JOBSITE EVALUATION OF CORROSION RESISTANT ALLOYS FOR USE AS REINFORCEMENT IN CONCRETE

PROBLEM STATEMENT

Premature deterioration of the nation's concrete highway and bridge structures as a consequence of chloride (salt) exposure and the corrosion of reinforcing steel has in the past several decades become a formidable technological and economic problem. Specification of epoxy-coated reinforcing steel (ECR) for at-risk structures commenced some thirty years ago; however, corrosion induced cracking of concrete bridge substructures in the Florida Keys as early as seven years after construction led to concern that ECR may not provide the 75-100 year service life presently required for major bridges. Consequently, recent attention has focused upon more corrosion resistant reinforcement, stainless steels in particular, as an alternative. This redirection has been facilitated by a transition in design and maintenance planning philosophy to a life-cycle costing basis: i.e., the higher initial expense of more corrosion resistant steel is recovered later in the life of the structure as a result of fewer repairs and rehabilitations.

The Federal Highway Administration Innovative Bridge Research and Construction Program (IBRC) was established to encourage the evaluation of corrosion resistant reinforcement in highway bridge projects. These evaluations will provide insights into various approaches to improving corrosion resistance in bridge structures.

OBJECTIVES

The purpose of this study was to document IBRC projects that utilized corrosion resistant reinforcement. Specific objectives included the following:

- summarize the different alternative reinforcements available for use in bridge construction
- summarize representative IBRC projects that have employed corrosion resistant reinforcements
- acquire samples of alternative reinforcement from different job-sites and characterize them in terms of
  - composition
  - mechanical properties
  - uniformity
  - conformance to specifications (where applicable)
  - performance in accelerated corrosion tests
- establish a repository for the acquired reinforcement samples and preserve them as an archival record

FINDINGS AND CONCLUSIONS

Records made available to the project team indicated that IBRC projects involving corrosion resistant reinforcement were approved for 27 states, 20 of which either completed the project as planned or with an alternate innovative reinforcement. The different innovative reinforcements used and the number of projects on which they were used is as follows:

1. Solid Type 316 stainless steel, 3 projects
2. Solid Type 2201LDX stainless, 1 project
3. Solid Type 2205 stainless, 3 projects
4. Type 316 stainless clad black bar, 2 projects
5. MMFX-II™, 12 projects
6. Galvanized steel, 3 projects

The research team visited five different job sites, acquired reinforcement samples, and documented pertinent project information, which is provided in the appendices of the Final Report of this study. Project reports were prepared for two additional projects, not visited by the team but for which sufficient information was available.

The samples acquired in the field were evaluated and found to conform to the applicable specifications: accelerated testing indicated corrosion resistance greatly in excess of that provided by black bar and, in some cases, what is anticipated for ECR (testing conducted in a companion study, BD228, confirmed these test results). A difficulty encountered on many of the construction projects was the inability of the producers of the clad stainless bar to reliably meet delivery schedules, which meant that alternative materials had to be substituted in all but two cases. Determining the full benefit of employing corrosion resistant reinforcement in these IBRC projects will depend upon the individual states maintaining records and acquiring performance data for decades into the future. The various state projects demonstrated that, subject to availability, corrosion resistant reinforcing steel can be incorporated into bridge construction projects with relative ease and, actually, with less difficulty than ECR.

BENEFITS

The study indicated that corrosion resistant reinforcing steel, including stainless steels, are a viable technical alternative to ECR. Also, these alloys can be employed is lieu of black steel to extend or better insure that the requisite design life is achieved. Alternatively, the improved corrosion resistance of these reinforcements can be utilized to affect design modifications, such as reduced cover, to at least partially offset their higher initial cost.

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