Environmental Product Declaration

DowelLam

EPD for Dowel Laminated Timber



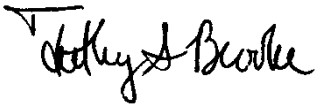
1. CONTENT OF THE EPD

Program Operator	**ASTM International** 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org
General Program Instructions	ASTM Program Operator Rules. Version 8.0, revised April 2020 (1).
Declaration Owner	**DowelLam, a division of:** StructureCraft Builders Inc. 1929 Foy Street Abbotsford, BC V2T 6B1, Canada www.StructureCraft.com
Manufacturing Facility	Abbotsford, BC
Declaration Number	EPD 1229
Declared Product	Dowel Laminated Timber (DLT); Brand name: DowelLam
Declared Unit	1 m^3 of DLT
Reference PCR and Version Number	**ISO 21930:2017** Sustainability in Building Construction — Environmental Declaration of Building Products (2). **UL Environment**: Product Category Rules for Building-Related Products and Services **Part A:** Product Category Rules for Building-Related Products and Services. Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Standard 10010. Version 4.0. March 28, 2022 (3) **Part B:** Product Category Rules (PCR) Guidance for Building-Related Products and Services. Part B: Structural and Architectural Wood Products EPD Requirements. UL Standard 10010-09. Version 1.1. May 29, 2020. Extended to October 31, 2026. (4)
Description of Product's intended application and use	DLT is a mass timber product that can be used for floor, wall, and roof structures. These solid panels use hardwood dowels to friction fit pre-milled boards together on edge, creating a panel which is particularly efficient for horizontal spans and allows for flexible architectural designs. DLT panels are the only all wood mass timber product – in concept, with only trace amounts of glue and no nails. DLT panels can be easily processed using CNC machinery, creating a high tolerance panel which can also contain pre-integrated acoustic materials and MEPF interfaces.
Markets of Applicability	North America
Date of Issue & Validity Period	July 21st, 2026 – 5 years
EPD Type	Product and manufacturer specific EPD

EPD Scope	Cradle to Gate		
Year of reported manufacturer primary data	2024		
LCA Software	SimaPro v10.2.0.1, 2025		
LCI Databases	Ecoinvent 3.11 Cut-off, U		
LCIA Methodology	IPCC AR5 2013, TRACI 2.2 2022, CML-baseline v4.8 2016, Cumulative Energy Demand (CED) LHV, V1.01 2024		
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** 280 Albert Street, Suite 404. Ottawa, Ontario, Canada. K1P 5G8 www.athenasmi.org 		

This declaration was independently verified in accordance with ISO 14025:2006 (5).
The UL Environment Part A PCR (3), in conformance with ISO 21930:2017 (2) serve as the core PCR, with additional considerations from the UL Environment Part B PCR for Structural and Architectural Wood Product (4).

☐ 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 in results for upstream or downstream of the life cycle stages declared.

2. GENERAL INFORMATION

DowelLam's DLT

DowelLam's DLT (Dowel Laminated Timber) is the first all wood mass timber panel in North America. It gives architects, engineers, contractors and owners a sustainable, efficient and versatile product for their mass timber buildings.

Our vision at DowelLam is to support project teams through the engineering, manufacturing and supply of DLT across North America. We have been manufacturing DLT since 2017, and over nine years we have fabricated more than 3 million square feet of panels across 150 projects delivered and built with DLT.

From engineering through fabrication and supply, DowelLam brings the product and the expertise to help mass timber projects come together.

DLT is a proprietary engineered wood product that is prefabricated using several layers of kiln-dried lumber. The structural strength of DLT is obtained by wooden dowels (instead of glue) that are introduced perpendicular to the wide side of the lumber layers (Figure 1). Table 1 provides the UNSPSC and CSI/CSC product classification for DLT.

