ICC-ES Listing Report

ESL-1170

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This listing is subject to renewal October 2023.

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CSI: DIVISION: 06 00 00 – WOOD, PLASTICS AND COMPOSITES
Section: 06 17 19 – Cross-laminated Timber

Product Certification System:

The ICC-ES product-certification system includes evaluating reports of tests of standard manufactured product, prepared by accredited testing laboratories and provided by the listee, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the listee's quality system.

Product: CLT BY STORA ENSO

Listee: STORA ENSO OYJ

Compliance with the following standards:

- ANSI/APA PRG 320-2019, Standard for Performance-Rated Cross-Laminated Timber, APA-The Engineered Wood Association.
- ANSI/APA PRG 320-2012, Standard for Performance-Rated Cross-Laminated Timber, APA-The Engineered Wood Association.

Compliance with the following building code:

CLT by Stora Enso panels, as described in this listing report, has met the structural performance requirements in ANSI/APA PRG-320 and Clause 8.2 of CSA-O86-14. The materials were evaluated based on analysis and testing in accordance with ANSI/APA PRG-320. Refer to Table 1 for the layups of Stora Enso CLT panels which meet the layup requirements as noted in Clause 8.2.2 of CSA-O86-14 and Tables 2 and 3 for reference design values which are used to determine Limit States Design (LSD) requirements noted in Clauses 8.3, 8.4 and 8.5 of CSA O86-14. CSA-O86-14 is referenced in the applicable section of the following code edition:

- *National Building Code of Canada*® 2015
  Applicable Section: Volume 1- Division B: 4.3.1.1.(1)

Description of product:

CLT by Stora Enso is a cross-laminated timber (CLT) panel for use as components in floors and roofs.

CLT by Stora Enso panels are plane timber building components which are made of at least three laminations of sawn and planed softwood lumber boards. Adjacent laminations are glued at an angle of 90°. The panels can be produced with a width up to 9.68 feet (2.95 meters) and a length of up to 52.5 feet (16 meters). The CLT by Stora Enso panels are manufactured by face-bonding each layer of lamination using a formaldehyde-free, polyurethane-based structural adhesive. The layers are placed in a press to form a dimensionally stable structural element. The laminations within a layer of CLT panels may be edge-bonded by either EPI glue, or a mixture of hotmelt and PVA dispersion glue. Refer to Table 1 for the layups of CLT by Stora Enso panels. Figure 1 depicts the panel layup and section structure of a possible CLT by Stora Enso panel.

Wood laminations used in manufacturing CLT by Stora Enso panels must be an equivalent to Select Structural sawn lumber provided in Table 4A of AWC National Design Specifications® (NDS) for Wood Construction; and complying with the report holder's approved quality documentation. The minimum specific gravity is 0.42.

Adhesive used to face-bond layers of CLT by Stora Enso panels and adhesive used for finger-joints of wood laminations are one-component polyurethane based, exterior-type structural adhesives, conforming to ANSI/APA PRG 320 and the product specifications in the approved quality documentation.

Design Requirements:

CLT by Stora Enso panels are designed in accordance with the applicable code and Clause 8 of CSA O86-14.

Tables 2 and 3 provide reference design values for bending capacities and in-plane shear capacities of CLT by Stora Enso panels, respectfully. The reference design values in Table 2 are intended for Limit States Design (LSD) in accordance with Clauses 8.4 and 8.5 of CSA O86-14 and must be adjusted using adjustment factors in accordance with Clause 8.3 of CSA O86-14. Maximum deflection of CLT panels with consideration for creep effects to be determined in accordance with Clause 8.5.2 of CSA O86-14. CLT by Stora Enso panels are used as components in floor and roof decks under dry service condition such as in most covered structures, where the moisture content in service is less than 16 percent.

Identification:

1. CLT by Stora Enso panels are identified with stamps noting the Stora Enso Oyj name or logo (Figure 2), product layup and designation, production date and shift, and ICC-ES evaluation report number (ESR-4381) and/or the ICC-ES listing report number (ESL-1170), and the ICC-ES listing mark, as applicable.

