Rolling shear In CLT

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Thesis advisor: Prof. Dr. Christophe Sigrist
Experts: Dr. Ing. Martin Lehmann, Dr. sc. Thomas Ehrhart
Industrial partner: Pius Schuler AG, Rothenthurm

Influence of cross-layer lamella edge-bonding/adhesive-type on rolling shear properties of different Cross-Laminated-Timber lay-ups

Ali Zare
alizare9473@gmail.com

The goal of this study is to evaluate the influence of different cross-layer lamella width to thickness (w:t) ratios without edge bonding, on mechanical properties of Cross-Laminated-Timber (CLT) panels, especially rolling shear (RS) strength and stiffness. The tests were carried out according to EN 16351—Long-span 4-point bending, Short-span 4-point bending, and direct planar shear tests. Since the specimens from these tests have different volumes subject to rolling shear, and different stress distribution over the length and depth, the comparison of the obtained results is made possible using the Weibull size effect law and the corresponding fullness parameters. It is concluded, as in other studies, that the rolling shear properties reduce with reducing cross-layer w:t ratios. It is also seen that in each ratio, with the increase of the cross-layer thickness, the rolling shear properties reduce. A minor reductive effect of gaps between cross-layer lamellas on rolling shear properties is also observed in the results.

Experimental

The idea behind the conducted tests was to simulate the loss of edge bonds over time—by testing CLT specimens with different cross-layer lamella w:t ratios. Each w:t ratio represents a certain point in the life span of the CLT with different number of edge bond failures. i.e., as time passes on, and edge bonds start to fail one by one, the w:t ratio of the lamellas in the cross-layer reduces. To make sure no edge bonding happens between the cross-layer lamellas, an anti adhesion agent was applied to the edges of the mentioned lamellas before the pressing of the CLT panels. All tests were carried out according to EN 16351.

Test series

In the first test series, 40 CLT panels were produced in two lay-up configurations—3-layer and 5-layer CLT panels. Each layup included two length and two bonding variants. The panel length variants were 1.8 m and 0.8 m, to be tested in the long-span and short-span 4-point bending test, resp. The bonding variants were, suggested panels and reference panels, in which lamella edge-bonding was and was not prevented, resp.

For the second test series, 24 CLT panels were produced and cut to 120 specimens, which can be categorized into 3 groups—No edge-bond, and No gaps; No edge-bond, and gaps; Edge-bond, and No gaps—all to be tested in the direct shear test.

Results

In the first test series, on average, the long-span panels exhibited a 15% decrease of strength when edge-bonding was prevented. Regarding stiffness in 5-layer panels, the non-edge-bonded panels out-preform the reference panels—the average bending and rolling shear stiffness of the reference panels are on average, 5.6% and 10.8% lower compared to the non-edge-bonded panels. Regarding the stiffness of 3-layer panels, the reference panels out preform the non-edge-bonded panels—the average bending and rolling shear stiffness of the reference panels are on average 6.5% and 29.6% higher compared to the non-edge-bonded panels.

In the second test series, in each w:t ratio, with the increase of the cross-layer thickness, the average and 5-percentile rolling shear strength and stiffness