

Mechanical and physical properties of Cross-Laminated Timber made from Acacia mangium wood as function of adhesive types

ABSTRACT

In this study, three-layered Cross-Laminated Timber (CLT) manufactured from Acacia mangium wood panels were developed by using two different types of adhesives, namely, phenol resorcinol formaldehyde (PRF) and one-component polyurethane (PUR). The aim of this work is to investigate and compare the physical and mechanical properties of CLT manufactured using PRF and PUR adhesives. Water absorption (WA), thickness swelling (TS), and delamination of both types of samples were investigated as their physical properties. PRF-bonded CLT showed better physical properties than PUR-bonded CLT. In terms of mechanical properties, bending test, shear modulus, and compression parallel to grain were studied. The results revealed that global modulus of elasticity ($E_{m,g}$) and modulus of rupture (MOR) of panels bonded with PRF adhesive were higher than three-layered panels made from PUR adhesive. Meanwhile, shear modulus (G) of PRF-bonded CLT was 116.50 N/mm², 20% higher than that of the PUR-bonded CLT which recorded a shear modulus value of 92.48 N/mm². As for compressive properties, the MOE in compression ($E_{c,0}$) and compression strength ($f_{c,0}$) of the PRF-bonded CLT (5304 N/mm² and 28.99 N/mm², respectively) was slightly higher compared to that of the PUR-bonded (4787 N/mm² and 28.14 N/mm², respectively). Three main types of bending failure modes were observed in the CLT samples, namely, rolling shear, glue-line failure, and tension. The failure modes of shear were observed by two ways, which is delamination and rolling shear. Lastly, shearing, splitting, and crushing were recorded in compression failure modes.

Keyword: Acacia mangium; Cross-laminated timber; Delamination; Bending; Compression