CRACKING AND CHLORIDE CONTENTS IN REINFORCED CONCRETE BRIDGE DECKS

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RESEARCH

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Introduction

The corrosion of reinforcing steel in bridge decks is a significant financial and safety problem that is exacerbated by bridge deck cracking and deicing chemicals, primarily sodium chloride and calcium chloride. Many recommendations have been made that have resulted in material and design specification changes, more stringent weather limitations on concrete placement, and improved construction procedures.

Project Objective

The effects of material properties, design specifications, construction practices, and environmental site conditions on the performance of reinforced concrete bridge decks were evaluated.

Project Description

Field surveys were performed on 59 bridges to measure deck cracking, chloride ingress, and delaminated area. The surveys were limited to steel girder bridges – bridges that are generally agreed to exhibit the greatest amount of cracking in the concrete decks. The study includes two bridge deck types with silica fume overlays. The performance of silica fume overlay decks relative to conventional overlay and monolithic decks is of particular interest due to the widespread use of silica fume overlays in the state of Kansas.

Project Results

The results of the study indicate that chloride contents increase with the age of the bridge deck, regardless of deck type. In addition, concrete for all bridge deck types sampled in the same age range exhibit similar chloride contents for samples taken both at and away from cracks, regardless of deck type. For bridges within the same age range, the average chloride concentration taken away from cracks at the level of the top transverse reinforcement rarely exceeds even the most conservative estimates of the corrosion threshold for conventional reinforcement. Chloride concentrations taken at crack locations, however, can exceed the corrosion threshold in as little as nine months. Based on these observations, it appears clear that attention should be focused on minimizing bridge deck cracking rather than concrete permeability. The study demonstrates that crack density increases with increases in the volume of cement paste and that neither higher compressive strengths nor higher concrete slumps are beneficial to bridge deck performance. In addition, crack density is higher in the end regions of decks that are integral with the abutments than decks with pin-ended girders. The results of the crack surveys indicate that cracking increases with age, although a large percentage of the cracking is established early in the life of the deck. Even with the increase in crack density over time, however, both monolithic and conventional overlay bridges cast in the 1980s exhibit less cracking than those cast in the 1990s.

Report Information

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