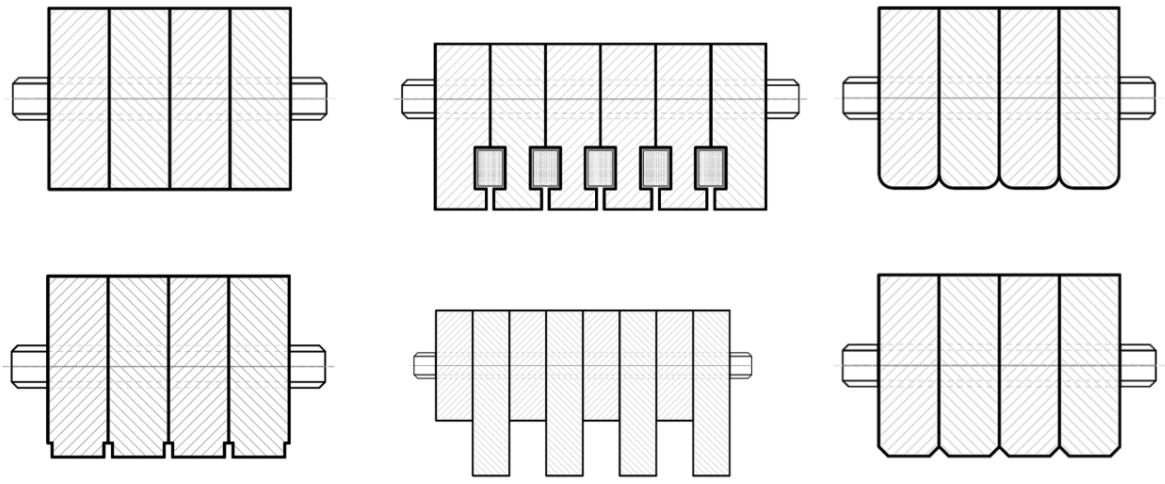


Figure 1 Technical drawings of dowel laminated timber profiles.

DowelLam's DLT has high structural strength and stability. It is a mass timber product used for floor, wall, roof, core and shaft panels. Produced at our facility in Abbotsford, BC, DLT is made primarily from dimensional softwood lumber sourced from sustainable managed forests in North America. DowelLam is FSC and PEFC certified, and Chain of Custody Certification is available on request.

Table 1 United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) MasterFormat Code for dowel laminated timber.

Classification Scheme	Product category	Product Code
UNSPSC	Wood Sheathing or Sheets	30103604
CSI/CSC	Engineered Wood Products	06 11 13
	Heavy Timber Construction	06 13 00
	Shop-Fabricated Structural Wood	06 17 00

Applicable product standards for dowel laminated timber include:

- ASTM D9-20: Standard Terminology Relating to Wood and Wood-Based Products
- ANSI/APA PRG 320-2025: Standard for Performance-Rated Cross-Laminated Timber
- ASTM D5456-21e1: Standard Specification for Evaluation of Structural Composite Lumber Products

