Environmental Product Declaration

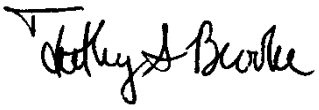
STRUCTURLAM
MASS TIMBER CORPORATION
Intelligence In Wood

CROSSLAM CLT

EPD for Cross Laminated Timber produced by Structurlam in Okanagan Falls, BC

ASTM Certified Environmental Product Declaration

Program Operator	**ASTM International** 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org		
General Program Instructions and Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) - General Program Instructions, version: 6.0		
Declaration Owner	**Structurlam Mass Timber Corporation** 2176 Government Street Penticton, BC, Canada V2A 8B5 www.structurlam.com		
Declaration Number	EPD124		
Declared Product	Cross Laminated Timber (CLT); Brand name:		
Declared Unit	1 m^3 of CLT produced at Structurlam's facility in Okanagen Falls		
Reference PCR and Version Number	**ISO 21930:2017** Sustainability in Building Construction — Environmental Declaration of Building Products. [12] **UL Environment**: Product Category Rules for Building-Related Products and Services **Part A:** Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2 [17] **Part B:** Structural and Architectural Wood Products EPD Requirements, v1.0 [18]		
Description of Product's intended application and use	Crosslam CLT is an engineered wood product with high structural strength and stability. It can be used as building material for any floor, wall, roof, or core construction.		
Markets of Applicability	Construction Sector, Mass timber design		
Date of Issue	January 13, 2020		
Period of Validity	January 12, 2025		
EPD Type	Product-specific EPD		
EPD Scope	Cradle to Gate		
Year of reported manufacturer primary data	2018		
LCA Software	SimaPro v8.5 [15]		
LCI Databases	USLCI [14], Ecoinvent 3.5 [19], Datasmart [13], Athena [4]		
LCIA Methodology	TRACI 2.1 [6]		
The sub-category PCR review was conducted by:	Dr. Thomas Gloria (chair) Industrial Ecology Consultants	Dr. Indro Ganguly University of Washington	Dr. Sahoo University of Georgia

LCA and EPD Developer This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	**Athena Sustainable Materials Institute** 119 Ross Ave. #100 Ottawa, ON K1Y 0N6 613-729-9996 www.athenasmi.org  James Salazar
This declaration was independently verified in accordance with **ISO 14025:2006**. The **UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2** (December 2018), in conformance with **ISO 21930:2017** and **EN 15804 + A1:2013 [8]**, serves as the core PCR, with additional considerations from the **USGBC/UL Environment Part A Enhancement (2017)**. ☐ INTERNAL x EXTERNAL	
Independent Verifier This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Timothy S. Brooke ASTM International 
Limitations · Environmental declarations from different programs (ISO 14025) may not be comparable. · Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building. · This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.	

COMPANY AND PRODUCT DESCRIPTION

Structurlam Mass Timber Corporation

Structurlam Mass Timber Corporation is a manufacturer of engineered wood products. The company's main products are cross laminated timber (CLT) and glued laminated timber (glulam).
Structurlam provides in addition services related to mass timber design, engineering, 3D modeling, and production machining, to integrate building designed and the prefabrication of building modules from CLT and glulam. The company is located in Penticton, British Columbia. Their production facility is close by in Okanagan Falls, British Columbia.

Crosslam CLT

CLT is an engineered wood product consisting of several alternating layers of kiln-dry dimensional lumber glued together. Panels typically consist of three, five, seven or nine layers. CLT has a high strength to weight ratio and shows advantages for structural, fire, thermal and acoustic performance. [7]
Structurlam merchandises CLT under the brand name 'Crosslam CLT'. Crosslam CLT has high structural strength and stability. It can be used as building material for any floor, wall, roof, or core construction.

The main product components of Crosslam CLT are dimensional softwood lumber (99.5%) and various resins (0.5%). The softwood lumber used for Crosslam CLT production is derived from sustainable managed forests in Canada (See below 'Treatment of biogenic carbon and sustainable forest management certification'). If required, FSC and SFI Chain of Custody Certification are available from Structurlam.

CLT is part of the Supplement to the National Building Code of Canada (NBC). CLT was approved for the 2016 Supplement to the CSA-O86 [16]. The adopted package includes: 1) CLT as a structural member; 2) CLT connections; and 3) CLT as a lateral load resisting system. For code acceptance, all CLT products must be manufactured to the standards of ANSI/APA PRG 320-2012 [2].

CrossLam CLT is certified to meet the requirements of the Standard for Performance Rated CLT ANSI/APA PRG 320 [2] and the APA Product Report PR-L314 [3]. These standards outline the requirements and test methods for qualification and quality assurance for CLT and are the same across North America.

