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Axial-Flexural Interaction in FRP-Wrapped RC Columns

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Abstract: The study reported herein aims at investigating the behavior of medium-scale circular reinforced concrete columns wrapped with fiber reinforced polymer (FRP) sheets under concentric and eccentric axial loads. The experimental program was devised to assess the effects of loading conditions, absence/presence of an FRP jacket as well as the FRP wrapping system. To achieve the study objectives, four column groups were tested under axial compression at 0, 25, 50 and 65 mm loading eccentricities corresponding to eccentricity-to-diameter ratios of 0, 0.13, 0.26 and 0.34, respectively. Specimens in a fifth group were tested in pure bending simulating axial compression at infinite loading eccentricities. Three column subcategories were tested under each of the 5 loading eccentricities: unwrapped; wrapped with one ply of hoop FRP sheets; and wrapped with two FRP plies with fibers oriented at 0 and 90 degrees to the longitudinal column axis thereby providing externally-bonded longitudinal reinforcement and hoop confinement, respectively. Tests confirmed that FRP confinement enhances the axial-flexural column resistance even at large eccentricities that exceed the balanced state of unconfined columns. Although axial column resistance decreased with increasing bending moments, relative enhancements (25-35%) in axial resistance provided by FRP confinement were found to be more significant under eccentric loading than in pure compression. Compared to hoop FRP-confined columns, using additional longitudinal sheets resulted in minor (7-9%) but stable enhancements in axial resistance that were unaffected by the increase in loading eccentricity. The FRP hoop wraps had a minor effect on the flexural resistance of specimens tested in pure bending but managed to double their resistance when combined with the externally-bonded longitudinal FRP sheets. Finally, three stress-strain models of FRP-confined concrete were used in conventional section analysis to assess the axial-flexural inter