**UNIVERSITI TEKNOLOGI MARA**

# SHEAR PROPERTIES OF STRUCTURAL SIZE TIMBER FROM SELECTED MALAYSIAN TROPICAL TIMBER BASED ON TORSIONAL TEST IN ACCORDANCE WITH EN 408:2010

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**PhD**

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# AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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# ABSTRACT

The strength properties of solid timber are very important to ensure the safe and practical use of this source in construction. The strength of timber broadly refers to the ability of a material to resist external forces or loads that tend to change its size and shape. One of the most important characteristics of timber is its shear properties. Currently, In Malaysia, the timber shear strength properties data established in MS 544: Part 2 (2001) was obtained from small clear samples. The larger the specimen, the more defects it has, resulting in inaccurate shear strength properties. The shear strength properties of timber in other countries/regions have been changed to structural size, such as ASTM D198:2009 and EC5. Therefore, this study aims to find the torsional shear strength properties of large-scale specimens in accordance with EN 408-2010 and EN 338: 2016. To establish these data, a special structural torsion jig (Tinius Olsen) was manufactured according to EN 408-2010 to determine the shear performance. According to EN 408-2010, the structure size specimens were investigated with the shear properties parallel to the grains on Balau, Geronggang, Resak, Kapur, Kempas, Kelat, Kering, light red Meranti and Mengkulang with the total number of 1800 samples. The grade stresses for small clear and structural size specimens of shear strength are found to be higher than MS 544. A moderate to strong correlation between shear strength, shear modulus and density were observed for all species. In general, the results show that the shear strength of small clear specimens is higher than those obtained from structural size specimens. A regression analysis of shear between shear strength and shear modulus of structural size specimen was plotted and found that to have a fairly strong relationship with R= 0.93. Furthermore, the derived characteristic values are lower when compared to the respective strength class in EN 338: 2016. Through the correlation of shear strength for small clear and structural size specimens, the equation of fm,k = fm,k,small x 0.8 stated in EN 384: 2016 is not fit to determine characteristic values of tropical structural size timber because the obtained verification equation to determine shear strength characteristic value is fm,k = 0.15fm,k,small x 1.94. Furthermore, the ratio of E to G obtained from the study is not constant for all species. It was found that the E:G ratio of all species varies from 20:1 to 33:1 with a total average of 27:1. The second equation which determines the correlation between mean bending modulus of elasticity values of structural size specimens with the mean values of the shear modulus of torsional shear modulus gives a linear regression analysis of the predicted value using the formula in EN 384:2016 is (Gmean = 1/16(E0,mean) = 0.0625(E0,mean)) which is different compared to that the actual test regression equation (Gmean = 0.0429(E0,mean) - 0.1). To conclude, in the future, mechanical properties of Malaysian tropical hardwood based on structural size specimens should be investigated to offer an accurate and cost-effective design. The outcomes of this study are the first to attempt to determine a characteristic value for Malaysian hardwood timber using European standards.

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