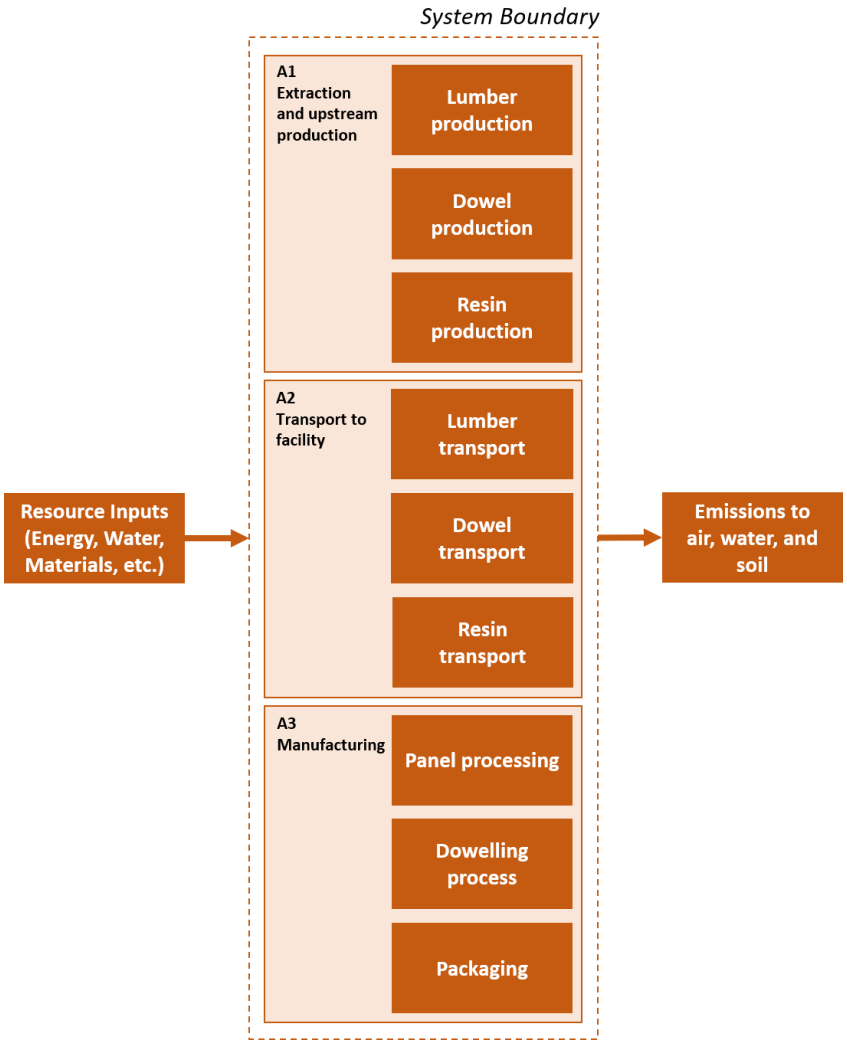


Figure 2 Cradle-to-Gate DLT production flow diagram

3. METHODOLOGICAL FRAMEWORK

Declared Unit

The declared unit is used in instances where the function and the reference scenario for the whole life cycle of a wood building product cannot be stated. The declared unit is defined as one cubic meter (m^3) of DowelLam's DLT, as specified in UL Part B PCR Section 3.2 (4).

Table 2 Declared Unit and Product Information

Declared Unit		
The declared unit *is the production of one cubic meter (1 m^3) of DLT produced at DowelLam's facility in Abbotsford, BC*.		
Property	**Unit**	**Value**
Mass	kg	449
Thickness to achieve declared unit	mm	85-282
Density	kg/m^3	449
Moisture Content	%	15-19
Product Composition		
Softwood Lumber	%	98.9
Hardwood Dowel	%	1.0
Resins	%	0.1



Figure 3 Visual representation of DLT product sample

System Boundary

The underlying LCA (6) investigates the cradle-to-gate DLT product system (Production Stage), which is shown in Figure 2 above. The Production stage includes the information modules *A1 Extraction and upstream production*, *A2 Transport to factory* and *A3 Manufacturing* (Figure 4).

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

A1 Extraction and upstream production

A1 includes the cradle-to-gate production of softwood lumber, hardwood dowels and resins that are used in DLT 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 DLT product, including panel processing, the dowelling process and packaging.

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 (2). 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, Data Quality and Period Under Review

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 Part A and Part B. The primary gate-to-gate LCI data is based on 2024 calendar year production and was collected by means of a survey.

This EPD estimates the impacts of softwood and hardwood lumber production using the following sources:

Softwood lumber: British Columbia profile from *Canada Wood Council. A Regionalized Industry Average EPD for Canadian Softwood Lumber. ASTM International. EPD 845. February 4, 2025.* (7)

Hardwood lumber: *A Life Cycle Assessment of Hardwood Lumber Production in the Northeast and North Central United States. CORRIM. April 27, 2020.* (8)

Secondary data sources are gathered from USLCI Q3 2024 and Ecoinvent 3.11 Cut-off, U for the completion of the LCA study.

