

1 INTRODUCTION

Mass-timber is the collective term for large solid timber construction materials, including cross-laminated timber (CLT or X-lam), nail laminated timber (NLT), and glued laminated timber (glulam).

CLT like other mass-timber products incorporates modern offsite manufacturing and onsite assembly technology to create time and energy efficient materials that are robust enough to compete with concrete or steel for mid- to high-rise development.

Mass timber construction is increasingly seen as a solution

to improving the environmental impact of the built environment while still meeting the demands of modern design. A mass timber building is a quarter the weight of concrete, and can be built in up to half the time. Wood sequesters carbon, and the CO₂ emissions due to the manufacture and transport of engineered timber, is less than that emitted by concrete and steel production and construction.

2 PRODUCTION, ASSEMBLY, AND APPLICATION

CLT is an engineered wood material that improves the performance of natural timber by cross laminating timber boards into large solid panels.

Fabrication of CLT includes sorting and cutting kiln-dried

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Figure 1: C4D Building, Cranfield University, Milton Keynes, by Niall McLaughlin Architects. CLT by KLH.

CROSS-LAMINATED TIMBER



Figure 2 Brock Commons student residence, Vancouver. Image courtesy of naturally: wood.com. Photographer: KK Law.

CLT is an engineered wood building system comprising layers of boards glued together under pressure with the grain of the boards in one layer running perpendicular to the grain in adjoining layers. It has high strength and dimensional stability and can be used with or as alternative to concrete, masonry and steel in many building types including multi-storey buildings such as the 18-storey Brock Common student residence in Vancouver, Canada. The 17 timber storeys were erected over the concrete ground floor in 9 weeks using a single crane.



Figure 4: West Buckland School by Rundell Associates, completed in 2010. CLT by KLH.



Figure 3: 52 Whitmore Road, Hackney. A 6 storey mixed use development by Waugh Thistleton Architects, completed in 2011. CLT by KLH.

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timber, generally softwood boards. The boards are finger jointed and aligned in laminae, which are stacked in alternate layers at right angles and glued under high pressure. CLT panels are generally between 60 – 300 mm thick, up to 2.95 m wide and 16 m long, consisting typically of three, five or seven layers.

They have bi-axial structural performance and high in-plane stiffness. In the way that glulam is now commonly considered for selection in beam design, CLT is a viable choice for structural floor, roof, and wall elements, including stairwells and lift shafts.

All of the structural elements of a building, from the foundation up, can be made with CLT.

Unlike traditional low-rise timber frame construction, multi-storey development using CLT is usually either platform construction, where each successive storey is built from the floor below for mid-rise development, or CLT flat slab and glulam frame for high rise.

The panels are manufactured offsite and transported in sequence for assembly, with a mobile crane. Panels are connected manually with proprietary connection systems. The building is weatherproofed and insulated in the same way as framed concrete and steel construction.

CLT can also be incorporated into traditional concrete, steel, and masonry construction.

Offsite manufacturing and quick assembly, along with no drying out time, can significantly shorten the construction programme. Sequenced delivery and assembly reduces disturbance to the public.

Computer-aided design/manufacturing (CAD/CAM) and computer numerical controlled (CNC) cutting enable precise dimensions improving the overall air tightness of the building.

Panels may be edge-glued to provide better weather protection, particularly during construction. Cross-laminated timber lends itself well to modifications on site.

The use of mass-timber is growing worldwide, especially in central Europe, Scandinavia, and Canada where there is a long tradition of building with wood. Its popularity is increasing also in earthquake-prone regions such as the West coast of the US, Italy, and New-Zealand, due to the reduced seismic loads associated with this light-weight building system.



Figure 5: Kingsdale School, London by dRMM. CLT by KLH, with a 9 week build period.



Figure 7: CLT, image courtesy of Eurban.

3 MAIN MARKETS AND END USERS

Cross-laminated timber was first patented in France in 1985, with projects in Switzerland and Germany in 1993. It was introduced to the UK in 2000, to form a roof in a masonry building.