2. The report holder's contact information is the following:

   STORA ENSO OYJ
   WOOD PRODUCTS HEAD OFFICE
   PO BOX 309
   HELSINKI FI-00101
   FINLAND
   +358 2046 111
   www.storaenso.com

Installation: Installation of CLT by Stora Enso panels must be in accordance with this evaluation report, the applicable code provisions and the manufacturer's published design and installation instructions. The manufacturer's design and installation instructions must be available at the jobsite at all times during installation.

Conditions of Listing:

1. The listing report addresses only conformance with the standard and code section noted above.

2. Approval of the product's use is the sole responsibility of the local code official.

3. The listing report applies only to CLT by Stora Enso panels tested and analyzed as submitted for review by ICC-ES.

4. Use of CLT by Stora Enso panels must be limited to dry service conditions where the moisture content in lumber in service is less than 16 percent, as in most covered structures.

5. Calculations and drawings demonstrating compliance with this evaluation report must be submitted to the code official. The calculations and drawings must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

6. Connections between wall panels and roof/floor panels, and other support members shall be accompanied by complete detailing and design that are satisfactory to the code official. Fasteners and connectors must be properly specified, including size, length, dimension, fastener bearing length and location. Edge distance, end distance and fastener spacing must be in accordance with Clause 12 of CSA O86-14.

7. Cutting, drilling, and notching of CLT by Stora Enso panels when used as components in floor and roof decks have not been evaluated and are outside the scope of this evaluation report.

8. CLT by Stora Enso panels used to resist out-of-plane transverse forces in walls must be accompanied by complete detailing and wall design that are acceptable to the code official.

9. CLT by Stora Enso panels are fabricated in Ybbs, Austria, under a quality-control program with inspections by ICC-ES.

TABLE 1—CLT BY STORA ENSO PANEL LAYUPS

LAYUP[1]	CLT THICKNESS t_p[2]		LAMINATION ACTUAL THICKNESS[3]						
			∥	⊥	∥	⊥	∥	⊥	∥
60 L3s	[mm]	60	20	20	20	—	—	—	—
	[in.]	2.36	0.79	0.79	0.79	—	—	—	—
80 L3s	[mm]	80	20	40	20	—	—	—	—
	[in.]	3.15	0.79	1.57	0.79	—	—	—	—
90 L3s	[mm]	90	30	30	30	—	—	—	—
	[in.]	3.54	1.18	1.18	1.18	—	—	—	—
100 L3s	[mm]	100	30	40	30	—	—	—	—
	[in.]	3.94	1.18	1.57	1.18	—	—	—	—
120 L3s	[mm]	120	40	40	40	—	—	—	—
	[in.]	4.72	1.57	1.57	1.57	—	—	—	—
100 L5s	[mm]	100	20	20	20	20	20	—	—
	[in.]	3.94	0.79	0.79	0.79	0.79	0.79	—	—
120 L5s	[mm]	120	30	20	20	20	30	—	—
	[in.]	4.72	1.18	0.79	0.79	0.79	1.18	—	—
140 L5s	[mm]	140	40	20	20	20	40	—	—
	[in.]	5.51	1.57	0.7	0.79	0.79	1.57	—	—
160 L5s	[mm]	160	40	20	40	20	40	—	—
	[in.]	6.30	1.57	0.79	1.57	0.79	1.57	—	—
180 L5s	[mm]	180	40	30	40	30	40	—	—
	[in.]	7.09	1.57	1.18	1.57	1.18	1.57	—	—
200 L5s	[mm]	200	40	40	40	40	40	—	—
	[in.]	7.87	1.57	1.57	1.57	1.57	1.57	—	—
160 L5s-2	[mm]	160	30 + 30	40	30 + 30	—	—	—	—
	[in.]	6.30	2.36	1.57	2.36	—	—	—	—
180 L7s	[mm]	180	30	20	30	20	30	20	30
	[in.]	7.09	1.18	0.79	1.18	0.79	1.18	0.79	1.18
200 L7s	[mm]	200	20	40	20	40	20	40	20
	[in.]	7.87	0.79	1.57	0.79	1.57	0.79	1.57	0.79
240 L7s	[mm]	240	30	40	30	40	30	40	30
	[in.]	9.45	1.18	1.57	1.18	1.57	1.18	1.57	1.18
220 L7s-2	[mm]	220	30 + 30	30	40	30	30 + 30	—	—
	[in.]	8.66	1.18 + 1.18	1.18	1.57	1.18	1.18 + 1.18	—	—
240 L7s-2	[mm]	240	40 + 40	20	40	20	40 + 40	—	—
	[in.]	9.45	1.57 + 1.57	0.79	1.57	0.79	1.57 + 1.57	—	—
260 L7s-2	[mm]	260	40 + 40	30	40	30	40 + 40	—	—
	[in.]	10.24	1.57 +1.57	1.18	1.57	1.18	1.57 + 1.57	—	—
280 L7s-2	[mm]	280	40 + 40	40	40	40	40 + 40	—	—
	[in.]	11.02	1.57 + 1.57	1.57	1.57	1.57	1.57 + 1.57	—	—
300 L7s-2	[mm]	300	40 + 40	30	40 + 40	30	40 + 40	—	—
	[in.]	11.81	1.57 + 1.57	1.18	1.57 + 1.57	1.18	1.57 + 1.57	—	—
320 L7s-2	[mm]	320	40 + 40	40	40 + 40	40	40 + 40	—	—
	[in.]	12.60	1.57 + 1.57	1.57	1.57 + 1.57	1.57	1.57 +1.57	—	—

