Mass Timber Systems: Schedule

13:30 - 15:00 Presentations

- 13:30 – 13:45 Intro by Andy Leitch and Robert Hairstans
- 'Mass Timber Research and Optimisation' by Wojciech Plowas and Alexandre Morin-Bernard (ENU)
- 'CSIC Mass Timber Fabrication' by Mark Milne (CSIC)

14:40 – 15:00 Tea/coffee

15:00 - 17:00 Focus Groups

- Focus group 1: 'Is there a Market for a home grown Mass Timber product?" lead by Robert Hairstans
- Focus group 2: 'Home grown resource compatibility, durability and performance in fire" lead by Wojciech Plowas
- Focus group 3: 'Mass timber fabrication requirements and scale" lead by Mark Milne

- Final session (for everyone): 'The direction of the research and 'Mass Timber Alliance' – next steps, reference group, ongoing engagement'

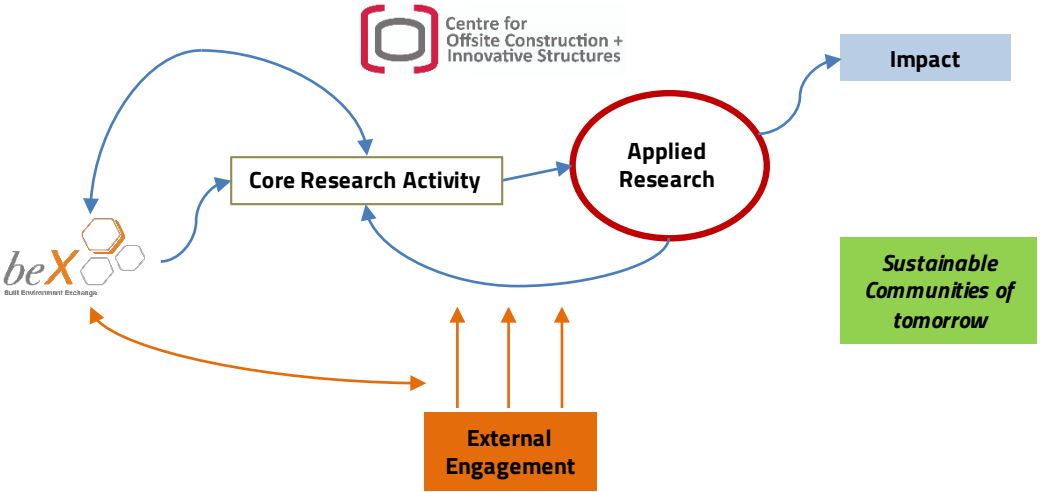
CONSTRUCTION SCOTLAND INNOVATION CENTRE

Edinburgh Napier UNIVERSITY

Scottish Forestry Coilltearachd na h-Alba

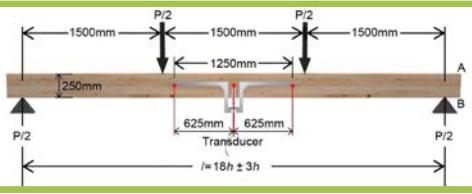
Architecture & Design Scotland
Ailtearachd is Dealbhadh na h-Alba

MODUS OPERANDI



CASE STUDY 1: GLULAM

In 2011, Edinburgh Napier University engaged with **NorBuild Timber Frame Fabrication and Fine Carpentry Ltd** in Forres to determine opportunities for diversifying the latter's Glulam portfolio by using other available species - primarily Sitka spruce and Scots pine.



The lay-up of the Glulam beams employed a combined Glulam methodology in which the outer lamination zones were of higher grade material than the inner ones in order to structurally optimise the use of the resource. In this scenario, the middle zone in bending is at the neutral axis, with the outer lamellae subject to stresses, the top chord being in compression and the bottom chord in tension.

