FAYOUM UNIVERSITY

FACULTY OF ENGINEERING

Structural Behavior of Strengthened RC Deep Beams using Ultra-High-Performance Fiber Reinforced Concrete (UHPFRC) Laminates Subjected to Concentrated or Suspended Loads

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ABSTRACT

The enhancement and restoration of existing structures are increasingly crucial to construction efforts. Various strengthening and rehabilitation approaches are employed to enhance deep beam strength under diverse loading circumstances, such as concentrated loads. In the past decade, a new approach for enhancing reinforced concrete (RC) structural elements is ultra-high performance fiber reinforced concrete (UHPFRC).

This research aims to investigate the shear behavior of reinforced concrete (RC) deep beams strengthened with (UHPFRC). For this purpose, eight RC deep beams were fabricated and tested to failure. One beam served as a control beam (un-strengthened), while the remaining seven deep beams were strengthened utilizing various strengthening schemes. This experimental study primarily focused on the thickness of the UHPFRC layer, the volume fraction of steel fibers, and the strengthening schemes (jacketing, bilateral layers, and strips exclusively in the shear zone). The experimental findings demonstrated that UHPFRC significantly enhanced the shear capacity, toughness, and stiffness of RC deep beams. The performance of the strengthened beams exhibited improvements in ultimate shear strength, stiffness, and toughness by about 43.6%, 102.2%, and 171.3%, respectively, higher than that of the un-strengthened deep beam. Utilizing a UHPFRC U-jacketing in strengthening RC deep beams proved to be a very efficient strengthening scheme. The incorporation of steel fibers into the UHPFRC mixture improved the shear properties of the strengthened specimens and delayed fracture propagation. The shear capacity of the strengthened specimens was compared to the values predicted by the analytical approaches presented by earlier researchers. Finally, numerical investigation was made by VecTor2 software to predict the shear capacity of three specimen under concentrated and suspended loads.