Implementation of Performance-Based Bridge Deck Protective Systems

Introduction

When considering the durability of a bridge, the concrete deck is often the most vulnerable component and can be the limiting factor affecting service life. To enhance the durability of both new and existing bridge decks, a protective system is often provided. The main requirements of an effective bridge deck protective system are the following:

- Create a physical barrier to prevent the ingress of chlorides and moisture
- Provide a sacrificial wearing surface
- Extend the life of the bridge deck for both new and existing bridges

In the state of Indiana, this protective system typically comes in the form of a latex-modified concrete overlay or a thin polymer overlay. Another protective system widely used in the United States and in many countries internationally consists of a waterproofing membrane overlaid with asphaltic concrete. Due to a history of poor performance in the 1970’s and the 1980’s, a moratorium has been placed on the installation of waterproofing membranes and asphalt overlays in Indiana.

While there are a variety of techniques and systems that can be used for bridge deck protection, history and experience have resulted in limited practices in the state of Indiana in this regard. Therefore, the objective of this research is to provide the Indiana Department of Transportation (INDOT) with an enhanced toolbox of bridge deck protective systems that can extend the life of a bridge deck for both new and existing construction.

Findings

A review of the state-of-the-art and state-of-the-practice in bridge deck protective systems was conducted with an emphasis on membrane systems and their use domestically and internationally. Indiana experiences with various protective systems were also documented. Based on this information, the various technologies were evaluated and the most promising technologies and practices were identified. Recommen-
two decades. This system was found to provide many benefits which include a quick installation time, a thin application, and a straightforward installation process. Two other systems, SafeLane® by Cargill, Inc. and Rosphalt® by Royston Laboratories, which have been implemented occasionally in the US, have been used with mostly positive responses.

Comparison of Systems

Installation. It was recognized that the most important factor leading to the success of any protective system is the quality of the installation. Of the three main systems evaluated, thin polymer overlays require the least intensive installation process, whereas membrane systems require a very extensive installation process. Additionally, because of the large thickness of an asphalt overlay, auxiliary work is required to reconstruct the joints, drains, and approaches on existing bridges when a membrane system is installed. Other concerns regarding the installation of membrane systems became evident throughout the study. These concerns include the added dead load of the asphalt overlay and the loss of ability to inspect the top-side of the concrete deck.

Service Life. While latex-modified concrete overlays have been observed to provide the longest expected service life in surveys completed by US and Canadian transportation agencies, membrane systems are also expected to provide long service lives. As an example, Danish engineers expect membranes to provide a service life of 50 years. Thin polymer overlays are expected to provide the shortest service life of the three systems.

Cost. Although they provide the shortest service life, thin polymer overlays have the lowest initial cost and the lowest life cycle cost. The costs associated with installing a concrete overlay or membrane system are comparable to each other and are both higher than that of a thin polymer overlay.

Implementation

Based on these findings, the following recommendations are provided.

Current Protective Systems
The practice of installing latex-modified concrete overlays and thin polymer overlays has been successful in Indiana; therefore, it is recommended that these two systems continue to be implemented.

- Latex-modified concrete overlays are recommended for bridge decks where more extensive damage is observed. Because these systems provide a long service life, they are also recommended for more critical bridges as both a preventative maintenance and a rehabilitation measure.
- Thin polymer overlays are recommended for situations where quick installations are required and where a thin protective system is needed. It is also recommended that thin polymer overlays be considered as a preventative maintenance system on new bridge decks.

Moratorium
It is strongly recommended that INDOT uphold the moratorium on asphalt overlays used without a waterproofing membrane. However, it is recommended that the moratorium on waterproofing membranes with asphalt overlays be removed. This system has significant potential for increasing the service life of bridge decks.

Membrane Systems
Due to the large amount of auxiliary work that is necessary to install a membrane system on an existing bridge (i.e. reconstruction of joints, drains, and approaches), it is recommended that membrane systems be installed on new bridges or on existing bridges that required reconstruction of approaches and joints. However, it is recommended that membrane systems be avoided where extensive patching is required. It is also recommended that INDOT develop an installation specification and a product approval process. By performing a pilot study which involves the installation of a membrane system on a new bridge, the new specification can be tested and any necessary changes can be made prior to standardizing.

Recommended Citation

View the full text of this technical report here: http://dx.doi.org/10.5703/1288284315214

Published reports of the Joint Transportation Research Program are available at http://docs.lib.purdue.edu/jtrp/.