Research Project: ***SP309B4G***
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RESEARCH SUMMARY

STAINLESS STEEL PRESTRESSING STRANDS AND BARS FOR USE IN PRESTRESSED CONCRETE GIRDERS AND SLABS

Problem

Corrosion decay on structures has continued to be a challenge in the scientific and engineering communities, where significant federal and state funds have been spent towards replacement or rehabilitation of bridges that were damaged by corrosion deterioration. In Maryland, a great portion of its yearly bridge funding allocation is spent on performing repairs and rehabilitations on its aging bridge inventory. In an effort to turn this trend around, the Maryland State Highway Administration (SHA) has performed emergency span replacements on two different bridges because the strands had deteriorated to such an extent that serious safety concerns were exposed.

One tactic SHA has used to remedy this issue has been to increase the concrete cover requirements beyond code requirements to help prevent the onset of deterioration. This will help, but comes at a price. The strands are less effective and more strands are often required. Therefore, this research consisted of gathering and synthesizing information on how others have addressed this issue, as it relates to the deployment of other materials that can be used in prestressed concrete girders and slabs to provide durable corrosion protection and prevention of premature spalling or corrosion-induced cracking. To assess the use of stainless steel and other materials, a survey was conducted and disseminated to contractors, personnel at various departments of transportation, and in the construction industry. This study presents a summary of various projects that have used corrosion-resistant rebar (CRR), a summary of what other states are doing to address this issue, and the results from the survey of how various states are addressing the issue of corrosion decay on structures.

Objectives

To determine the feasibility and accessibility of stainless steel and other materials to be considered as alternative materials for use in prestressed strands in concrete girders and slabs, four main objectives were carried out:

- Conduct an extensive literature survey of best demonstrated practices for use and availability of stainless steel strands,
- Contact manufacturers of stainless steel strands directly to verify research facts and get contacts of clients that have used the material.

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A survey to manufacturers was distributed to document information and experiences from different manufacturers,

- Identify other materials that may achieve similar results and be more advantageous such as carbon fiber strands, and
- Synthesize all information obtained and compile a document that evaluates the aforementioned questions, information gathered and lessons learned, including recommendations for future work, if applicable.

Results

This report provides critical information on the current state-of-the-practice and art of using alternate materials (often referred to as corrosion resistant rebar, CRR) and strategies to minimize the issue of corrosion. The main focus of the study was to explore the efficacy of stainless steel rebar such that SHA can have enough information to make a decision as to whether or not they would be interested in changing from traditional strands to stainless steel rebar and/or strands for various projects.

From the survey, the highest recommended strategies to minimize cracking of precast elements were minimizing curing times and using curing methods. The most used or recommended strategies to prevent corrosion of reinforcement in bridge elements was reported to be through the use of epoxy-coated rebar, lowering permeability concrete and increasing clear cover depth. Some other examples included using High Performance Concrete (HPC or higher strength concrete as indicated in the survey) to reduce cracking of bridge decks by reducing heat of hydration and slowing strength gain. Of course, this results in slower curing times as well as higher initial costs, in general. Nevertheless, the overall investment in stainless steel specifically over the other CRR for its life-cycle performance can outweigh the higher initial costs as presented by the life-cycle cost analysis (LCCA) example estimates. These estimates can be used by SHA on a case-by-case basis to determine whether the use of stainless steel rebar is suitable and saves money.

Report Information

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Link to final report: http://www.roads.maryland.gov/OPR_Research/MD-13_SP309B4G_Stainless-Steel-Prestressing-Strands_Report.pdf