For **Imperial**: 1 mm = 0.0394 inch

[1]The panel layups are developed based on the ANSI/APA PRG 320, using equivalent SPF Select Structural sawn lumber with a minimum specific gravity of 0.42. Layups ended with "-2" in CLT layup designations are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces of the panels. 300 L7s-2 and 320 L7s-2 layups are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces and in the middle of the panels.

[2]Gross thickness of CLT panels.

[3]Actual thickness of lamination after planning. "∥": Face laminations are oriented parallel to the major strength direction and "⊥": Face laminations are oriented perpendicular to the major strength direction.

TABLE 2—LSD VALUES FOR CLT BY STORA ENSO PANELS[1]

CLT LAYUP[2]	CLT PANEL THICKNESS t_p (mm)	MAJOR STRENGTH DIRECTION				MINOR STRENGTH DIRECTION			
		$(F_bS)_{eff,f,0}$ ($x10^6$ N-mm/m)	$(EI)_{eff,f,0}$ ($x10^9$ N-mm^2/m)	$(GA)_{eff,f,0}$ ($x10^6$ N/m)	$V_{s,0}$ (kN/m)	$(F_bS)_{eff,f,90}$ ($x10^6$ N-mm/m)	$(EI)_{eff,f,90}$ ($x10^9$ N-mm^2/m)	$(GA)_{eff,f,90}$ ($x10^6$ N/m)	$V_{s,90}$ (kN/m)
60 L3s	60	8.55	179.83	9.41	25.01	1.16	6.87	9.41	8.33
80 L3s	80	13.85	387.91	11.18	33.36	4.64	55.17	19.42	16.68
90 L3s	90	19.23	605.41	14.12	37.54	2.61	23.26	14.12	12.50
100 L3s	100	23.09	808.78	14.71	41.69	4.64	55.17	18.83	16.68
120 L3s	120	34.18	1435.85	18.83	50.05	4.64	55.17	18.83	16.68
100 L5s	100	19.67	688.27	18.83	41.69	10.05	179.83	18.83	25.01
120 L5s	120	31.32	1316.27	23.54	50.05	10.05	179.83	19.42	25.01
140 L5s	140	44.71	2191.90	28.24	58.37	10.05	179.83	20.30	25.01
160 L5s	160	56.35	3156.98	39.13	66.73	16.29	387.91	22.36	33.36
180 L5s	180	67.37	4246.34	37.66	75.05	27.16	808.78	29.72	41.69
200 L5s	200	78.66	5508.01	37.95	83.41	40.21	1435.85	37.95	50.05
160 L5s-2	160	62.06	3477.11	28.24	66.73	4.64	55.17	20.30	16.68
180 L7s	180	63.57	4006.25	42.37	75.05	29.94	1069.59	30.60	50.05
200 L7s	200	55.06	3855.61	33.54	83.41	66.30	3156.98	58.55	66.73
240 L7s	240	93.24	7835.50	44.43	100.09	79.26	4246.34	56.19	75.05
220 L7s-2	220	109.01	8396.65	47.66	91.74	27.16	808.78	31.48	41.69
240 L7s-2	240	137.34	11540.45	64.14	100.09	16.29	387.91	26.77	33.36
260 L7s-2	260	157.83	14367.90	58.55	108.42	27.16	808.78	33.54	41.69
280 L7s-2	280	178.83	17533.36	56.78	116.77	40.21	1435.85	40.60	50.05
300 L7s-2[3]	300	203.82	21410.62	82.97	125.10	46.52	1938.63	37.95	58.37
320 L7s-2[3]	320	225.40	25254.92	78.26	133.43	64.86	3103.32	44.72	66.73