Allocation Methods

Allocation is used to partition the environmental load of a process when several products or functions share the same process. DLT production is a single output process and StructureCraft provided inventory data specific to their DLT production. Therefore, allocation was not applicable.

The manufacturing process does produce wood waste that is transferred for free to downstream users. No environmental burden has been allocated to these wastes.

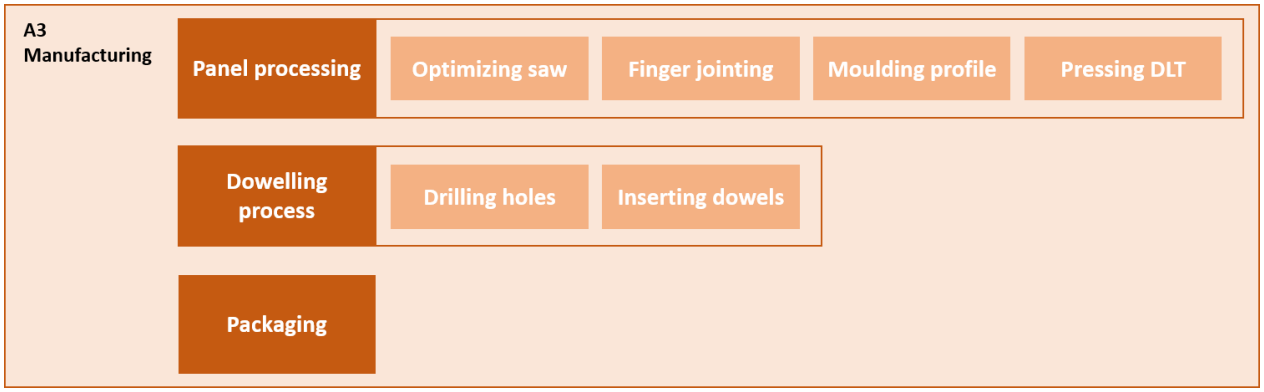
4. TECHNICAL INFORMATION AND SCENARIOS

Manufacturing

In the Optimizing saw, visual defects are marked and automatically cut out as necessary. Then, boards up to 6” x 12” in cross section are structurally finger-jointed, creating continuous lamellas up to 60ft long. Each lamella is run through a moulder, ensuring exact board thickness and applying the many different profile options to the bottom of the board. The Lamellas are automatically fed into the DLT press, where 10 metric tonnes of pressure are applied both vertically and horizontally on the panel.

A drilling aggregate drills 3/4” diameter holes into the wide face of the lamellas with a custom-designed drill bit. The 3/4” diameter hardwood dowels are hydraulically pressed into the hole. Additional packages of lamellas are pushed into the DLT press and dowelled into the previous packages until a full width panel is created. As the drier dowel comes into moisture equilibrium with the surrounding lumber, it expands, creating a tight friction fit between the two materials.

Figure 5 Manufacturing process



Packaging

Packaging materials represent less than 1% of the mass of the main product. Lumber wrap and plastic strapping were used as packaging materials. The packaging is allocated 100% to the primary product. These packaging materials are assumed to be disposed of in an appropriate municipal landfill during the installation module (A5).



Figure 6 Visual of DLT press

5. ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

Table 3 presents the LCIA and LCI parameter results for 1 m^3 of DLT. 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 2.2. 2022.

The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method published by ecoinvent. 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. The ACLCA's Guidance to Calculating non-LCIA Inventory Metrics (9) have been followed in accordance with ISO 21930:2017.

IPCC AR5 has been used to calculate the global warming potential LCIA metric, as specified by UL Environment Part A PCR (3). This method does not account for the removals or emissions of biogenic CO_2. The biogenic CO_2 has been manually calculated the component of the global warming potential related to biogenic carbon separately, in accordance with EPD International Part A PCR Annex 2 (10). The GWP indicator is separately reported as GWP-total, GWP-fossil, and GWP-biogenic for transparency. SimaPro v10.2.0.1 was used to organize and accumulate the LCI data and to calculate the LCIA results.

