

# Structural Testing of UK Homegrown Mass Timber Systems

T Transforming  
↑ Timber



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# OVERVIEW







**A significant amount of test work has been carried out on UK homegrown CLT, GLT and NLT to date. These tests were carried out on beams and panels manufactured on mechanical/hydraulic presses. For this reason, it was recommended to carry out an initial type testing on homegrown CLT and GLT panels manufactured using vacuum press. This will allow for confirmation of their mechanical properties and compare them with the properties of the panels pressed using mechanical presses.**

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# TEST SAMPLES

The manufacture of the CLT, GLT and NLT panels used for structural lab testing was carried out in accordance with BS EN 16351:2021, BS EN 14080:2013 and BS EN 408:2010 respectively. All panels were from manufactured homegrown spruce boards (C16 strength class). Prior to testing, the panels were stored in a conditioning chamber at a relative humidity of 65% and at a temperature of 20 °C, for a period of 1 week. The dimensions and layouts of each specimen was determined from the geometrical constraints outlined in relevant standards.

Table 1 - Homegrown mass timber sample description

	Test sample cross-section	Test type and sample description
Cross Laminated Timber		Test type: Out-of-plane bending & bond strength Layup: 32-38-32 (3ply) Panel thickness: 102 mm Panel length: 2500 mm Panel width: 500 mm
		Test type: Out-of-plane bending & bond strength Layup: 40-20-40-20 (5ply) Panel thickness: 160 mm Panel length: 3520 mm Panel width: 500 mm
		Test type: In-plane bending & bond strength Layup: 29-30-29 (3ply) Panel thickness: 88 mm Panel length: 4116 mm Panel width: 240 mm
Glue Laminated Timber		Test type: Out-of-plane bending & bond strength Layup: 8 no. of 38mm Panel thickness: 140 mm Panel length: 2660 mm Panel width: 304 mm
		Test type: In-plane bending & bond strength Layup: 7 no. of 31mm Panel thickness: 90 mm Panel length: 4390 mm Panel width: 217 mm
Nail Laminated		Test type: Out-of-plane bending Layup: 9 no. of 32mm Panel thickness: 92 mm Panel length: 2200 mm Panel width: 288 mm

*Figure 1 - Laying up boards and adhesive application*



# TEST PROGRAMME

Homegrown mass timber test samples were tested with load applied out-of-plane (CLT, GLT and NLT) and in-plane (CLT and GLT) to replicate slab-like and beam-like behaviour of the system. Specimens for tests assessing bond strength of glue lines between layers were cut out from previously tested full-size beams and slabs.

For the purpose of this initial structural evaluation, the following tests have been conducted:

- 7 no. tests on 3ply CLT out-of-plane (slabs)
- 8 no. tests on 5ply CLT out-of-plane
- 7 no. tests on 3ply CLT in-plane (beams)
- 14 no. tests on 3ply CLT glue line shear (bond strength)
- 7 no. tests on GLT out-of-plane (slabs)
- 7 no. tests on GLT in-plane (beams)
- 12 no. tests on NLT out-of-plane (slabs)

In addition the above, the bond integrity of the glue lines between layers of the CLT and GLT panels was also tested.



Figure 2 - 3ply CLT - Test setup for bending out-of-plane

# FINDINGS

Based on the results from full scale panel testing, the strength and stiffness of all mass timber systems evaluated in this study (CLT, GLT and NLT) was higher than estimated based on the strength class of the baseline material (C16). Moreover, the samples performed well under severe stress conditions, exhibiting minimum amount glue line failures which could indicate issues with bond integrity. The bond quality was further confirmed by the results from bond strength tests where all specimens have met the minimum required shear capacity for CLT and GLT.

These findings mean that homegrown raw material and manufacturing processes adopted by ECOSystems are appropriate for producing strong and durable mass timber panels which could, with confidence, be used for construction purposes. The summary of the results derived in this study is shown in Table 2. Detailed test results, including characteristic and mean values of strength and stiffness of individual test samples are included in the full report.

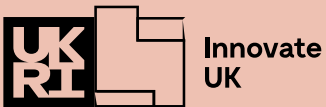
Mechanical property	UK CLT	UK GLT	UK NLT
<b>1. Mechanical actions out of plane of the panel (slab)</b>			
Modulus of elasticity (N/mm <sup>2</sup> ) – parallel to the grain of the boards, $E_{0,mean}$	10225	11084	9490
Bending strength – parallel to the grain of the boards, $f_{m,k}$	23.40	32.91	31.09
Shear modulus – perpendicular to the grain of the boards, $G_{9090,mean}$	166		
<b>2. Mechanical actions in plane of the panel (beam)</b>			
Modulus of elasticity – parallel to the grain of the boards, $E_{0,mean}$	9215	11376	
Bending strength – parallel to the grain of the boards, $f_{m,k}$	27.33	23.95	

Table 2 - Mechanical properties homegrown mass timber systems derived from TT study

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