

CFRP Strengthening of Beams in Reinforced Concrete Frames with Openings in Shear Zone

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Abstract – Openings through reinforced concrete frame beams are often necessary to accommodate utility pipes and/or ducts. Openings in flexural members may decrease their load-carrying capacity and stiffness leading to increased deflection. This paper presents the findings of a numerical study that examined the effectiveness of carbon fibre reinforced polymer (CFRP) fabric in strengthening reinforced concrete flexural members with openings. The effectiveness of different strengthening configurations in the vicinity of openings in the shear zone are evaluated by modelling nine frames and comparing the results to the 10th (control) frame with has opening but without strengthening. The FRP fabric configurations included strengthening around the opening, inside the opening, and both around and inside the opening. In addition, for each of the configurations, the thickness of fabric layers was varied. Finite element models demonstrated that CFRP strengthening increases the ultimate load-carrying capacity and decreases deflection. However, increasing CFRP sheet thickness has little effect on the maximum load capacity.

Keywords: Flexural member, CFRP, RC Frame, Opening in shear zone, Strengthening, finite element method.