The upstream LCA data from CWC and CORRIM for softwood and hardwood lumber report TRACI 2.1 LCIA metrics. In TRACI 2.2, eutrophication is separated into two impact categories, freshwater and marine, whereas TRACI 2.1 reports a single eutrophication metric that covers both. To enable the use of these upstream data, the conversion of TRACI 2.1 Eutrophication to TRACI 2.2 Eutrophication-marine and Eutrophication-freshwater has been performed in conformance with guidance provided by Smart EPD in their PCR Errata and Clarifications, v4 (11).

As specified in UL Environment Part A PCR, Section 4.7 (3), the following impact categories are globally deemed mature enough to be included in Type III environmental declarations:

- global warming potential
- ozone depletion potential
- acidification potential
- eutrophication potential, marine
- eutrophication potential, freshwater
- smog formation potential
- abiotic depletion potential for fossil resources

Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

Table 3 LCIA Results Summary for Cradle-to-Gate production of 1 m^3 of DLT

Core Mandatory Impact Indicator	Abbreviation	Units	A1	A2	A3	Total
Global warming potential – total	GWP_{total}	kg CO_2 eq.	-624	28.1	708	112
Global warming potential - fossil	GWP_{fossil}	kg CO_2 eq.	54.0	28.1	30.0	112
Global warming potential – biogenic	GWP_{bio}	kg CO_2 eq.	-678	0	678	0
Acidification potential of soil and water sources	AP	kg SO_2 eq.	0.59	3.48E-02	7.70E-02	0.70
Eutrophication potential, freshwater	EP-f	kg P eq.	6.13E-03	7.47E-05	2.84E-03	9.05E-03
Eutrophication potential, marine	EP-m	kg N eq.	6.19E-03	5.76E-03	1.85E-02	3.05E-02
Formation potential of tropospheric ozone	SFP	kg O_3 eq.	12.5	0.67	2.16	15.4
Depletion potential of the stratospheric ozone layer	ODP	kg CFC-11 eq.	2.00E-06	6.93E-07	4.51E-07	3.15E-06
Abiotic depletion potential for non-fossil resources	ADPe	kg Sb eq.	2.52E-05	7.60E-07	9.30E-07	2.69E-05
Abiotic depletion potential (ADPfossil) for fossil resources;	ADPf	MJ, LHV	840	384	482	1706
Use of Primary Energy Resources						
Renewable primary energy carrier used as energy	RPRE	MJ, LHV	1157	0.95	386	1544
Renewable primary energy carrier used as material	RPRM	MJ, LHV	6640	0	0	6640
Non-renewable primary energy carrier used as energy	NRPRE	MJ, LHV	918	385	516	1819
Non-renewable primary energy carrier used as material	NRPRM	MJ, LHV	-	-	-	-
Secondary Materials and Fuels						
Secondary material	SM	kg	-	-	-	-
Renewable secondary fuel	RSF	MJ, LHV	-	-	-	-
Non-renewable secondary fuel	NRSF	MJ, LHV	-	-	-	-
Recovered energy	RE	MJ, LHV	-	-	-	-
Freshwater						
Consumption of freshwater resources	FW	m^3	2.52E-02	5.41E-03	6.53E-03	3.72E-02
Indicators Describing Waste						
Hazardous waste disposed	HWD	kg	0.10	6.89E-03	7.94E-02	0.19
Non-hazardous waste disposed	NHWD	kg	15.0	0.55	0	15.6
High-level radioactive waste, conditioned, to final repository	HLRW	kg	7.42E-05	5.33E-06	6.79E-05	1.47E-04
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	kg	2.23E-04	1.79E-05	2.38E-04	4.79E-04
Components for re-use	CRU	kg	-	-	-	-
Materials for recycling	MR	kg	0	0	107	107
Materials for energy recovery	MER	kg	-	-	-	-
Recovered energy exported from the product system	EE	MJ, LHV	-	-	-	-
Additional Inventory Parameters						
Biogenic carbon removal from product	BCRP	kg CO_2	-678	0	0	-678
Biogenic carbon emission from product	BCEP	kg CO_2	0	0	678	678

6. 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.

