

UNIVERSITI TEKNOLOGI MARA

**TENSILE STRENGTH CLASS
SYSTEM FOR MALAYSIAN
HARDWOOD ACCORDING TO
EUROPEAN STANDARDS EN 384
AND EN 408**

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ABSTRACT

Timber has been widely used as load-bearing building elements such as roof trusses, beams and columns subjected to tensile, shear, bending and compression loading. In order to design such structural system, the strength properties of a timber need to be precisely determined. Currently, in Malaysia, the strength properties are based on MS 544 which were determined by grade stresses of small clear specimens. However, in Europe and partly in North America, the concept of grade stresses of small clear specimens has been abandoned and new approach involving determination of characteristic values in structural sized specimens has been introduced to produce more accurate data for structural timber design purpose. Glue laminated timber (GLT) is now the most versatile engineered structural timber products produced in many countries. In order to produce GLT, information on characteristic tensile strength is used. Therefore, there is need to establish the tensile strength data for Malaysian timber based on characteristic values as data in EN 338 are specially mentioned to be used for softwood timber only. Nine species namely Balau, Kempas, Kapur, Kelat, Resak, Keruing, Mengkulang, Light Red Meranti and Geronggang, varied from strength group (SG) 1 to SG 7 were chosen from region Kelantan, Pahang, Johor and Sarawak to perform tension test in both small and structural sized specimens. The test were done according to BS373:1957 for tension parallel and perpendicular to grain of small clear specimens and EN408 for tension parallel to grain of structural sized specimens with total of 3360 specimens tested. A very weak correlation of density versus tensile strength and moderate correlation for modulus of elasticity (MOE) versus density were observed for all species. Tensile grade stresses determined from both small clear and structural sized are found to be higher compared to the data in MS 544 as tensile strength in MS 544 are concurrently calculated by 60% of the bending strength values. The order of grade stresses for small clear specimens are Balau, Mengkulang, Light Red Meranti, Keruing, Kapur, Kelat, Resak, Kempas and Geronggang. However, different order were observed for structural sizes which is Kempas, Keruing, Kapur, Balau, Mengkulang, Kelat, Resak, Geronggang and Light Red Meranti. Thus, there is a weak correlation found in grade stresses between small clear and structural sized specimens. The characteristic values of tensile strength determined are also higher and did not fit in Table 2 EN338 so new strength class timber was established. Kempas, Balau, Keruing, Kelat, Resak, Kapur, Mengkulang, Light Red Meranti and Geronggang are devoted to strength group T36M, T33M-HD, T30M, T29.5M-HD, T27M-HD, T26M, T21M, T14.5M and T11.5M respectively. Different trend of characteristic tensile strength, $f_{t,0,k}$ versus characteristic density, ρ_k , has been found where, ρ_k more than 700 kg/m^3 , the $f_{t,0,k}$ of the species are found to be decreasing. A new equation to determine characteristic MOE, $E_{t,0,k} = 0.54E_{t,0,\text{mean}}$ and mean density $\rho_{\text{mean}} = 1.01\rho_k + 151.7$ were established. A validation study on the T-class with the properties of glulam was conducted and the result shows that based on this study, the current formula in design the bending strength of glulam from tropical hardwood was found not suitable. This is due to the properties of tensile strength for Keruing does not fit with the established T-table in EN 338.

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