ABSTRACT

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Cracking in concrete bridge decks can result in increased susceptibility to deterioration. As cracks provide direct routes for the ingress of deleterious elements to the reinforcement and superstructure, cracking can lead to reduced service lives for bridge structures. Several factors affect the extent of cracks which develop in bridge decks; however, relatively few are within the control of the designer. The objective of this research was to evaluate the influence of design parameters on the performance of bridge decks with respect to cracking and to develop simple design tools that are appropriate for both steel and nonmetallic reinforcement. This research was conducted in two phases. The first phase consisted of a field investigation of four bridges which incorporated different design elements to determine the in-service performance of bridge decks. Bridges were instrumented, monitored, and crack mapped. In the second phase of the research, a simple, finite element model was developed and calibrated against data from the field investigation and laboratory studies conducted by others. A parametric study was then conducted using this method to evaluate the effects of a range of design variables on the resistance to crack formation and the width of cracks that subsequently formed. Based on the results of the parametric study, it was determined that the amount and spacing of reinforcement in the deck directly influenced the extent of cracking that developed. It is recommended that the amount of reinforcement provided be sufficient to prevent localized yielding at cracks in the case of steel reinforcement and to prevent fatigue failure when FRP reinforcement is considered. Simple design equations are provided for the amount and spacing of reinforcement for both steel and FRP reinforcement to control cracking in bridge decks.