

## Strengthening of Cross-Laminated Timber by adding aluminium plates

Jonas Turesson<sup>†\*</sup>, Dmitry Dosmaev<sup>†</sup>, and Mats Ekevad<sup>†</sup>

<sup>†</sup>Luleå University of Technology, jonas.turesson@ltu.se

Wood is commonly judged as orthotropic with three material directions: longitudinal, radial and tangential. Shear stress and strain can occur in different directions on surfaces with different directions and shear stiffness is commonly described by three shear moduli. Of those, the weakest shear modulus is called the rolling shear modulus [1].

Cross laminated timber (CLT) is a rather recent and innovative engineered wood product with properties that can be improved and which still requires research. The benefits of using wood in buildings and construction are far from being maximized [2]. During recent years, timber has been used for constructing higher buildings. It has been seen that previous small and acceptable movements of the building are magnified, which can create discomfort for the occupants [3]. In these cases, the problem is the low in-plane shear stiffness of the CLT panel. One way to increase the in-plane shear stiffness is to build CLT mixed with other materials, with high modulus of shear, and by that increase the in-plane shear stiffness of the CLT panel. A practical test and finite element analysis (FEA) of the shear modulus was performed on 3-layer samples reinforced with aluminium plates, see Figure 1.

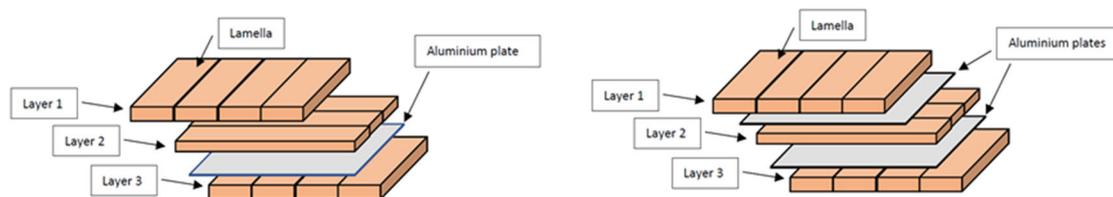


Figure 1: Constructed CLT plates reinforced with one (left)/two (right) aluminium plates.

The panels were built by three layer of wooden lamellas and the aluminium plate was added between the first and second and/or second and third layer of boards. Two different thicknesses of the aluminium plate were used, 1 mm and 1.5 mm. Also, panels without aluminium plates were used as reference. Diagonal compression test was performed on the CLT panels, see Figure 2, where the modulus of shear could be calculated. The diagonal compression method was performed based on experience from Andreolli [5].

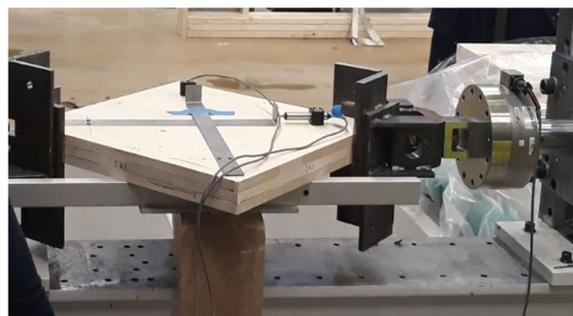


Figure 2: Practical diagonal compression test of a CLT panel

The panels containing aluminium plates had a higher shear modulus than panels without aluminium plates. This was concluded in both the practical testing and FEA.

### References

- [1] Wood handbook – Wood as an Engineering Material (Centennial edition). 2010. Madison, Wisconsin: p. 3.4, 5.3.
- [2] Saavedra Flores E.I., Dayyani I., Ajaj R.M., Castro-Triguero R., DiazDelaO F.A., Das R., González Soto P. Analysis of cross-laminated timber by computational homogenisation and experimental validation. *Composite Structures* 2014:121:386-387.
- [3] Reynolds T, Casagrande D, Tomasi R. Comparison of multi-storey cross-laminated timber and timber frame buildings by in situ modal analysis. *Construction and Building material* 2016:102:1009.
- [4] Brandner, R. (2013), “*Production and Technology of Cross Laminated Timber*”, Focus Solid Timber Solutions – European Conference on Cross Laminated Timber (CLT) (COST Action FP1002), Graz, Austria.
- [5] Andreolli M, Rigamonti MA, Tomasi R. Diagonal Compression Test on Cross Laminated Timber Panels. In: *Proceedings of the 13th World Conference on Timber Engineering (WCTE 2014)*, Quebec, 10-14 August 2014.