METHODOLOGICAL FRAMEWORK

Type of EPD and Life Cycle Stages

The underlying LCA [5] investigates the CLT product system from cradle to gate. This comprises the production stage including the information modules 'A1 Extraction and upstream production', 'A2 Transport to factory' and 'A3 Manufacturing' (Figure 1).

Building Life Cycle Information Modules															
Production stage			**Construction Stage**		**Use stage**							**End-of-life stage**			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport to waste processing or disposal	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Figure 1 Life Cycle Stages and Information Modules per ISO 21930:2017. (MND: module not declared)

System Boundaries and Product Flow Diagram

The product system described in Figure 2 includes the following information modules and unit processes:

A1 Extraction and upstream production	A1 includes the cradle-to-gate production of softwood lumber and resins that are used in CLT manufacture. The upstream resource extraction includes removal of raw materials and processing, processing of secondary material input (e.g., recycling processes) after crossing the system boundary of the previous product system. A1 also includes reforestation processes that include nursery operations (which include fertilizer, irrigation, energy for greenhouses if applicable etc.), site preparation, as well as planting, fertilization, thinning and other management operations.
A2 Transport to facility	Average or specific transportation of raw materials (including secondary materials and fuels) from extraction site or source to manufacturing site (including any recovered materials from source to be recycled in the process).
A3 Manufacturing	Manufacturing of the CLT product, including packaging (lumber wrap).

