World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:16, No:08, 2022

Effect of Pressure and Glue Spread on the Bonding Properties of CLT Panels Made from Low-Grade Hardwood

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Abstract : In this modern century, Cross-laminated timber (CLT) evolved as an excellent material for building and high load-bearing structural applications worldwide. CLT is produced mainly from softwoods such as Norway spruce, White fir, Scots pine, European larch, Douglas fir, and Swiss stone pine. The use of hardwoods in CLT production is still at an early stage, and the utilization of hardwoods is expected to provide the opportunity for obtaining higher bending stiffness and shear resistance to CLT panels. In load-bearing structures like CLT, bonding is an important character that is needed to evaluate. One particular issue with using hardwood lumber in CLT panels is that it is often more challenging to achieve a strong, durable adhesive bond. Several researches in the past years have already evaluated the bonding properties of CLT panels from hardwood both from higher and lower densities. This research aims to identify the effect of pressure and glue spread and evaluate which poplar lumber characteristics affect adhesive bond quality. Three-layered CLT panels were prepared from poplar wood with one-component polyurethane (PUR) adhesive by applying pressure of 0.6 N/mm2 and 1 N/mm2 with a glue spread rate of 160 and 180 g/m2. The delamination and block shear tests were carried out as per EN 16351:2015, and the wood failure percentage was also evaluated. The results revealed that glue spread rate and applied pressure significantly influenced both the shear bond strength and wood failure percentage of the CLT. However, samples with lower pressure 0.6 N/mm2 and less glue spread rate showed delamination, and in samples with higher pressure 1 N/mm2 and higher glue spread rate, no delamination was observed. All the properties determined by this study met the minimum requirement mentioned in EN 16351:2015 standard.

Keywords : cross-laminated timber, delamination, glue spread rate, poplar, pressure, PUR, shear strength, wood failure percentage
Conference Title : ICWFC 2022 : International Conference on Wood and Timber Construction
Conference Location : London, United Kingdom
Conference Dates : August 16-17, 2022