

Cross Laminated Timber

Key Information

General Process Description 1 m³ of cross laminated timber based on the UK consumption mix

Reference Flow/Declared Unit 1 m³ of cross laminated timber, 12% wood moisture content (dry basis), average product density of 488 kg/m³

Reference Year 2013

Methodological Approach

This generic dataset has been developed with reference to CEN/TR 15941:2010 *Environmental product declarations — Methodology for selection and use of generic data* and has made use of data from existing databases and EPD, compensated with data from UK industry and national statistics for the specific situation related to UK consumption of timber products. With regard to methodology, the datasets are in line with the core Product Category Rules given in EN 15804+A1: 2013 *Environmental product declarations — Core rules for the product category of construction products*, and further detailed in FprEN 16485:2013 *Round and sawn timber — Environmental Product Declarations — Product category rules for wood and wood-based products for use in construction* and the draft EN 16449, *Wood and wood-based products — Calculation of sequestration of atmospheric carbon dioxide*.

The generic dataset is intended for use as upstream data for UK consumed timber products within EPDs and building level LCA assessments to EN 15978:2011 *Assessment of environmental performance of buildings — Calculation method*.

Modelling & Assumptions

Cross laminated timber (CLT) is an engineered wood product consisting of a number of layers of wood glued at right angles to one another. The first stages of CLT manufacture are the same as those for the production of kiln-dried sawn softwood timber, namely, logging, sawing and kiln drying. Kiln dried timber arriving at the manufacturing site is classified according to its strength properties, with laminates of similar strength grouped together. The ends of the individual pieces of timber are finger-jointed allowing them to be glued together forming long continuous laminates. Once the finger joints have been set and dried, the laminates are planed and glued together so that the grain in each layer is set at right angles to the grain in the previous layer. CLT is usually formed of three to seven layers, with the grain in the outer layers oriented along the length of the product. After gluing, the CLT product is pressed to allow the adhesive to cure before a finishing stage

where the CLT is planed or sanded and cut to lengths.

The modelled product is a five layer product manufactured from kiln-dried softwood. The finished product has a moisture content of 12%. The overall adhesive content of the product is 2.0%.

CLT in the UK is imported from a number of European countries. An analysis of the UK CLT market by Edinburgh Napier University was used to model the typical countries of origin for CLT in the UK [COCIS 2013]. This analysis indicates that the majority of the UK's CLT comes from Austria, with smaller quantities from Germany, Italy, Switzerland, Czech Republic and Spain. Estimates for the proportion of CLT imported from each nation are shown in the table below.

Origin	Estimated Percentage of Consumption Mix
<i>Austria</i>	74%
<i>Germany</i>	9%
<i>Italy</i>	9%
<i>Switzerland</i>	4%
<i>Czech Republic</i>	2%
<i>Spain</i>	2%

Kiln-dried sawn softwood used in the CLT product is modelled using the same assumptions about forestry practices, sawmilling and kiln drying as the "Kiln dried sawn softwood" dataset also produced as part of this project [Wood First 2014], with energy grids adapted to reflect the country of production.

CLT manufacturing is based on information compiled by PE International and its industrial partners for the manufacture of engineered wood products, including CLT in Germany [PE International 2012]. EPD results from other studies have not been used directly as part of this dataset due to inconsistencies in the reporting of sequestered carbon (physical vs economic allocation basis), water consumption and primary energy demand. The inclusion of such data would result in CLT being modelled with different modelling approaches and assumptions to other products

Several adhesives can be used in CLT manufacture, so an average adhesive mix of 1.4% melamine urea formaldehyde (MUF), 0.5% polyurethane (PUR) and 0.1% emulsion polymer isocyanate (EPI) has been assumed as specified in in the Studiengemeinschaft Holzleimbau EPD for German CLT producers [BS Holz 2012]. The energy mix has been adapted to reflect the specific electricity and fuel mix in each production country. The manufacturing steps included are: Finger jointing, planing and gluing, pressing and finishing

(planing and trimming).

Transport to UK customers was calculated based on:

- Truck transport from a major producer of CLT in the country to a large national port
- Sea transport from the designated port to Hull, Felixstowe, Southampton or Liverpool (dependent on country of origin)
- Transport of 130 km from port to customer [DfT 2005]

This yielded values for plywood transport of 300 km by sea and 1216 km by road.

Product use and maintenance have not been included due to the wide range of potential uses and consequently the high level of uncertainty surrounding this stage of the lifecycle.

End-of-life data are provided for three scenarios: 100% of wood waste to recycling, 100% of wood waste to incineration with energy recovery and 100% of wood waste to landfill. Wood transport distances to landfill and recycling of 25km and 21km were taken from survey data related to construction end of life practices in the UK compiled by BRE [BRE 2013]. Transport to wood energy recovery plants was estimated to be 46km based on average transport to one of an estimated 25 suitable biomass or waste-to-energy plants.

The composition of the waste (water content, adhesive content) is taken into account in the end-of-life modelling to reflect the characteristics of the waste in each scenario, with adhesives modelled as inert in landfill.

Landfill gas production is modelled based on the MELMod model for landfill emissions in the UK. The values used in this project take into account improvements to the assumptions regarding organic carbon degradation suggested by Eunomia as a result of their review of MELMod for DEFRA [Eunomia 2011]. Using typical values for cellulose, hemicellulose and lignin, an organic carbon conversion of 38.5% has been calculated. The landfill gas is assumed to have a 50:50 methane to carbon dioxide ratio by volume. The landfill is assumed to be a modern "Type 3" landfill (large modern landfill with comprehensive gas collection) with a landfill gas extraction efficiency of 50%.

