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Experimental Investigation on Strengthening of Timber Beam Using Glass Fibers and Steel Plates

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Abstract : The strengthening of timber beams can be necessary for several reasons including the increase of live loads (possible in a historical building for a change of destination of use or upgrading to meet new requirements), the reduction of the resistant cross-sections following deterioration (attacks of biological agents such as fungi, and insects) or traumatic events (fires) and the excess of deflection in the members. The main purpose of strengthening an element is not merely to repair it, but also to prevent and minimize the appearance of future problems. This study did an experimental investigation on the behavior of reference and strengthened solid timber beams. The strengthening materials used in this study were CSM-450 glass fiber and steel materials for both flexural and shear strengthening techniques. Twenty-two solid timber beams of Juniperus procera (TID) species with the dimensions of 60 x 90 x 780 mm were used in the present study. The binding material to bond the strengthening materials with timber was general-purpose resin with Luperox® K10 MEKP catalyst. Three beams were used as control beams (unstrengthen beams) while the remaining nineteen beams were strengthened using the strengthening materials for flexure and shear. All the beams were tested for three points loading to failure by using a Universal Testing Machine, UTM-600kN machine. The experimental results showed that the strengthened beams performed better than the unstrengthen beams. The experimental result of flexural strengthened beams showed that the load-bearing capacity of strengthened beams increased between 16.34 – 42.55%. Four layers of Glass Fiber Reinforced polymer on the tension side of the beams was shown to be the most effective way to enhance load-bearing capacity. The strengthened beams also have an enhancement in their flexural stiffness. The stiffness of flexural strengthened beams was increased between 1.18 – 65.53% as compared to the control beams. The highest increment in stiffness has occurred on beams strengthened using 2x60 mm steel plates. The shear-strengthened beams showed a relatively small amount of performance as compared to flexural-strengthened beams; the reason is that the beams are sufficient for shear. The polyester resin used in the experimental work showed good performance in bonding agents between materials. The resin showed more effectiveness in GFRP materials than steel materials.

Keywords : heritage structures, strengthening, stiffness, adhesive, polyester resin, steel plates
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