The UL Environment Part B PCR (4) allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO21930:2017 Section 5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences in results for upstream or downstream of the life cycle stages declared.

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.

When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

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.

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.

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. Variability was

estimated in this EPD by performing a sensitivity analysis on key upstream data sources to quantify the variability associated with the use of different upstream data sources. The results of the sensitivity analysis are documented in the confidential project LCA report.

7. ADDITIONAL ENVIRONMENTAL INFORMATION

Environment and Health during Manufacturing

No substances required to be reported as hazardous are associated with the production of the declared product.

Furthermore, no dangerous substance emissions, i.e. indoor air emissions, gamma or ionizing radiation emissions or chemicals released to air or leached to water and soil, were reported for the declared product.

Extraordinary Effects

Fire
A fire rating test on DowelLam's Dowel Laminated Timber (DLT) has been conducted by the Southwest Research Institute's (SwRI) Fire Technology Department. The test determined a 2hr fire resistance of an unrestrained load-bearing floor panel in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, and CAN/ULC-S101, Standard Methods of Fire Endurance Test of Building Construction and Materials (12). DowelLam's Douglas Fir and SPF DLT products have also been tested in conformance with ASTM E84-20 Standard Test Method for Surface Burning Characteristics of Building Materials (13).

Water
Weather protection during construction is an important consideration in installation of a mass timber building. While DLT may be exposed to rain during the construction stage, 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 Certification

On request, DLT can be produced with FSC or PEFC certified wood. DowelLam maintains the chain of custody record for those products.

Permanent Carbon Sequestration

Permanent carbon sequestration is calculated below as specified in Appendix A of UL Environment Part B PCR (4). These calculations conservatively assume that 100% of wood goes to landfill at end of life.

Table 4 Permanent carbon sequestration calculation per m^3 of DLT

Density of oven dry DLT: (Conservatively assume 19% moisture content)	$\frac{449\ kg}{1 + 0.19}$ = 377.3 kg
Proportion of oven dry DLT that is carbon: (Value taken from Appendix A of PCR)	49%
Mass of carbon in 1 m^3 of DLT:	377.3 × 49% = 184.9 kg C
Conversion factor from carbon (kg C) to carbon dioxide equivalent (kg CO_2 eq.):	1 kg C = 3.67 kg CO_2 eq.
Sequestered CO_2 in 1 m^3 of oven dry DLT:	184.9 kg C × 3.67 = 678.6 kg CO_2 eq.
Landfill methane emissions factor from the PCR:	0.00353 kg CH_4 per kg of oven dry wood
Landfill methane emissions for 1 m^3 of oven dry DLT:	0.00353 × 377.3 = 1.33 kg CH_4
Convert methane emissions to CO_2 eq.	1.33 kg CH_4 × 28 = 37.25 kg CO_2 eq.
Landfill CO_2 emission factor from the PCR:	0.206 kg CO_2 per kg of oven dry wood
Landfill CO_2 emissions for 1 m^3 of oven dry DLT:	0.206 × 377.3 = 77.7 kg CO_2
Total landfill emissions for 1m^3 of oven dry DLT:	37.25 kg CO_2 eq. + 77.7 kg CO_2 = 114.95 kg CO_2 eq.
Net permanent sequestered carbon per m^3 of oven dry DLT:	678.6 kg CO_2 eq (original) – 114.95 kg CO_2 eq. (landfill emissions) = 562.95 kg CO_2 eq.

Further Information

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

REFERENCES

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2. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

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EXIT