The tests undertaken via these respective studies included:

- bending strength and stiffness of beams
- shear strength of glue lines
- tests of the tensile strength of the glue line (larch Glulam)
- compression strength of the Glulam (larch Glulam)
- bending strength of finger joints (larch Glulam)

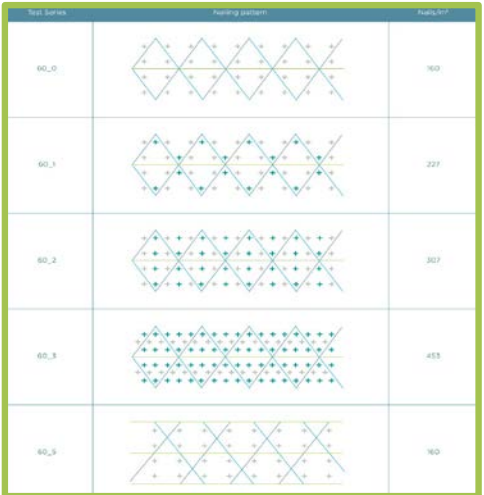
The work undertaken demonstrates **the viability of UK-grown timber for Glulam fabrication for relatively low load span conditions**, such as low-rise construction, rim beams or lintels manufactured mainly from Sitka spruce.

CASE STUDY 2: NLT & nCLT

David Blaikie Architects, working in collaboration with **Kraft Architecture**, conceived the idea of a new building typology, 'Future Affordable', a low carbon affordable housing solution, that was built at the Kingdom Housing Association Innovation Park in Fife.

The predefined layout of the house provided the opportunity to introduce a pre-assembled service pod, the e.CORE, formed from NLT.

At ground floor level, the e.CORE unit services a bathroom and contains a small service-control compartment with electrical distribution board, smart meter, the control gears for the central-heating, the whole-house mechanical ventilation with heat recovery (MVHR) system and micro-renewable devices. The upper (first floor) level of the e.CORE contains a larger bathroom.

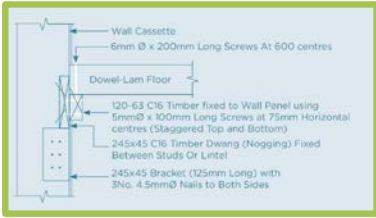


A further iteration of the nail lamination technology was explored in partnership with **Carbon Dynamic Ltd** in the form of nailed Cross Laminated Timber (nCLT)

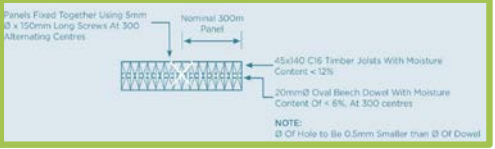
CASE STUDY 3: DLT

Edinburgh Napier University engaged with a series of industry partners **(MAKAR Construction LLP et al.)** to determine the feasibility of fabricating Dowel Laminated Timber from the Scottish timber resource. Three different species were investigated for use in forming lamellae: Sitka spruce, Scots pine and Larch. Birch, oak, beech, sycamore and ash were considered as the most suitable hardwood species for dowels.

The connection test work undertaken for beech dowels demonstrated the best overall performance criteria with respect to moisture movement with corresponding strength and stiffness of connection. A series of Dowel Laminated Timber panels were then manufactured and tested according to these criteria using birch dowels at spacings calculated to optimise the structural performance.



A consequence of this work was the inclusion of Dowel Laminated Timber in a live project as an intermediate floor.

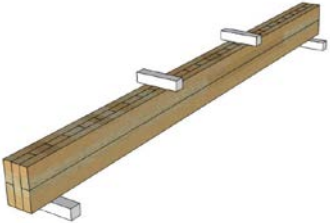


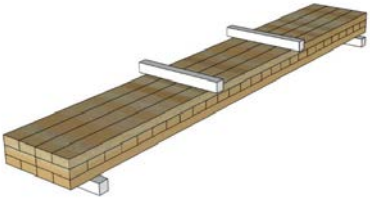
CASE STUDY 4: CLT

A collaborative network was set up to determine the feasibility of producing Cross Laminated Timber from the Scottish forest resource. The initial phase of this research carried out an evaluation of the suitability of a variety of Scottish timber species, with six selected for investigation: Lawson cypress, Douglas fir, Western hemlock, European larch, Scots pine and Sitka spruce.

The production of Cross Laminated Timber requires the material supplied to be at 12 ± 2% moisture content, a constraint on the study that necessitated the use of a bespoke kilning process. Each board was then acoustically graded.

