Jordan University of Science and Technology

Behavior of Eccentrically-Loaded Circular Reinforced Concrete Columns Strengthened with Carbon Fiber Reinforced Polymers

Authors: Hanan Al-NimryRabi Al-Rabadi

Abstract: The study reported herein aims at investigating the behavior of circular RC columns wrapped with carbon fiber reinforced polymer (CFRP) sheets, under concentric and eccentric loading conditions. A total of thirty circular RC columns were tested. All columns had the same circular cross-section with a diameter of 192 mm and a height of 1200 mm. Columns were tested under 0, 25, 50, 65 mm and infinite eccentricities using displacement control. The column specimens were divided into five groups with six specimens each. Each group of columns was divided into three subgroups with two specimens each. Columns of the first subgroup served as control unwrapped specimens whereas columns of the second and third subgroups were wrapped with unidirectional CFRP sheets using two different configurations: 1C and 1V1C. One hoop FRP layer with the main fibers oriented parallel to the column circumference was used to confine the 1C columns. Two FRP layers with fibers oriented perpendicular and parallel to the column circumference were used to wrap the 1V1C columns. Test results showed that wrapping the columns with CFRP sheets significantly increased their strength, toughness, axial ductility and axial and lateral deformation capacities. Strengthening eccentrically loaded columns with one vertical and one circumferential CFRP layers slightly enhanced their load resistance in comparison to columns strengthened with one circumferential layer. P-M interaction diagrams for the columns confined with one hoop FRP layer showed a significant increase in the compression strength in comparison with unconfined columns. On the other hand, the columns wrapped with two FRP layers showed a significant increase in both axial compression strength and moment capacities in comparison to the unconfined columns. Comparison between theoretical and experimental P-M interaction diagrams demonstrated that the use of the ACI 440.2R-08 recommendations for the development of P-M interaction diagrams were conservat