

RESEARCH PROBLEM STATEMENT

DATE: 09/06/2019	PROJECT AREA: Maintenance
TITLE: Cover Depths for Rapid Setting Concretes	
PROBLEM STATEMENT:	
<p>Rapid setting concrete made with ettringite based cements (often calcium sulfoaluminate [CSA] cements) are becoming popular for bridge deck and pavement repairs because they can return concrete to serviceability with minimal impact to traffic. These ettringite based binders have many advantages including lower environmental impact, increased early strengths, and low shrinkage. A major disadvantage that has been cited in the literature is increased carbonation and potentially reduced passive layer to protect the embedded steel from corrosion. ARDOT has observed that some areas patched with CSA cement concrete appear to show signs of reinforcing steel corrosion. Because of the carbonation in these binders, a greater cover depth may be required than typically specified for portland cement concrete, but no research has been performed to determine what these depths should be. A comprehensive analysis of the corrosion resistance of ettringite based binders with an end goal of specifications for steel protection measures would be a benefit to ARDOT's continuing efforts to repair aging bridge decks, and a nationally relevant study to improve understanding of these new cements.</p>	
OBJECTIVES:	
<ol style="list-style-type: none"> 1. Obtain samples of commercially available ettringite based binder systems. 2. Create appropriate mix designs that would be used for bridge and pavement repairs. 3. Perform a range of corrosion potential testing, including standard lab scale tests and longer term corrosion tests with concrete samples submerged in corrosion inducing environments. 4. Based on observed results, make recommendations on protecting steel from corrosion when ettringitge based binders are used. 	
FORM OF RESEARCH IMPLEMENTATION AND RETURN ON INVESTMENT:	
<ol style="list-style-type: none"> 1. Specifications for cover depths for ettringite based cements will be drafted 2. Observations about the influence of mix design on corrosion performance and resulting specification impacts will be addressed. 3. Bridge repairs in Arkansas using ettringite cements will be more long lasting based on this work. 4. Nationally, this study will provide a basis for corrosion specifications for ettringite based binders in new construction and for repairs. 	
Estimated Project Duration: 24 Months	
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Standing Subcommittee
Ranking

Advisory Council
Ranking

Statement Combined with
Statement Number(s)

Cover Depths for Rapid Setting Concretes

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Bridge Deck Repairs

- Costly
- Time Consuming
- Require detours or lane closures
- Need to be structural strength
 - Many repair techniques only address ride quality
- Rapid setting, ettringite based products becoming common



Ettringite Based Cements

- Similar to OPC
- Extremely fast setting and strength gain
 - 4000 psi in less than 2 hours
 - Final set in as little as 20 minutes
- Questions about corrosion resistance
 - Carbonation
 - Chloride permeability
- No specifications regarding cover depth of steel



Cover Depth

- Sufficient cover prevents corrosion
 - Factor of “passive layer”
 - Also depends on porosity of concrete
- No studies thus far on ettringite based cements
- Also not clear if carbonation will affect strength of structures

Study Goals

- Test variety of commercially available rapid setting binders
- Full-scale corrosion tests at varying cover depths
- Carbonation depth testing
 - Including effects on strength
- Other corrosion tests like chloride permeability and resistivity testing
- What are appropriate cover depths for these cements?