Wood waste sent for recycling is assumed to be used as woodchips and is assigned credits related to the avoided production of woodchips from virgin softwood. The adhesive component is assumed to be lost during recycling.

Environmental Parameters Derived from the LCA

Production & Distribution (Cradle-to-Site)

Parameters describing environmental impacts	Units	Production (A1-A3)	Distribution and Installation (A4-A5)
Global Warming Potential	kg CO2 eq.	-494	43.2
Ozone Depletion Potential	kg CFC11 eq.	2.32E-08	1.82E-10
Acidification Potential	kg SO2 eq.	1.06	0.247
Eutrophication Potential	kg PO4 eq.	0.175	0.0484
Photochemical Ozone Creation Potential	kg Ethene eq.	0.0928	-0.0621
Abiotic Depletion Potential (Elements)	kg Sb eq.	0.000141	0.00000146
Abiotic Depletion Potential (Fossil)	MJ	3990	590

Parameters describing primary energy	Units	Production (A1-A3)	Distribution and Installation (A4-A5)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	2400	19.6
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	8230	0
Total use of renewable primary energy resources	MJ, net calorific value	10600	19.6
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	4570	592
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	4570	592
Use of secondary material	kg	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0
Net use of fresh water	m ³	2.31	0.0142

Other environmental information describing waste categories	Units	Production (A1-A3)	Distribution and Installation (A4-A5)
Hazardous waste disposed	kg	0.704	0.00123
Non-hazardous waste disposed	kg	6.67	0.0628
Radioactive waste disposed	kg	0.232	0.000745

Other environmental information describing output flows	Units	Production (A1-A3)	Distribution and Installation (A4-A5)
Components for re-use	kg	0	0
Materials for recycling	kg	0	0
Materials for energy recovery	kg	0	0
Exported energy	MJ per energy carrier	0	0

Environmental Parameters Derived from the LCA

End-of-Life

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Global Warming Potential	kg CO2 eq.	817	-8.39	843	-591	932	-78.9
Ozone Depletion Potential	kg CFC11 eq.	2.44E-10	-2.30E-10	3.16E-10	-2.50E-08	3.55E-10	-4.7E-09
Acidification Potential	kg SO2 eq.	0.0449	-0.0419	0.799	-1.52	1.51	-0.271
Eutrophication Potential	kg PO4 eq.	0.00731	-0.00775	0.157	-0.136	0.105	-0.0227
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00191	-0.00204	0.0801	-0.0946	0.228	-0.0154
Abiotic Depletion Potential (Elements)	kg Sb eq.	4.23E-07	-1.60E-07	2.00E-06	-1.40E-05	6.59E-06	-2.30E-06
Abiotic Depletion Potential (Fossil)	MJ	263	-109	295	-8250	689	-1010

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	4.52	-3.51	8240	-388	22.5	-73.0
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	-8230	0	-8230	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	-8230	-3.51	5.14	-388	22.5	-73.0
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	276	-121	309	-9690	707	-1280
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	276	-121	309	-9690	707	-1280
Use of secondary material	kg	0	488*	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Net use of fresh water	m ³	0.0168	-0.0140	0.582	-1.61	-0.452	-0.302

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Hazardous waste disposed	kg	0.00584	-0.00529	0.00659	-0.614	0.0158	-0.116
Non-hazardous waste disposed	kg	9.83	-0.100	2.32	-2.33	206	-0.369
Radioactive waste disposed	kg	0.00556	-0.00509	0.00600	-0.591	0.00748	-0.111

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Components for re-use	kg	0	0	0	0	0	0
Materials for recycling	kg	488	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0
Exported energy from Electricity	MJ	0	0	2700	0	509	0
Exported energy from Thermal Energy	MJ	0	0	2780	0	0	0

*Represents use of secondary material in next product system

References

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BS Holz 2012	Studiengemeinschaft Holzleimbau, 2012. <i>Environmental Product Declaration - Cross laminated timber (X-Lam)</i> . Declaration number EPD-SHL-2012211-E. IBU, Königswinter, Germany.
COCIS 2013	Crawford, D., 2013. <i>Feasibility of Cross-Laminated Timber Production from UK Sitka spruce</i> . Presentation for Timber Expo 2013 by David Crawford - Centre for Offsite Construction + Innovative Structures (COCIS), Edinburgh Napier University, Edinburgh, UK.
DfT 2005	Department for Transport, 2005. Continuous Survey of Road Goods Transport. Department for Transport, London, UK.
Eunomia 2011	Eunomia Research & Consulting 2011. <i>Inventory Improvement Project – UK Landfill Methane Emissions Model: Final Report to DEFRA</i> . Eunomia Research and Consulting Ltd., Bristol, UK.
PE International 2012	PE International, 2012. <i>GaBi 6 Software and Database for Life Cycle Engineering</i> . Data on the manufacture of cross laminated timber in Germany. LBP, University of Stuttgart and PE International, Stuttgart, Germany
Wood First 2014	PE International and Wood For Good. <i>Kiln dried sawn softwood</i> . Timber Trade Federation, London, UK