ABSTRACT

MODELING OF AS-IS, RETROFITTED, AND REPAIRED R/C COLUMNS USING FIBER-REINFORCED POLYMERS (FRP) AND COMPARED TO EXPERIMENTAL SHAKING TABLE TESTS

This thesis presents a comprehensive study on the seismic repair and retrofit of circular reinforced concrete (R/C) bridge columns using Fiber-Reinforced Polymer (FRP) composites. An as-is, two-column R/C bridge bent was built at 40% scale and designed with current seismic code requirements (per the California Department of Transportation, Caltrans) and tested on a shaking table at CSU, Fresno. The columns were modeled using an actual bent on Highway 99 and 2nd Street in Selma, California. A computer algorithm was developed to model the Inelastic Behavior of As-is, Retrofitted, and Repaired Reinforced Concrete Circular Columns (IBARC). Five damage states that were identified using strain and drift parameters from published literature of R/C column tests were embedded in IBARC and used to design optimal number of FRP wraps to retrofit "already-damaged" columns. In this light, IBARC was developed to accurately model the moment-curvature and force-deflection relationships for as-is and FRP-retrofitted R/C columns having various boundary conditions. The model was verified using various experimental shaking table tests. The results show that the proposed algorithm may be used by structural engineers to design a suitable FRP retrofit scheme for improving strength and ductility in existing seismically deficient R/C bridge columns.

Michael David Wesson
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