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Performance and Retrofitting of Reinforced Concrete Bridge Piers with Skewed FRP Columns under Seismic Loading

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Abstract

In recent decades, earthquakes have caused significant damage to the structures of existing bridges, especially when the natural frequency of the structure is in the range of applied force frequency. This study is aimed at bridge pier behavior, changes in the skew angle of the bridge pier, and three dimensional simulations of superstructure and deck angle changes under seismic loads. We employed ABAQUS finite element software for modeling the bridge structure and used CFRP confinement to improve structure behavior and strenghthen the bridge pier under lateral seismic loads. Bridge pier behavior was explored through using finite element method. Structural analysis for studying the behavior of bridges is of non-linear time history analysis and by lateral seismic loading in accordance with the seismic record in which the natural frequency of the structure is in the range of applied force frequency, this has further stimulated the bridge structure. Studies indicate widespread tensile and compressive damages, permanent plastic strains, and broad tensional cracks lasting longer than the length of the plastic hinge along the unconfined bridge piers. Results show improvement in flexural capacity, enhanced ductility, controlled ultimate displacement, and reduced damages in bridge piers confined with CFRP under lateral seismic loading.

Key words: Bridge Pier, CFRP, Skewed, Retrofitting, Ductility