Design of Concrete Bridge Deck Rehabilitation

Introduction

Bridge decks are a main structural component designed to carry vehicle traffic and transfer live load to the girder system. In addition to safely carrying vehicle loads, the bridge deck must also withstand the application of road salt, abrasive forces and varying climatic conditions throughout its service life. Concrete bridge decks are also susceptible to cracking under live loading and shrinkage cracking. Measures must be taken to prevent or minimize the ingress of salt laden moisture. Without proper and timely maintenance and rehabilitation actions, concrete bridge decks are susceptible to concrete deterioration and corrosion of the reinforcing steel.

Bridge decks undergo a number of maintenance and rehabilitation actions during their life cycle to maximize their service life. These actions usually include routine annual maintenance such as bridge deck washing to remove accumulations of debris and road salt and periodic sealing of the concrete surfaces. Major rehabilitation actions may range from installation of a protective wearing surface system to complete replacement of the bridge deck.

The Department has adopted this best practice guideline for various typical bridge deck rehabilitation measures. The typical systems and approaches to be used are described below together with guidance on when each should be used. However, the selection of a particular rehabilitation alternative will be based on a life cycle cost analysis.

Asphalt Concrete Pavement Overlay

The Department's standard Deck Waterproofing System, as per the current version of Standard Drawing S-1443, consists of a 5mm asphalt membrane, 5mm protection board and 2-40mm lifts of hot-mix asphalt concrete pavement. Initial rehabilitation of this waterproofing system can be the replacement of the top 40mm lift of asphalt concrete pavement as condition warrants. Subsequent rehabilitation actions for this waterproofing system may be the complete removal and installation of a new deck overlay system. This approach is typically used where the major deck problem is with the asphalt concrete pavement and the membrane system appears to be functioning as designed.

Concrete Overlay

The Department's typical concrete overlay consists of Class SF concrete with steel fibres. The overlay will have a minimum nominal thickness of 65mm. This approach is typically used on bridge decks that originally had a 50mm asphalt concrete pavement wearing surface (no membrane) or had concrete cast to grade. The deck is showing signs of concrete delamination or other defects.

Polymer Overlay

A non-skid polymer overlay is a thin, flexible, multi-layered, polymer-aggregate wearing surface that is intended to bridge narrow cracks in the concrete surface and prevent the ingress of moisture in to the concrete deck. This system is typically used on bridge decks with existing concrete cast to grade or an existing concrete overlay where the concrete surface is in fairly good condition. The concrete surface may have narrow cracks and/or the CSE readings and/or chloride ion contents are rising.

Reinforced Concrete Overlay

The installation of a reinforced concrete overlay will consist of Class SF concrete reinforced with steel fibres. The concrete overlay will have a minimum 150mm thickness with 75mm cover on the top of the slab. The concrete slab will be reinforced with one layer of epoxy coated reinforcing steel. This system is typically used on bridge decks that have concrete girders placed side by side without grout keys or short span concrete girders where grout key breakdown is a problem.

With a 150mm deck overlay thickness, the higher concrete volumes may require pumping for more efficient concrete placement. While steel fibres is the preferred reinforcement, Class SF concrete with steel fibres cannot be pumped during placement. Where pumping of the wet concrete is required for efficient concrete placement, steel fibres may be replaced with polyolefin fibre reinforcement.

Deck Replacement

The replacement of a concrete bridge deck will be designed in accordance with the Department's Best Practice Guideline for the "Design of New Concrete Bridge Decks," BPG 3. This approach is typically used where the bridge deck has a number of problems and is in poor condition. These are often bridge decks that have already had at least one rehabilitation intervention.

Contact

Questions or further information on this guideline may be directed to the Bridge Preservation Specialist in the Bridge Engineering and Water Management Section of the Technical Standards Branch, Alberta Transportation.

Adopted:

Original Signed by Reg Quinton, P. Eng. — January 7, 2003

Director, Bridge Engineering Section — Date