

TR-405 Impact of Deck Cracking on Durability

Key Words: Bridge Deck Cracking, PCC Durability, Epoxy-coated Reinforcement, Corrosion

ABSTRACT

Concrete bridge decks subjected to corrosive environment because of the application of deicing chemicals could deteriorate at a rapid rate. In an effort to minimize corrosion of the reinforcement and the corresponding delaminations and spalls, the Iowa Department of Transportation started using epoxy-coated rebars (ECR) in the top mat of reinforcing around 1976 and in both mats about 10 years later. The overall objective of this research was to determine the impact of deck cracking on durability and estimate the remaining functional service life of a bridge deck. This was accomplished by conducting a literature review, visually inspecting several bridge decks, collecting and sampling test cores from cracked and uncracked areas of bridge decks, determining the extent to which epoxy-coated rebars deteriorate at the site of cracks, and evaluating the impact of cracking on service life.

Overall, 81 bridges constructed with ECR were sampled. Fick's Second Law was applied in this study to estimate the time required to reach the corrosive threshold of chloride concentration at the rebar level, i.e., the time length of the corrosion initiation stage.

No signs of corrosion were observed on the rebars collected from uncracked locations. Rebars that had surface corrosion undercutting the epoxy coating were those collected from cores that were taken from cracked locations. In general, no delaminations or spalls were found on the decks where these bars were cored. The surface chloride concentration at 0.5 inches below the deck surface and the diffusion constant were found to be 14.0 lb/yd^3 and $0.05 \text{ in}^2/\text{yr}$, respectively. For a corrosion threshold range from 3.6 to 7.2 lb/yd^3 , the predicted service life for Iowa bridge decks considering corrosion of ECR was over 50 years. This illustrates that ECR can significantly extend the service life when compared with bridges constructed with black steel rebars.