Innovative Strategies for the Repair of Pre-Stressed Beam Ends

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Pre-stressed concrete girder bridges in the United States often experience corrosion at beam end due to exposure to water and deicing agents at the joint between the abutment and bridge deck. Extensive damage to the girders at this location can result in the loss of ultimate strength in a member, therefore increasing the risk of failure. Full replacement of the girder is an expensive solution to address this issue. The ability to install a localized repair would be a more cost effective alternative method of restoration. Ultra-High Performance Concrete (UHPC) has gained popularity in research and engineering practice for the structural restoration/retrofit of concrete bridges. For the same reasons, UHPC is considered as an alternative material for local repair. Additionally, the use of composite materials has demonstrated promise for concrete girder rehabilitation due to their desirable material behavior and amenable application qualities. Specifically, one possible technique for restoring the integrity of a damaged beam is utilizing Engineered Cementitious Composite (ECC). Another potential resolution is the use of Fiber-Reinforced Concrete (FRC). Studies have demonstrated successful implementation of composite materials for the repair of damaged bridge components, including reduced cost of repair and low traffic closure time. However, conducted research and technical literature are limited in the United State on the use of UHPC, ECC, and FRC for local restoration in the shear-critical zone of the girder (i.e., beam ends). To address this gap, the current study investigates the application of UHPC, ECC, and FRC to repair local damage at the beam-end of pre-stressed concrete girders. Specimens tested for this project consist of eight BTC-110 pre-tensioned, pre-stressed concrete beams. The web sections at each beam-end was artificially damaged to simulate in-situ corrosion damage and repaired with either UHPC, ECC, or FRC. Full-scale load testing was used to evaluate the effectiveness of the repair method and develop supporting guidelines.

Keywords: Beam end; Corrosion; Repair materials; Full-scale structural tests