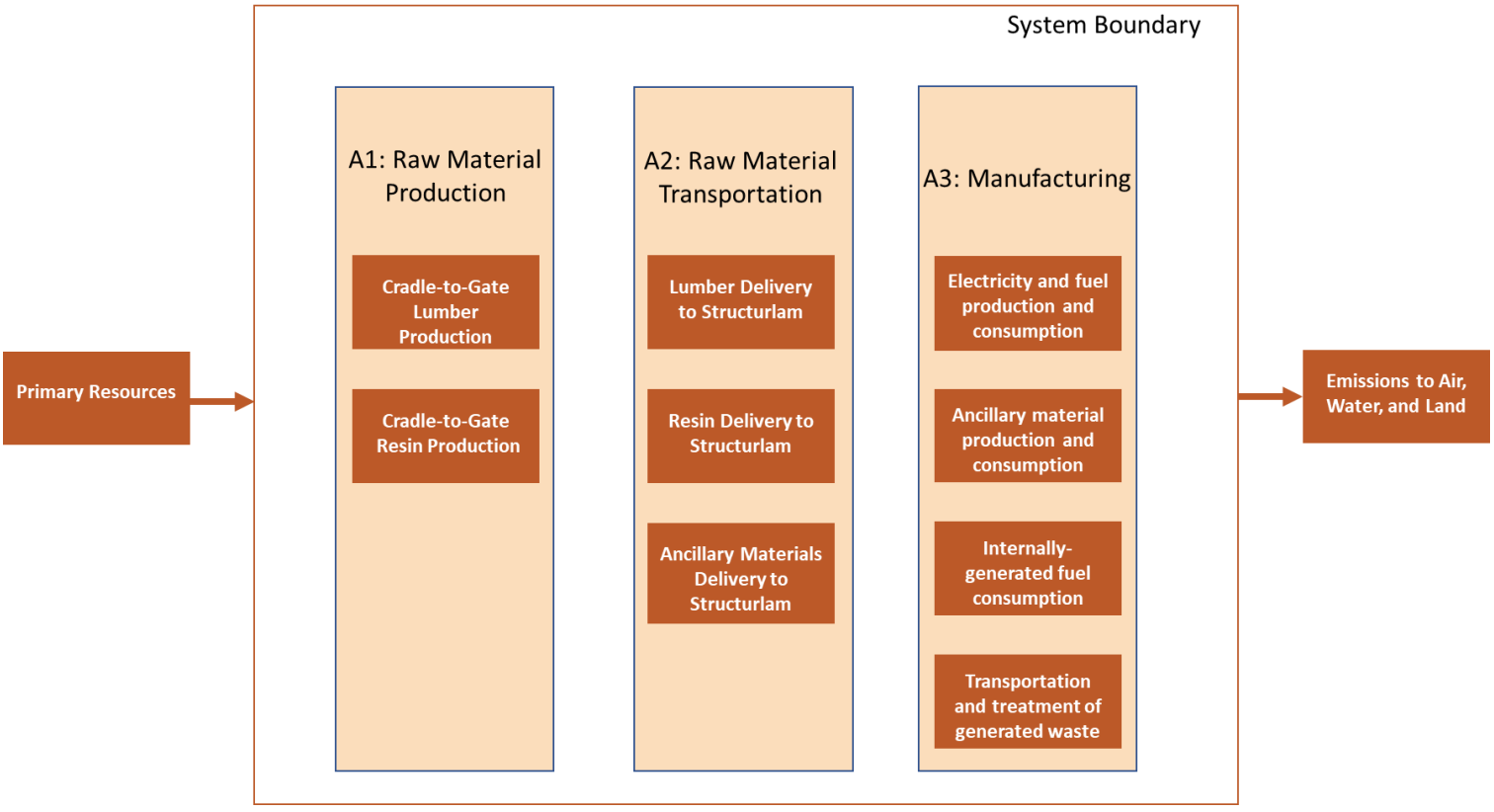


Figure 2: Cradle-to-Gate CLT Product System

Declared Unit

Table 1 shows the declared unit and additional product information.

Table 1: Declared Unit and Product Information

Declared Unit		
The declared unit is "the production of one cubic meter (1 m3) of CLT produced at Structurlam's facility in Okanagan Falls ".		
Property	**Unit**	**Value**
Mass	kg	± 481 (SPF)
Thickness to achieve declared unit	mm	87 - 315
Density	kg/m^3	± 481 (SPF)
Moisture Content	%	12% (± 3%)
Product Composition		
Softwood Lumber	%	99.5
Resins	%	0.5

Allocation Methods

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. The Structurlam Facility at Okanagan Falls produces CLT and glulam (main products) as well as industrial CLT mats (co-products). In accordance with UL Part B PCR 2019 [18], the environmental load among these products is allocated according to its mass. Furthermore, the manufacturing process does produce wood waste that is transferred for free to downstream users. No environmental burden has been allocated to these wastes. A detailed explanation of the allocation methodology of upstream lumber production is provided in the lumber LCA project report.

Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded from the system boundary.

Data Sources

Primary and secondary data sources, as well as the respective data quality assessment are documented in the underlying LCA project report in accordance with UL PCR 2019.

This EPD estimates the impacts of forest management by the weighted industry average EPD of Canadian softwood lumber.

Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impact to any of the required impact categories identified by the applicable PCR.

Treatment of Biogenic Carbon and Sustainable Forest Management Certification

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. Detailed information is provided in the underlying LCA in Section 2.5.

ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO2e/kg CO2. ISO 21930 Section 7.2.11 Note 2 states the following regarding demonstrating forest sustainability: “Other evidences such as national reporting under the United Nations Framework Convention on Climate Change (UNFCCC) can be used to identify forests with stable or increasing forest carbon stocks.” Canada’s UNFCCC annual report Table 6-1 provides annual net GHG Flux Estimates for different land use categories. This reporting indicates non-decreasing forest carbon stocks and thus the source forests meet the conditions for characterization of removals with a factor of -1 kg CO2e/kg CO2.

Table 3 provides additional inventory parameters related to biogenic carbon removal and emissions.

ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

Table 2 presents the LCIA and LCI parameter results for the declared unit of 1 m^3 of CLT.
The impact categories and characterization factors (CF) for the LCIA were derived from the U.S. EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts -TRACI 2.1 [6].

The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method published by ecoinvent [19]. Lower heating value of primary energy carriers is used to calculate the primary energy values reported in the study.

Other inventory parameters concerning material use, waste, water use and biogenic carbon were drawn from the LCI results. We followed the ACLCA's Guidance to Calculating non-LCIA Inventory Metrics in accordance with ISO 21930:2017 [1].

SimaPro v8.5 [15] was used to organize and accumulate the LCI data, and to calculate the LCIA results.

