UNIVERSITI TEKNOLOGI MARA

STRUCTURAL PERFORMANCE OF GFRP DOWELLED MORTISE AND TENON CONNECTIONS MADE OF SELECTED TROPICAL SPECIES

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ABSTRACT

The mortise and tenon is widely seen as one of the most important traditional timber structural joint. However, report and guidelines on its structural performance is very limited. Therefore in order to study the load-carrying capacity and performance of the structural mortise and tenon joint, the existing theoretical back ground of timber joint design is made as a reference. Current equations applicable in estimating the load-carrying capacity of timber joint is using European Yield Model (EYM). However, the existing EYM equation use to estimate load-carrying capacity of timber joints is only established and limited to steel fasteners. This caused the difficulties in designing the structural connection using other types of fastener material such as glass fibre reinforced polymer (GFRP) or wood wherever it is in need to substitute the steel dowels. The advantages of using steel as a fastener in timber joint are well known to the construction industry; however the use of GFRP as a new material in the construction especially in the timber industry is also proven to be successful. Therefore, the main aim of this research is to determine the applicability of GFRP dowel to substitute steel and wood dowel as a fastener in strengthening structural mortise and tenon joints.

In this research, the load-carrying capacities of double shear joint performed experimentally were compared to the strength value calculated theoretically using EYM equations. The outcomes of the comparison were then used as guidelines and comparisons as well as to investigate the reliability of EYM in predicting the load-carrying capacity of mortise and tenon structural joint. The double shear joint test is currently the only method was developed in determining the timber joint capacity.

In order to determine the load-carrying capacity of the double shear joint, the complimentary test that is the dowel-bearing strength and dowel bending yield test is necessary. Thus, the laboratory experimental work comprising of the dowel-bearing strength tests, dowel bending tests and double shear strength tests were done to experimentally determine the performance of the structural mortise and tenon and compared with the theoretical equations. All experimental work was done using three dowels, one at a time either steel, GFRP or wood dowel. The steel dowels are used to validate the findings since the EYM is mean for the steel fastener and the results of wood dowel were used as a comparison to the performance resulted from the GFRP dowel. Structural mortise and tenon tests were performed in accordance to shear, bending and tension laterally loaded. All experimental work was done using Kempas species and repeated with Kapur species for comparison purposes.

The results from this research enhance the understanding of the performance of the structural mortise and tenon fastened with GFRP dowel and on the use of the existing National Design Specification (NDS), 2005 in estimating the load-carrying capacity of this type of connections. The existing EYM, NDS, 2005 are found applicable in estimating the GFRP dowelled mortise and tenon joints. The EYM equations are found reliable and sufficient in estimating the GFRP dowelled mortise and tenon joints subjected to tensile load. However the EYM equations under predicted the GFRP dowelled mortise and tenon joints subject to shear and bending load. Therefore the factor of safety values for the mortise and tenon joints dowelled with GFRP subjected to the shear and bending load are presented in this thesis for future references.

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