Three-layer panel systems were then fabricated at **NorBuild Timber Frame Fabrication and Fine Carpentry Ltd**'s premises, using a modified veneer press.
The adhesive used was PURBOND HB S709.



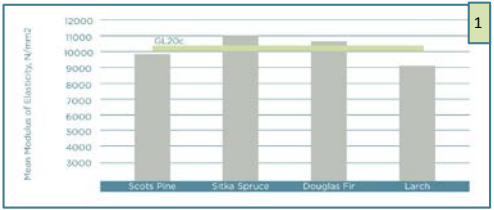


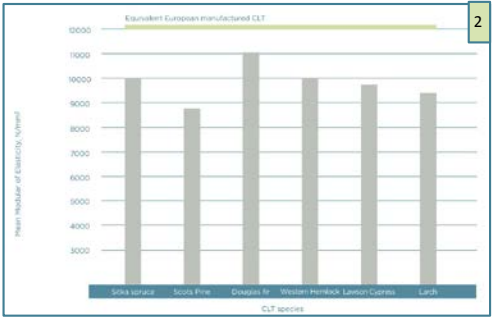
After curing, the panels were cut to their sample and tested in both edgewise (beam application) and flatwise (roof and floor applications) orientations.

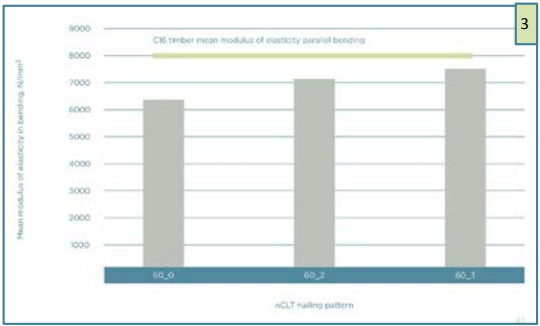
The results demonstrated the viability of producing Cross Laminated Timber from home grown.

The BRE Visitor centre and Commonwealth Games 2014 are examples of pilot projects.

The collaborative research work undertaken by all these case studies demonstrated the potential to produce a range of Solid Laminate Timber Systems from the Scottish timber resource.







1	Glulam manufactured from UK-grown timber compared to BS EN 408 GL20c
2	CLT manufactured from varying UK-grown species compared to equivalent European product (edgewise bending)
3	Nailed Cross Laminated Timber panel mean modulus of elasticity (edgewise bending) compared to C16 timber

C-3. Bending out-of-Plane, Test Series PB-P1A

PB-P1A-01 PB-P1A-02
PB-P1A-03 PB-P1A-04
PB-P1A-05 PB-P1A-06

Figures C9: Images of fracture, sample PB-P1A, specimen no. 05 to 06

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Market Opportunity: 2020 European production ≈ 1.8M m^3

CLT production in Europe 2016–2020

Current and prospective production >10,000 m^3/yr					
	Company	Location	2016	Until 2020	Comments
1	Binderholz[2]	Unterembergi/AT, Burgbernheim/DE, Gruvön, SE	145,000	270,000	Including announced second stage of expansion in Burgbernheim
2	Stora Enso[1]	Bad St Leonhard, AT, Ybbs, AT	130,000	260,000	Including 100,000m^3 for third production in Sweden
3	KLH Massivholz	Katsch an der Mur, AT 2 Standort	88,000	210,000	Including anticipated new production in Carinthia
4	Hasslacher Norica Timber[1]	Stall im Mölltal, AT Magdeburg, DE	40,000	120,000	Including second press; 80,000m^3 in Stall; 40,000m^3 in Madgeburg
5	Pfeifer Holz	Schlitz, DE	-	100,000	Installation start 1Q of 2019; full operation 2020
6	Mayr-Melnhof Holz[4]	Gaishorn, AT	60,000	80,000	-
7	Spilikon[2]	Åmot, NO	-	60,000	Relaunch
8	CLT Plant[4]	Kauhajoki, FI	-	50,000	Relaunch
8	Piveteaubois[4]	Vendée, FR	-	50,000	Relaunch
8	Schilliger Holz[1]	Küssnacht, CH	13,000	50,000	Post-fire relaunch with larger press possible
11	CLT Finland[4]	Hoisko, FI	5,000	40,000	Full operation with current machinery; 70,000^3 after expansion
12	Eugen Decker[4]	Morbach, DE	25,000	30,000	-
13	Züblin Timber[1]	Aichach, DE	30,000	30,000	-
14	Cross Timber Systems[4]	Jelgava, LV	25,000	25,000	-
15	XLam Dolomiti[1]	Castelnuovo, IT	20,000	23,000	-
16	Martinsons	Bygdsiljum, SE	-	20,000	-
16	Weinberger Holz	Reichenfels, AT	5,500	20,000	No conventional CLT, supplementary product
18	W.u.J. Derix[4]	Niederkrüchten, DE	12,500	15,000	-
		Sum	599,000	1,573,000	
Sum including smaller productions			680,000	1,780,000	

