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Flexural Strengthening of Steel Beams Using Fiber Reinforced Polymers

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Abstract : Fiber reinforced polymers (FRP) is one of the most environmentally method for strengthening and retrofitting steel structure buildings. The behaviour of flexural strengthened steel I-beams using FRP was investigated. The finite element (FE) models were developed using ANSYS® as verification cases to simulate the experimental behaviour of using FRP strips to flexure strengthen steel I-beam. Two experimental studies were selected for verification; first examined the effect of different thicknesses and modulus of elasticity while the second studied the effect of applying different carbon fiber reinforced polymers (CFRP) bond lengths. The proposed FE models were in good agreement with the experimental results in terms of failure modes, load bearing capacities and strain distribution on CFRP strips. The verified FE models can be utilized to conduct a parametric study where various widths (40, 50, 60, 70 and 80 mm), thickness (1.2, 2 and 4 mm) and lengths (1500, 1700 and 1800 mm) of CFRP were analyzed. The results presented clearly revealed that the load bearing capacity was significantly increased (+7%) when the width and thickness were increased. However, load bearing capacity was slightly affected using longer CFRP strips. Moreover, applying another glass fiber reinforced polymers (GFRP) of 1500 mm in length, 50 mm in width and thicknesses of 1.2, 2 and 4 mm were investigated. Load bearing capacity of strengthened I-beams using GFRP is less than CFRP by average 8%. Statistical analysis has been conducted using Minitab®.

Keywords : FRP, strengthened steel I-beams, flexural, FEM, ANSYS
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