

NEW ENGLAND TRANSPORTATION CONSORTIUM
RESEARCH PROBLEM STATEMENT

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

I. PROBLEM TITLE

Development of a Performance Specification for Bridge Deck Membranes

II. RESEARCH PROBLEM STATEMENT

Many of the New England state DOT's specify bridge deck membranes to protect the concrete deck from chloride intrusion. These membranes will typically be topped with a 3" hot mix asphalt pavement wearing surface. The membrane systems used are predominately torch applied non-woven polyester mat with bitumen. There are also high performance cold applied systems consisting of two component polymers, elastomerics and MMA resins. The costs of these cold applied systems are as much as 3 to 4 times the cost of torch applied systems.

It is theorized that the cold applied systems provide a longer lasting, more durable membrane and can prolong the bridge deck service life. Also they may be more resistant to damage when the bituminous overlay above is milled and filled on a periodic basis. Current practice at MaineDOT is to complete a bituminous wearing surface mill and fill at 15 years and a complete membrane replacement with new wearing surface at 30 years. If cold applied systems can provide better protection against concrete deck chloride intrusion and be more durable than the long term life cycle cost of the bridge deck may be lower.

There is no guidance to DOT's on selecting the most effective membrane to use, considering system performance and life cycle cost analysis. On typical bridge projects the contractor selects the membrane type using low bid so the torch applied systems are used. Occasionally the DOT will require a cold applied system be used.

III. RESEARCH OBJECTIVES

The purpose of this study is to develop performance specifications and testing methods for torch applied and cold applied membranes and conduct a life cycle cost analysis to provide DOT's with guidance on proper membrane selection.

Possible tasks are:

- 1. Develop lab test procedures and acceptance limits for membrane bond to concrete, measuring chloride penetration, freeze-thaw resistance.*
- 2. Conduct forensics on existing bridge decks to determine membrane performance.*
- 3. Develop model to predict membrane service life.*
- 4. Develop material performance specification based on test procedures.*
- 5. Develop construction specifications to ensure proper installation.*
- 6. Conduct life cycle cost analysis.*

IV. COST ESTIMATE

\$150,000

V. RESEARCH PERIOD

27 months

VI. URGENCY AND PAYOFF POTENTIAL

Proper guidance and performance specifications will ensure the most cost effective membrane system is used on bridge projects, prolonging costly concrete deck preservation projects and lowering the long-term life cycle cost.

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.

A 2012 NCHRP Synthesis study concludes there's a need for performance specifications for waterproofing membrane systems.

A Colorado DOT study completed in 2018 uses bond strength testing along with chloride penetration and freeze-thaw testing to evaluate four different types of membranes. The study provides some valuable information but recommends further investigation be done to determine the cost effectiveness of the WPM's. This may provide a good starting point for this proposed study.

NCHRP Synthesis 425 - Waterproofing Membranes for Concrete Bridge Decks

This synthesis was completed in 2012. The synthesis concludes that there's a need for better guidance and performance specifications.

Evaluation of Different Types of Waterproofing Membranes (Asphaltic and Non-Asphaltic) as Cost Effective Bridge Deck Barriers in Reducing Corrosive Chloride Effects – Colorado DOT - 2018

The use of WPMs was investigated by the Colorado Department of Transportation (CDOT) to analyze the performance of four products as an effective protection system: Polyguard, Protecto Wrap, Bridge Preservation™, and Sikadur. Each WPM was installed on Bridge F-17-YB and monitored for approximately two years. The performance of each WPM was evaluated for bond strength, resistance to chloride intrusion, freeze-thaw resistance, and cost analysis. Pull-off testing showed that all the WPMs have higher bond-strength than the control section, especially the constructed-in-place WPMs. Chloride penetration tests included testing the chloride concentration profiles of specimens extracted from the decks and from ponded specimens. The short-term results indicate that all four WPM systems can effectively control the concentration

of moisture, but not the chloride concentration. Among the materials tested, the Bridge Preservation™ product provided the best performance. At last, a simplified model has been developed to predict the long-term performance of WPMs.

No final implementation plan can be established for the application of the various WPM materials investigated but interim effort to specify and use the best performing WPMs for further study to determine their cost effectiveness should be initiated. In addition to the manufacturer's recommendations, the use of preliminary installation guideline for the WPMs and material properties provided in this report should be helpful in placing these materials in concrete decks of bridge structures.

Implementation of Performance Based Bridge Deck Protective Systems – Indiana DOT – 2013

This study reevaluates the state-of-the-practice of bridge deck protection in Indiana with the goal of enhancing the Indiana Department of Transportation's toolbox of bridge deck protective systems. Consideration was given to the state-of-the-art and state-of-the-practice in bridge deck protective systems used by other state transportation agencies as well as by international transportation agencies. Research focused on the practice of installing waterproofing membranes and the latest technologies being used. Based on the information gathered, various protective systems were evaluated, and recommendations are provided on the selection of the most appropriate systems for various bridge conditions. Furthermore, a recommendation is provided to remove the moratorium on membrane systems so that the benefits of this system can be more fully explored and realized.

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/>).

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.*

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Maine
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