UNIVERSITI TEKNOLOGI MARA

STRUCTURAL PERFORMANCE OF GLUED-IN RODS FOR PULL-OUT SPLICE (GRPS) TIMBER CONNECTIONS MADE OF MENGKULANG GLULAM

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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

Many enhancements were made to timber in order to ensure its continuous application and commercialization. Glulam is designated as structural member with crucial attention needed to its jointing system. Similar to other large structural system the weakest point of glulam elements is the connections. Incomplete and limited information on guideline for tropical glulam design for glued-in rod has contributed to a set back of the Malaysian timber as the structural member. Due to this limitation, the standard design for glued-in rod using glulam is basically referred to the estimated extrapolation for solid timber guidelines. Therefore, the main objectives of glued-in rods for pull-out splice (GRPS) are to investigate the pull-out performance of glued-in rods connections using the most common species, Mengkulang glulam (strength group 5) for timber splice joints. The method is by determining shear strength of the glued-in steel rod for Mengkulang species and the types of failure modes were observed. The experimental were the tensile load carrying capacity for glued-in rod in glulam splice joints, to investigate the physical and mechanical properties of glulam with different diameters of rod, glue-line thickness and grain direction. The pull-out was carried out with different thickness that is 2mm, 3mm and 4mm of glueline with a rate of 2mm/min. The rod diameter used are 12mm, 16mm and 20mm from S275 steel type with different embedded length and the failure modes were observed after the testing of pull-out test. Sikadur®30 is the adhesive used for the strengthening purposes. The results contribute in developing the shear strength of $GRPS_0{}^0$ (parallel) and $GRPS_{90}{}^0$ (perpendicular) to the grain equation's formula for pull-out. In conclusion, the mechanical properties shown the satisfied performance and pass the max delamination for a single glueline. The best glue thickness is 2 mm for 12 and 16 whilts 4mm for 20. The $GRPS_{0^0}$ for rod 12mm, 16mm and 20mm diameter are higher 3.03%, 17.57% and 7.84% than $GRPS_{90^0}$ grain directions. Conversely, comparing between glued-in rod strength for parallel direction produced the highest comparing for perpendicular grain direction. The maximum load for rod 20mm with $GRPS_{0^0}$ grain direction is 152.52 kN nevertheless for $GRPS_{90^0}$ is 140.57kN. Overall, it is expected that results from this research will guide the engineers and architects to design and build glulam structures from less-utilised Malaysian timber.

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