Nonlinear Finite Element Analysis Of Reinforced Concrete Columns Strengthened With Carbon Fiber Reinforced Polymer(CFRP)

Zahraa Abass Khdair

ABSTRACT

In this study, 3-dimensional finite element models have been presented using ANSYS program (release 16.0) to investigate reinforced concrete columns reinforced with CFRP composites and to evaluate the gain in overall performance (strength and ductility) because of strengthening.

The present observation compares the analytical results from the ANSYS finite element evaluation with experimental records for three kinds of columns (circular, square and rectangular) of five tests. The analytical outcomes display proper convergence with the experimental outcomes.

Three-dimensional eight-node brick element (SOLID65) was used to represent the concrete, three-dimensional spar element (LINK180) was used to represent the steel and three-dimensional shell element (SHELL41) was used to represent the CFRP composites, a full bond between concrete and carbon fibers was assumed.

The parametric study includes the effect of the maximum critical parameters with compressive strength of concrete, modulus of elasticity of CFRP, wrap orientation of CFRP, effect of absolutely and partly wrapping of CFRP, impact of strengthening of the upper poor part of long column, effect of longitudinal and transverse reinforcement ratios and corner radius of square column sections.

The parametric examination showed lower gain in strength and ductility with an increase in compressive strength of concrete. There has been also a decrease in the resistance and ductility with an increase of other factors including aspect relation of rectangular sections, slenderness ratio and when the columns are exposed to the state of eccentric loading. The impact of completely / partially wrapping the columns with CFRP has been studied. The orientation of the fiber and the thickness of the FRP wall have a significant effect on the stress and strain conduct and the resistance of the wrapped concrete columns. The confinement impact of FRP cannot be absolutely found out without adequate orientation of the fiber and enough wall thickness.

The failure of the square columns always starts at one of the corners proving that the stress concentration occurs at the corners. So reduce the sharpness of corners by increasing in the corner radius is a very effective parameter in enhancing the gain obtained in axial strength and ductility for the square RC columns.