Table 2: LCIA Results Summary for Cradle-to-Gate production of 1 m3 of CLT

Core Mandatory Impact Indicator			Total	A1	A2	A3
Global warming potential – TRACI 2.1	GWP_{TRACI}	kg CO_2e	124.02	61.61	40.80	21.61
Global warming potential – w/ biogenic CO_2	GWP_{BIO}	kg CO_2e	124.02	(1,211.74)	40.80	1,294.96
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	2.63E-06	1.59E-06	1.72E-09	1.04E-06
Acidification potential of soil and water sources	AP	kg SO_2e	1.33	0.59	0.54	0.20
Eutrophication potential	EP	kg Ne	0.20	0.11	0.03	0.06
Formation potential of tropospheric ozone	SFP	kg O_3e	29.66	11.69	13.81	4.15
Abiotic depletion potential (ADPfossil) for fossil resources;	ADPf	MJ, NCV	1,873.86	974.87	584.75	314.24
Fossil fuel depletion	FFD	MJ Surplus	262.39	135.00	86.42	40.98
Use of Primary Resources						
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	2,794.70	1,618.77	-	1,175.92
Renewable primary energy carrier used as material	RPRM	MJ, NCV	9,973.08	9,973.08	-	-
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	2,169.54	1,199.08	619.85	350.62
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	-	-	-	-
Secondary Material, Secondary Fuel and Recovered Energy						
Secondary material	SM	kg	-	-	-	-
Renewable secondary fuel	RSF	MJ, NCV	-	-	-	-
Non-renewable secondary fuel	NRSF	MJ, NCV	-	-	-	-
Recovered energy	RE	MJ, NCV	-	-	-	-
Mandatory Inventory Parameters						
Consumption of freshwater resources	FW	m^3	0.62	0.55	-	0.13
Indicators Describing Waste						
Hazardous waste disposed	HWD	kg	-	-	-	-
Non-hazardous waste disposed	NHWD	kg	6.21	-	-	6.21
High-level radioactive waste, conditioned, to final repository	HLRW	m^3	3.89E-07	3.83E-07	0.00E+00	6.08E-09
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m^3	3.88E-07	3.23E-07	0.00E+00	6.42E-08
Components for re-use	CRU	kg	-	-	-	-
Materials for recycling	MR	kg	-	-	-	-
Materials for energy recovery	MER	kg	-	-	-	-
Recovered energy exported from the product system	EE	MJ, NCV	-	-	-	-

To ensure transparency Table 3 shows additional inventory parameters related to biogenic carbon removal and emissions. The carbon dioxide flows are presented unallocated to consider co-products leaving the product system in information module A3. Even though, the system boundary of this study included only the information modules A1-A3, in accordance with ISO 21930, BCEK was reported in A5 and BCEP of the main product in C3/C4.

The net carbon emission across the entire life cycle is zero. It is assumed that all carbon removed from the atmosphere is eventually emitted to the atmosphere as CO2. Total GWP_{BIO} includes biogenic carbon emissions and removals from the information modules A1-A3, A5 and C3/C4, leading to a net zero contribution of biogenic carbon to GWP_{BIO}. Therefore, in Table 2, results for total GWP_{TRACI} and total GWP_{BIO} are equal.

Table 3: Biogenic carbon inventory parameters for CLT

Additional Inventory Parameters			Total	A1	A2	A3	A5	C3/C4
Biogenic Carbon Removal from Product	BCRP	kg CO_2	(969.71)	(969.71)	-	-	-	-
Biogenic Carbon Emission from Product	BCEP	kg CO_2	874.83	-	-	-	-	874.83
Biogenic Carbon Removal from Packaging	BCRK	kg CO_2	-	-	-	-	-	-
Biogenic Carbon Emission from Packaging	BCEK	kg CO_2	-	-	-	-	-	-
Biogenic Carbon Emission from Combustion of Waste from Ren. Sources Used in Production	BCEW	kg CO_2	94.88	-	-	94.88	-	-
Net biogenic carbon emission		kg CO_2	0.00					

INTERPRETATION AND LIMITATIONS

Comparability

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building.

Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.
Full conformance with the PCR for 'Structural and Architectural Wood Products' allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible.

Forest Management

While this EPD does not address landscape level forest management impacts, potential impacts may be addressed through requirements put forth in regional regulatory frameworks, ASTM 7612-15 guidance, and ISO 21930 Section 7.2.11 including notes therein. These documents, combined with this EPD, may provide a more complete picture of environmental and social performance of wood products.

While this EPD does not address all forest management activities that influence forest carbon, wildlife habitat, endangered species, and soil and water quality, these potential impacts may be addressed through other mechanisms such as regulatory frameworks and/or forest certification systems which, combined with this EPD, will give a more complete picture of environmental and social performance of wood products.

Scope of the EPD

EPDs can complement but cannot replace tools and certifications that are designed to address environmental impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, etc.

Data

National or regional life cycle averaged data for raw material extraction does not distinguish between extraction practices at specific sites and can greatly affect the resulting impacts.

Accuracy of Results

EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact when averaging data.

ADDITIONAL ENVIRONMENTAL INFORMATION

EXTRAORDINARY EFFECTS

Fire
E119 (S101) Fire resistance Rating and E84 (S102) Flame Spread tests for Structurlam's products are available on https://www.structurlam.com/resources/testing/.

Water
CLT may be exposed to rain during the construction stage. While the water impact must be minimized, no major negative effects have been documented if the mass timber product returns below 19% MC within a 2 months time span. If it stays saturated longer than this time span, the risk of fungal decay increases significantly.

Mechanical Destruction
The design of mass timber building ensures that wood components do not fail during a seismic event. Steel connections between wood elements are the yielding point and can be replaced after destruction.

ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

On request, CLT can be produced with FSC or SFI certified wood. Structurlam maintains the chain of custody record for those products.

FURTHER INFORMATION

Further information is available on request and on www.structurlam.com.

REFERENCES

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