*Sum of productions, **Sum of data/estimations given by the enterprise in table plus estimates of unquoted known productions with less than 10,000m^3 of annual production. 1: Timber-Online estimation; 2: 2016 Timber-Online estimation; 3: One-shift operation; 4: 2020 Timber-Online Estimation. Source: Data given by enterprise/supplier; Timber-Online estimation © Timber-Online 2017 PI1

https://www.timber-online.net/holzprodukte/2017/10/brettsperrholz-produktionen-in-europa-20162020.html

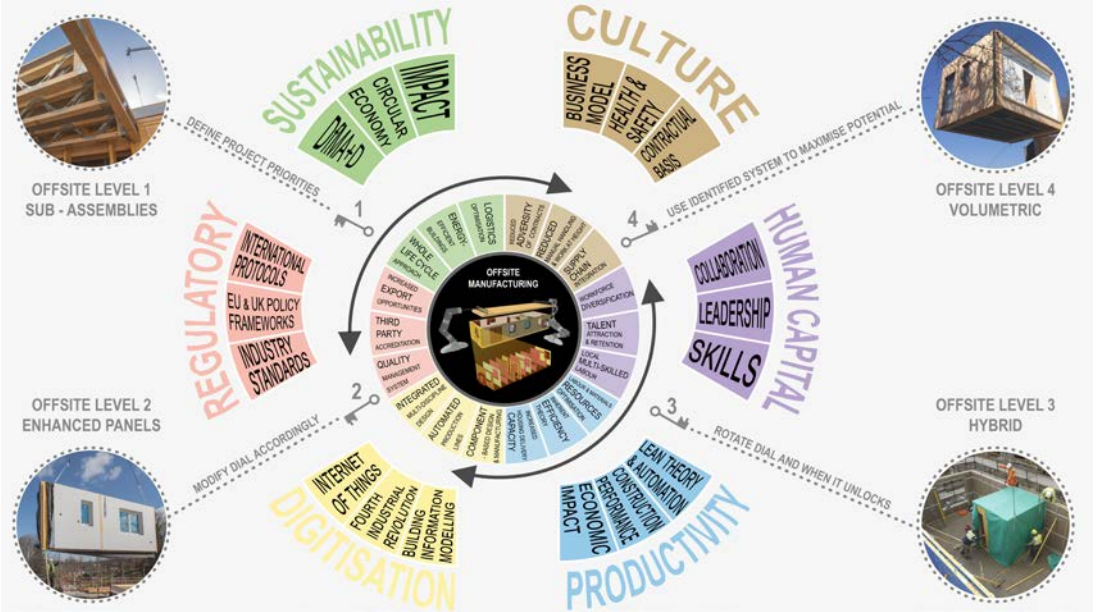
Mjostarnet, Norway

Kallesoe

USNR

Lignoloc Nail

DRIVERS



Hairstans, R. and Duncheva, T. A. (2019) 'Core Off-Site Manufacture Industry Drivers', Offsite Production and Manufacturing for Innovative, Construction: People, Process and Technology. 1st edn. London: Taylor & Francis. https://www.routledge.com/Offsite-Production-and-Manufacturing-for-Innovative-Construction-People/Goulding-Rahimian/p/book/9781138550711