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Interaction between Internal and External Shear Reinforcement for Strengthened RC Deep Beams

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Abstract **-** This paper presents a comprehensive experimental work to study the interaction between the internal and external shear reinforcement for strengthened reinforced concrete (RC) deep beams. For this purpose, a total of twelve medium-scale RC deep beams have been designed, fabricated, and loaded monotonically till a completed failure. Four beams were kept unstrengthened to act as reference beams, while others have been strengthened using hybrid carbon-glass Fiber-reinforced polymer (FRP) strips. All beams have been designed to be shear deficient in one side, which will be called herein as a critical shear span (CSS). The study included three test parameters: strengthening technique (externally bonded and near-surface mounted), number of internal and external shear reinforcement (two and three) in the CSS, and the alignment of the internal and external shear reinforcement (aligned and unaligned) to each other. The results revealed that the near-surface mounted (NSM) technique could be able to mitigate the premature debonding mode of failure which was dominant with the beams strengthened by the externally bonded (EB) counterpart. The NSM technique could be able to increase the shear capacity of the strengthened beams up to 45% compared to the corresponding technique. The results also showed that the unaligned configuration of the internal and external shear reinforcement was better than the aligned one for both NSM and EB techniques.

Keywords**:** Reinforced Concrete; Interaction; Deep Beams; Shear; Strengthening; Near-surface Mounted; Externally Bonded; Hybrid carbon/glass FRP.