Since then its use in the UK has grown exponentially with over 500 completed CLT projects across the UK.

The projects comprise all building uses including educational, residential, commercial, civic and public, and the health sector.

A landmark building was Waugh Thistleton's 9-storey apartment building in Hackney, London in 2009. It was constructed entirely of CLT from the first floor.

In 2012 the London borough of Hackney introduced a 'Timber first' policy, and in November 2014 there were 18 timber buildings in the 7 square miles of Hackney borough. CLT construction is very well suited to projects with a limited time frame. It lends itself especially to high density sites, where onsite storage is limited and traffic disruption is a major concern.



Figure 8: By Micah T. Jones, Architect. CLT by G-frame Structures.



Figure 6: Trafalgar Place, London. 30 new residential units, completed in 2015 by dRMM and Eurban.

Additionally, it is a suitable option, due to its reduced weight, in poor bearing ground, or where underground tunnels and services need to be avoided. Mass-timber buildings are also increasing in height including multi-storey buildings such as the 18-storey Brock Common student residence in Vancouver, Canada.

Permission has been granted to build a 34 storey timber building in Stockholm, Sweden, and a 30 storey mass-timber building is proposed by Michael Green Architects in Vancouver, Canada.

4 MANUFACTURERS AND SUPPLIERS

The leading specialists in CLT in Ireland and the UK are:

- KLH UK, Consultants, architectural and structural design, supply and erection.
- Stora Enso, CLT manufacturer and supplier.
- G-frame Structures, specialise in design, supply and installation of engineered timber and hybrid structures.
- B & K Structures, specialise in hybrid construction incorporating mass-timber, including CLT, with steel, concrete, and masonry.
- EURBAN UK, Consultants, structural design, supply and installation.
- Cedarlan Ltd, in Cork are importers of glulam and CLT, into Ireland.

The Irish Timber Information Centre (ITIC) was established in 2015 by the Wood Marketing Federation (WMF) in collaboration with the National University of Ireland Galway (NUIG).

The main objective of the centre is to provide information on a wide range of timber issues relevant to stakeholders working in wood including architects, engineers, designers, builders, timber preservation specialists, third level colleges, wood workers and other specifiers. ITIC also prepares literature on timber design, construction, usage and preservation.

ITIC is supported by the WMF, COFORD, NUIG and stakeholders in the forestry and forest products sector.

The ITIC project is compatible with the WMF mission to *promote wood as a renewable, sustainable and versatile natural material.*

5 OPPORTUNITIES FOR IRELAND

CLT is still relatively new to Ireland; however, its popularity in the UK, where construction methods and weather conditions are similar, suggest it is equally suited here. In addition to domestic one-off private developments, there are two buildings recently completed for Dun Laoghaire Rathdown County Council that use CLT. They include a crèche, public gym, and offices. Both buildings in Ballyogan, are by BucholzMcEvoy Architects.

CLT research in Ireland
As part of the project Innovation in Irish Timber Usage, funded by the Department of Agriculture, Food and Marine, researchers at the National University of Ireland, Galway have



Figure 9: Ballyogan Environmental Management Centre 2012 by BucholzMcEvoy Architects. CLT by KLH

demonstrated the viability of using Irish Sitka spruce for the manufacture of CLT. Additionally, the vibration and serviceability performance of CLT floors is being investigated as part of an NUI Galway-funded project.



Figure 10: Samuel Beckett Civic Campus 2016 by BucholzMcEvoy Architects. CLT by Cedarlan Ltd.

USEFUL LINKS

COFORD - www.coford.ie

Woodspec - www.woodspect.ie

NSAI - www.nsa.ie

Wood Marketing Federation - www.wood.ie

Wood Technology Ireland - www.woodtechnologyireland.ie

ITIC - email: info@iticwood.ie

Acknowledgments

This document is produced by the Wood Marketing Federation – www.wood.ie
Published October 2016

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