Framework for the Evaluation and Rehabilitation of Bridge Piers through Image Processing and CFRP

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Abstract:

Bridges represent a vital component of infrastructure, and their periodic assessment is essential to ensure safety and serviceability. This study proposes a framework for the structural health monitoring (SHM) of bridge piers using an image processing–based application. In addition to identifying crack types, the framework provides recommendations for rehabilitation, including the placement, thickness, and spacing of CFRP layers. To validate the approach, an experimental investigation was carried out on 1/4-scale bridge piers constructed with low-strength concrete, both in damaged and undamaged conditions, to examine the influence of retrofitting on their dynamic properties. Results revealed that the ductility of the retrofitted column at a 2% drift level increased by 39% compared to the original column, while the repaired column's ductility was restored to its initial level. The cumulative energy dissipation capacity of the retrofitted column improved by 39.38%, whereas the repaired, previously damaged column regained its original capacity. Under subsequent cyclic loading, the retrofitted and repaired columns exhibited improvements in energy dissipation of 25.8% and 18%, respectively.