Wasin Chimmanee 2010: Fatigue Behavior of Externally Strengthened RC Bridges with CFRP Composite. Master of Engineering (Civil Engineering), Major Field: Civil Engineering, Department of Civil Engineering. Thesis Advisor: Assistant Professor Piya Chotickai, Ph.D. 300 pages.

Carbon fiber reinforced polymer (CFRP) has been widely used for repairing and strengthening of reinforced concrete members due to its superior material properties, e.g., light weight and high strength. Although the CFRP is commonly recognized as a corrosion-resistant material, the bond strength at an interface of the concrete member and CFRP itself may be impaired when exposed to severe environments. This research was, therefore, aimed to evaluate the long term performance of reinforced concrete (RC) bridge members externally strengthened with CFRP. The failure mechanisms and load-carrying capacity of the members were examined under monotonic and fatigue loadings. The fourteen RC specimens were exposed to simulated corrosive environment in the laboratory for 90, 240, and 360 days, and were then tested under four-point bending up to failure. The experimental results revealed that the debonding between the CFRP and concrete members could be noticeable after the flexural cracks were developed in the members. The debonding was then extended toward the supports, as an increase in the applied load. The ultimate loads obtained from the experiments were less than those obtained based on the assumption of fiber break at ultimate. The ultimate capacities of the control specimens and specimens subjected to fatigue loadings were found to be comparable. However, the severe environment had detriment effects on reducing bond strength and fracture energy at the interface of the CFRP and concrete, as well as altering the mode of failure. In addition, nonlinear finite-element analyses were conducted to investigate the failure mechanisms and capture crack propagations in the concrete members. The research results provided herein could be used as database information for the design and evaluation of strengthened concrete bridge members exposed to severe environment.

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