including labor when applied by a contractor. The epoxy coatings tend to last about 5-10 years. The shields are estimated to have a life of 20 years by the manufacturer.
3) The chloride specimens installed under the shields provided inconclusive results. The chloride levels were low, and the specimens may have been contaminated by atmosphere, grit or animals.
4) The corrosion specimens provided mixed results. Corrosion probes showed less corrosion for the shielded piers. Reinforcing bar specimens showed no difference. Since the shields are not sealed to atmosphere, some corrosion is going to occur, since the bars were not protected by concrete cover. The results show that shield might help, but do not hurt the corrosion.
5) The shields were easy to remove to allow for inspection. Removal and reinstallation does take some time but they can be removed for inspection.
6) The shields are easy to repair. In a few cases, shields were hit by mowers. In most cases, the shield could simply be reinstalled. In case of damage, a new panel is easily installed.
7) The shields appear to protect against the abrasion from material being thrown onto the piers.

For the polyaspartic polyureas the conclusions were:

1) The coatings were not difficult to apply and could be applied with rollers and foam paint brushes. The Creative material product has a primer that can be applied to wet surfaces which meant the material could be applied after power washing. The Citadel material required a dry surface
2) When applied to a clean, properly prepared surface, the coatings performed well. The cost is about $8/sq ft. when installed by ODOT personnel.
3) When applied over rusted reinforcement, the rust did come through the coating. In some cases there appeared to be proper adherence and in other cases the coating could be peeled off. It is suggested that the steel be sandblasted to remove corrosion prior to the application of the material.
4) When applied over the patches, the material looked sound. There was no peeling and the material appeared to seal the crack. However, the V notch test showed the material would peel off the patch. The patching material was very smooth and dense and that seemed to affect the adherence. Roughening any surface is recommended to assure proper adhesion.
5) When applied with no surface preparation and in cold weather, the material did not perform well. However, this was an extreme test outside of the manufacturer’s suggested application method. It was done to see what the limit of the material would be. Thus, the material should be applied with proper surface preparation and according to the manufacturer’s recommendations.
6) In cases where there was an existing epoxy coating, there were failures of that coating under the polyaspartic. Again, this points to the need for proper surface preparation, including removing the existing epoxy coating and exposing sound concrete.

Recommendations

1) The polyethylene shields were easy to install, remove for inspection and repair. Due to mild winters and possible contamination of the samples, the results of this study are inconclusive. It is recommended that further studies be done.
2) The polyaspartic coatings work well if the surface is properly prepared and the coating is applied according to manufactures’ recommendation. This requires at the very least removal of any existing coating and cleaning the surface. Corroded rebar should be cleaned. Roughening the surfaces is highly recommended.

To access copies of the final report, visit: www.dot.state.oh.us/research

This research was sponsored by the Ohio Department of Transportation and the Federal Highway Administration.