UNIVERSITI TEKNOLOGI MARA

INVESTIGATION ON THE PERFORMANCE OF GFRP REINFORCED GLUED LAMINATED TIMBER (GLULAM COMPONENT)

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ABSTRACT

The glulam method enabled the use of smaller timber pieces being formed together into a stronger larger piece, a revolutionary method which made timber construction component much more reliable renewable material. However this method still relies on the rule that a larger component is always stronger. Several applications reinforcement like glass fibre reinforced polymer (GFRP) or carbon fibre reinforced polymer (CFRP) have been applied on glulam in order to allow it to have greater structural strength without any increase of its dimensions. Though reinforcement is proven to be workable, there is still no standardized method of manufacture and minimum parameter of reinforcement materials. Also there are no in depths understanding of an optimized alignment of the reinforcement fibres in relation to the glulam wood grain. This study had done flexural tests using solid timber with dimension of 50mm x 30mm x 3300mm and glulam beams with dimension of 140mm x 80mm x 3000mm. It has been identified from the solid timber test that the direction of GFRP strips at diagonal (45°) to the wood grain of a solid timber, gives 4.05% increase of the load carrying capacity compared to control samples while reinforcement perpendicular (90°) to the wood grain had an insignificant increase if at all. This justified in the glulam test to place the GFRP strips between the fifth and fourth layers of lamination from the top, at angle close to parallel to the wood grain (zero direction) and tested under a 4-point flexural test. The glulam beam flexural tests with varied area of 30%, 40% and 50% area of reinforcement over the lamination surface have an average maximum load capacity of 49.40kN, 45.81kN and 50.39kN respectively, compared with the control samples that have average maximum load at 54.69kN. This clearly shows that the reinforced test samples with varied area of 30%, 40% and 50% area of reinforcement each have a decrement in maximum load capacity at -9.67%, -16.24% and -7.86% respectively and decrement of modulus of rupture with -9.67%, -16.23% and -7.85% each respectively. While analysis of the damage pattern of the glulam beam and GFRP strips indicated a severe effect of delamination due to the difference of material behaviour when placed under load. These findings indicate that the alignment and layering of the GFRP strips could seriously affect the glulam strength in a detrimental manner, hinting and underlying mechanics at work. More study should be done to understand the alignment design to prevent premature delamination between reinforcement with the timber component that may lead to a terminal structural failure.

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