For **Imperial**: 1 mm = 0.0394 in; 1 m = 3.28 ft; 1 N = 0.2248 lb_f

[1]The tabulated values are unfactored Limit States Design (LSD) values and shall not be increased for the lumber size adjustment factor in accordance with CSA O86.

[2]The CLT layups are developed based on the ANSI/APA PRG 320, using equivalent SPF Select Structural sawn lumber with a minimum specific gravity of 0.42. Layups ended with "-2" in the layup designations are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces of the panels.

[3]300 L7s-2 and 320 L7s-2 layups are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces and in the middle of the panels.

TABLE 3—LSD VALUES FOR IN-PLANE SHEAR OF CLT BY STORA ENSO PANELS[1]

CLT LAYUP[5]	CLT PANEL THICKNESS t_p (mm)	FACE LAMINATION ORIENTATION[2] (MPa)		FACE LAMINATION ORIENTATION[3] (kN/m)	
		[4]II	⊥[4]	[4]II	⊥[4]
60 L3s	60	2.47	3.34	148	200
80 L3s	80	2.47	3.34	198	267
90 L3s	90	2.47	3.34	223	300
100 L3s	100	2.47	3.34	247	334
120 L3s	120	2.47	3.34	297	400
100 L5s	100	2.47	3.34	247	334
120 L5s	120	2.47	3.34	297	400
140 L5s	140	2.47	3.34	346	467
160 L5s	160	2.47	3.34	396	534
180 L5s	180	2.47	3.34	445	600
200 L5s	200	2.47	3.34	495	667
160 L5s-2[5]	160	2.47	3.34	396	534
180 L7s	180	2.47	3.34	445	600
200 L7s	200	2.47	3.34	495	667
400 L7s	240	2.47	3.34	594	801
220 L7s-2[5]	220	2.47	3.34	544	734
240 L7s-2[5]	240	2.47	3.34	594	801
260 L7s-2[5]	260	2.47	3.34	643	867
280 L7s-2[5]	280	2.47	3.34	693	934
300 L7s-2[6]	300	2.47	3.34	742	1,001
320 L7s-2[6]	320	2.47	3.34	792	1,068

For **Imperial**: 1 MPa = 145.04 psi; 1 mm = 0.0394 in; 1 m = 3.28 ft; 1 N = 0.2248 lb_f

[1] The tabulated values are reference design values intended for Limit States Design (LSD)**.**

