Progressive Damage and Non-Destructive Evaluation of FRP Rehabilitation at Component and System Level

By

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There is growing use of FRP composite materials in the civil infrastructure for rehabilitation of concrete bridge decks. However assessment of the effectiveness of rehabilitation over time and monitoring the progression of damage or change in load paths between the structural components has not been undertaken to date. Investigation was carried out at "component level" on field-rehabilitated slab specimens cut out from a major highway bridge. The slabs were tested to failure and the progression of damage was characterized using NDE methods including IR Thermography and forced excitation based dynamic testing. The test data on the failure modes and capacity loads were correlated to the available analytical models and design guidelines. The test capacity was also correlated to the bridge deck capacity based on local-global modeling. Research at the "systems level" was then performed, in which a three-girder bridge deck system was tested to simulate behavior under field loading in which the deck slabs are found to be susceptible to punching shear type failures and the longitudinal girders are usually found to be deficient in terms of shear demand.. The objective of the study was to evaluate damage progression in the deck slabs and the longitudinal girders under wheel load and to detect changes in the overall response of structure caused by strengthening of individual components that pushes other components towards critical levels. NDE techniques are being evaluated as means to identify the shifts in damage localization, overall response and damage progression caused by subsequent modifications to the structure. The test data on the failure modes, capacity loads and specimen behaviors are being correlated to the available analytical models and design guidelines.

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