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Confinement Effects of Unidirectional CFRP Sheets on Axial and Bending Capacities of Square RC Columns

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Abstract: The axial-flexural interaction of reinforced concrete columns wrapped with fiber reinforced polymer (FRP) sheets was investigated using 23 one-third scale specimens. The square column specimens, 1200 mm in height with a side dimension of 200 mm and a corner radius of 12.5 mm, were tested under eccentric axial compression with load eccentricities of 35, 50 and 65 mm and in pure bending. Under each of the four axial-flexural loading combinations three categories of columns were tested to examine the effects of different FRP wrapping systems : unwrapped; wrapped with one hoop carbon FRP ply; and wrapped with two plies of carbon FRP sheets with the main fibers oriented parallel to axial and hoop directions in the first and second plies, respectively. Although the use of the single ply of FRP confining wraps provided a relatively low confinement ratio , test results demonstrated the viability of using the FRP hoop confining system in enhancing axial resistance of the eccentrically-loaded columns. Despite the observed reductions in axial resistance of the control and FRP-confined columns with increasing load eccentricities, FRP confinement provided a stable increase in resistance of about 12% over that of the control unwrapped columns regardless of the level of applied bending moments. FRP confinement managed to provide considerable improvements in the ductility and toughness of the columns especially under largely eccentric loading. Combining the axially- oriented FRP sheets with the hoop wraps brought about further improvements (about 5%) in axial resistance. However, the increase in flexural stiffness of the FRP-jacketed columns provided by this arrangement of axial and hoop oriented fibers tended to counteract the enhancement in ductility and toughness of columns tested under large eccentricities bringing them to levels lower than those of the control specimens in the case of pure bending. Conventional section analysis and stress-strain models of FRP-confined concrete ad