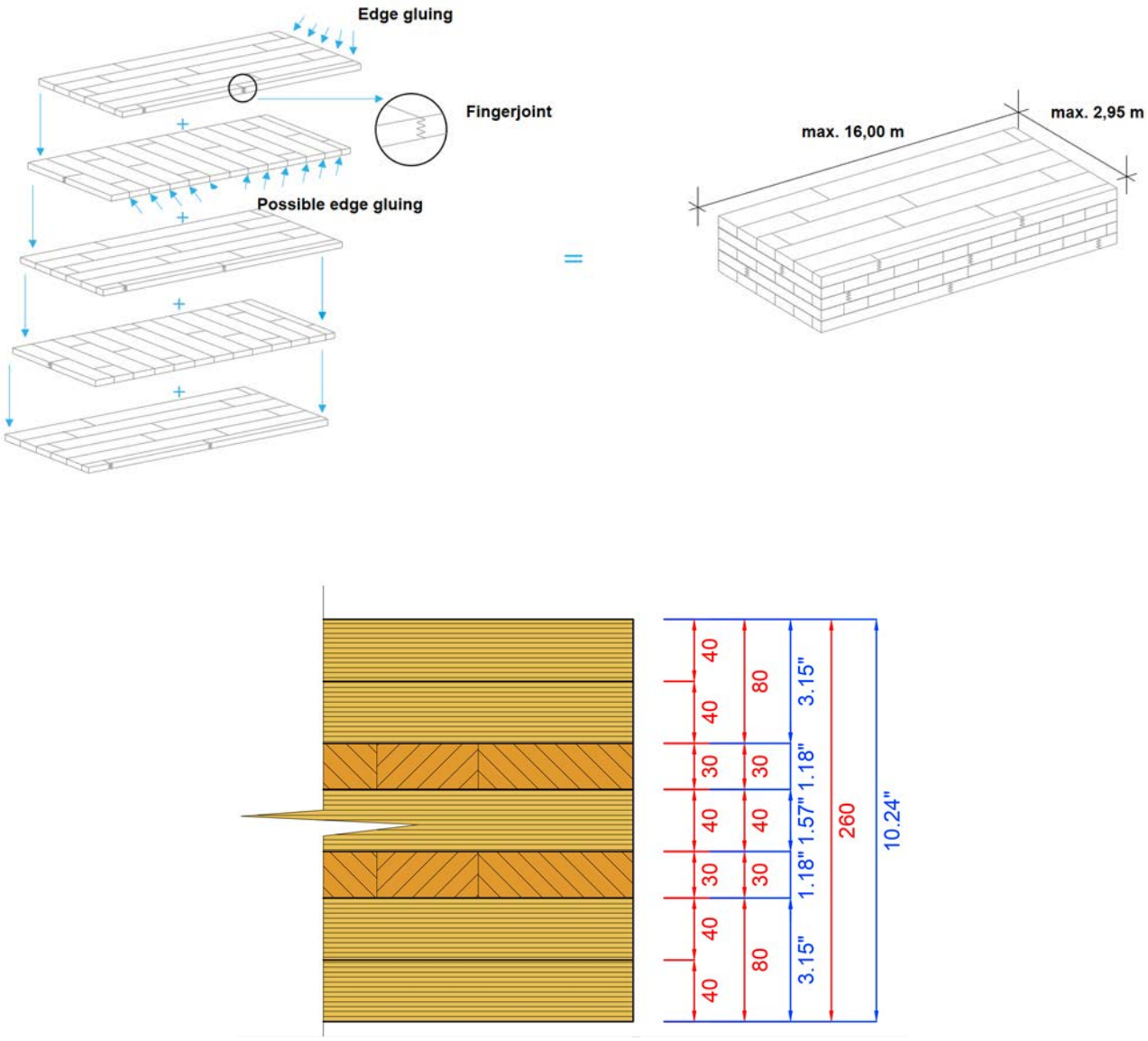
[2]The tabulated values are LSD reference edgewise shear stress of CLT in the major strength direction ($F_{v,e,0}$) and minor strength direction ($F_{v,e,90}$).

[3]The tabulated values are LSD reference edgewise shear capacity of the full thickness of the CLT in the major strength direction ($F_{v,e,0}$ t_p) and minor strength direction ($F_{v,e,90}$ t_p). The values shall be reduced when the CLT panel thickness is less than the full thickness of the CLT panels (t_p) specified in Table 1.

[4]"II" indicates the loads applied parallel to the major strength direction of the CLT. "⊥" indicates the loads applied perpendicular to the major strength direction of the CLT.

[5]The CLT layups are developed based on the ANSI/APA PRG 320, equivalent SPF Select Structural sawn lumber with a minimum specific gravity of 0.42. Layups with "-2" in the CLT layup designations are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces of the panels.

[6]300 L7s-2 and 320 L7s-2 layups are manufactured with two laminations with wood grain orientation running in the same direction at the outermost surfaces and in the middle of the panels.



CLT BY STORA ENSO LAYUP 260 L72-s

FIGURE 1—CLT BY STORA ENSO PANEL LAYUPS AND SECTION STRUCTURE
(1 m = 3.28 ft)

FIGURE 2—COMPANY LOGO FOR STORA ENSO OYJ WOOD PRODUCTS