NEW ENGLAND TRANSPORTATION CONSORTIUM
RESEARCH PROBLEM STATEMENT

Due to netc@ctcandassociates.com by January 25, 2019

I. PROBLEM TITLE

Performance Engineered Mixes for Structural Concrete

II. RESEARCH PROBLEM STATEMENT

Traditionally, Portland cement concrete has been accepted on bridge projects based on test methods measuring air content, slump and compressive strength. In more recent years state DOT's have implemented other tests such as rapid chloride permeability and surface resistivity to measure the ability of concrete to withstand chloride penetration and alkali-silica reactivity testing to mitigate early cracking due to this reaction.

Although these traditional test methods are important they may have limited influence on the long-term durability of concrete. A newer approach, Performance Engineered Mixes (PEM) for concrete, has been developed and there is now an AASHTO Provisional Specification (PP 84). This approach aligns the mix design, quality control and acceptance test methods with the desired long term performance. Performance properties include aggregate stability, fluid transport, shrinkage cracking resistance, strength, workability and freeze-thaw resistance. Newer test methods have been developed such as the Super Air Meter which quickly measures fresh concrete air void content and size.

To date much of the PEM effort across the country has focused on concrete pavements. However, the PEM system can also be applied to structural concrete with several potential benefits. One of the features of PEM is optimization of the aggregate grading, which provides a well-graded aggregate structure. This leads to improved workability and reduced permeability, all while using less cement (and therefore less water) than typical mixes, leading to a reduction in shrinkage cracking. In addition to the improved performance, lowering cement contents of concrete mixes could result in cost savings and reduced greenhouse gas emissions.

A focused regional effort on PEM for structural concrete will improve the performance and long term durability of our bridges.

III. RESEARCH OBJECTIVES

The purpose of this study is to help New England state DOT's implement performance engineered mixes for concrete bridges.
Possible tasks are:

1. *Support agency implementation of AASHTO PP 84 by identifying test methods to align with performance requirements for structural concrete.*
2. *Help educate agencies on the AASHTO PP 84 specification and test methods.*
3. *Measure and relate early age concrete properties to performance.*

4. *Draft PEM specifications that align with agency needs.*
5. *Conduct shadow testing on pilot projects.*

IV. COST ESTIMATE

$150,000

V. RESEARCH PERIOD

24 months

VI. URGENCY AND PAYOFF POTENTIAL

Proper guidance and performance specifications will ensure performance engineered mixes for concretes are aligned well with agency needs. Implementation of these methods will improve concrete durability and bridge service life.

VII. PRELIMINARY LITERATURE SEARCH

To avoid duplicating research already published or in progress, the submitter of the Problem Statement will perform a brief literature search prior to submitting the Problem Statement. This literature search can be conducted using the Transportation Research Board's TRID database, available at https://trid.trb.org/*. The TRID database contains information on completed research as well as research in progress.*

***Attach a brief summary (1-3 paragraphs)** of the results of this literature search to the Problem Statement. The summary should describe how the subject of this Problem Statement would differ from or add to existing studies.*

The National Concrete Pavement Technology Center at Iowa State University is the lead on a Transportation Pooled Fund study on performance engineered mixes for concrete pavements. https://cptechcenter.org/performance-engineered-mixtures-pem/

This pooled fund effort is supporting participating state DOT's with implementation of the PEM for concrete pavements.

AASHTO Provisional Specification PP-84 covers the PEM process and will be used as the starting point for this study. In addition, the existing work on PEM at Iowa State University is a valuable resource and will be applied to structural concrete.

VIII. RESEARCH KEY WORDS

Provide a list of key words that can be used to conduct an additional search of the TRID database for related research. To the maximum extent possible, key words should be selected from the Transportation Research Thesaurus (http://trt.trb.org/*).*
Performance engineered mixes, concrete, structural concrete

TWO DOT ENDORSEMENTS ARE REQUIRED (To be signed by separate individuals.)

IX. ENDORSEMENT BY THE SPONSORING DOT (To be signed by the DOT representative to the NETC Advisory Committee through whom the Problem Statement is submitted.)

By signing the endorsement, the DOT representative is certifying that:

1. *The Problem Statement follows the required format.*
2. *The required literature search has been conducted.*
3. *The Problem Statement addresses a transportation issue of relevance to NETC and does not duplicate another Problem Statement being submitted at this time.*

___Dale Peabody_____ ___Maine_____
Name DOT

__Dale Peabody_____ ____1/24/19_____
Signature Date

X. ENDORSEMENT BY A SECOND EMPLOYEE OF THE SPONSORING DOT who agrees to chair the project's technical advisory committee (TAC) if the Problem Statement is selected for funding. (To be signed by a DOT staff person who has technical knowledge of the project topic and is committed to the research outcome.)

DOT Technical Endorsement*: I agree to chair the project's Technical Advisory Committee if this Problem Statement is selected for funding by NETC.*

_Richard Bradbury_____ ___Maine_____
Name DOT

_Richard L Bradbury _____1/24/2019_____
Signature Date

NOTE: To expedite the processing of Research Problem Statements, NETC requires submittal by e-mail (netc@ctcandassociates.com) by January 25, 2019.