



- Compliance to International Codes
- Compliance to State/Regional Codes

ICC-ES Evaluation Report

ESR-4381

Reissued October 2022

This report is subject to renewal October 2024.

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES

Section: 06 17 19—Cross-laminated Timber

REPORT HOLDER:

STORA ENSO OYJ

EVALUATION SUBJECT:

CLT BY STORA ENSO

1.0 EVALUATION SCOPE

Compliance with the following codes and standard:

- 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)
- ANSI/APA PRG 320-2019 Standard for Performance-Rated Cross-Laminated Timber

For compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see [ESR-4381 LABC and LARC Supplement](#).

Properties evaluated:

- Structural
- Fire Resistance

2.0 USES

CLT by Stora Enso is a cross-laminated timber (CLT) panel for use as components in floors and roofs in Type I and II Construction (IBC) and in roof and floor decks in Type III (interior floor decks only), IV and V construction (IBC). The CLT by Stora Enso panels, when installed under the IRC, an engineered design is required in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 General:

The CLT by Stora Enso panels described in this evaluation report complying with requirements noted in Section 2303.1.4 of the 2018 and 2015 IBC, for allowable stress design (ASD) in accordance with 2018 IBC Section 2302.1(1) (2015, 2012 and 2009 IBC Section 2301.2(1)). The 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, complying with Section 3.2.2 of this evaluation report. 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 the CLT by Stora Enso panels.

3.2 Material:

3.2.1 Wood Laminations: Wood laminations used in manufacturing CLT by Stora Enso panels must be sawn lumbers having the reference design values for SPF 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.

3.2.2 Adhesives: 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 320-2019 and the product specifications in the approved quality documentation

4.0 DESIGN AND INSTALLATION

4.1 General:

Design and 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. The requirements specified for allowable stress design in accordance with 2018 IBC Section 2302.1(1) (2015, 2012 and 2009 IBC Section 2301.2(1)), and Chapter 10 of the 2018 or 2015 NDS, are applicable to CLT by Stora Enso panels.

4.2 Reference Design Values:

Tables 2 and 3 provide reference design values for bending capacities and in-plane shear capacities of CLT by Stora

Enso panels, respectively. The reference design values in Tables 2 and 3 are intended for allowable stress design (ASD) and must be adjusted in accordance with Section 4.3 of this evaluation report.

4.3 Adjustment Factors:

The reference design values in Tables 2 through 3 must be adjusted using the adjustment factors specified in Table 10.3.1 of the 2018 or 2015 NDS. The reference design values in Tables 2 and 3 must not be increased for the lumber size adjustment factor in accordance with NDS. The time dependent deformation (creep) factor, K_{cr} , of 2.0, as specified in Section 3.5.2 of the NDS must be used to calculate the total deflection due to long-term loading for CLT by Stora Enso panels 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 specified in Section 10.1.5 of the 2018 and 2015 NDS.

4.4 Fire Resistance:

When fire resistance is required, the fire resistance for the exposed CLT by Stora Enso panels must be determined by calculation in accordance with Chapter 16 of the 2018 or 2015 NDS. As an alternative to the NDS calculation, the CLT by Stora Enso panels must be tested in accordance with ASTM E119 and must be rated for fire resistance in accordance with the test results and conditions of such tests.

5.0 CONDITIONS OF USE

The CLT by Stora Enso panels described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Fabrication, design, and installation must comply with this evaluation report and the manufacturer's published design and installation instructions. In the event of a conflict between the manufacturer's published design and installation instructions and this evaluation report, the more restrictive requirements govern.
- 5.2 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.
- 5.3 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.
- 5.4 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. Connections must be designed in accordance with the mechanical connection provisions in NDS or proprietary connectors and fasteners recognized in a current ICC-ES evaluation report.

- 5.5 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.
- 5.6 The in-plane shear values for CLT by Stora Enso panels listed in Table 3 are applicable for in-plane shear design of the CLT panels used in roof diaphragms, and floor diaphragms. The complete diaphragm designs have not been evaluated and are outside the scope of this evaluation report.
- 5.7 CLT by Stora Enso panels used to resist in-plane shear forces in floor and roof diaphragms must be accompanied by complete detailing and diaphragm design that are acceptable to the code official.
- 5.8 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.
- 5.9 CLT by Stora Enso panel roof decks must be covered with approved roof coverings secured to the building or structure in accordance with applicable provisions of IBC Chapter 15.
- 5.10 Special inspection must be conducted in accordance with the applicable requirements of Sections 1704 and 1705 of the IBC.
- 5.11 CLT by Stora Enso panels may be used as components in floor and roof decks under the IRC when an engineered design is submitted in accordance with Section R301.1.3. CLT by Stora Enso panels are fabricated in Ybbs, Austria, under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Cross-laminated Timber Panels for Use as Components in Walls, Floors and Roofs (AC455), dated February 2019 (editorially revised June 2020).

7.0 IDENTIFICATION

- 7.1 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).
- 7.2 The report holder's contact information is the following:

STORA ENSO OYJ
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TABLE 1—CLT BY STORA ENSO PANEL LAYUPS

LAYUP ¹	CLT THICKNESS		LAMINATION ACTUAL THICKNESS ³						
	t_p^2			⊥		⊥		⊥	
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 SI: 1 in. = 25.4 mm

¹The panel layouts are developed based on the ANSI/APA PRG 320, using visually graded sawn lumber noted in Section 3.2.1 of the evaluation report. Layouts ended with “-2” in CLT layout 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 layouts 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.

²Gross thickness of CLT panels.

³Actual 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—REFERENCE DESIGN VALUES FOR CLT BY STORA ENSO PANELS¹

CLT LAYUP ²	CLT PANEL THICKNESS t_p (in.)	MAJOR STRENGTH DIRECTION				MINOR STRENGTH DIRECTION			
		$(F_bS)_{eff,f,0}$ (lb _f -ft/ft)	$(EI)_{eff,f,0}$ ($\times 10^9$ lb _f -in. ² /ft)	$(GA)_{eff,f,0}$ ($\times 10^6$ lb _f /ft)	$V_{s,0}$ (lb _f /ft)	$(F_bS)_{eff,f,90}$ (lb _f -ft/ft)	$(EI)_{eff,f,90}$ ($\times 10^9$ lb _f -in. ² /ft)	$(GA)_{eff,f,90}$ ($\times 10^6$ lb _f /ft)	$V_{s,90}$ (lb _f /ft)
60 L3s	2.36	953	19.1	0.32	850	129	0.73	0.32	283
80 L3s	3.15	1,544	41.2	0.38	1,134	517	5.86	0.66	567
90 L3s	3.54	2,144	64.3	0.48	1,276	291	2.47	0.48	425
100 L3s	3.94	2,575	85.9	0.50	1,417	517	5.86	0.64	567
120 L3s	4.72	3,811	152.5	0.64	1,701	517	5.86	0.64	567
100 L5s	3.94	2,193	73.1	0.64	1,417	1,121	19.1	0.64	850
120 L5s	4.72	3,493	139.8	0.80	1,701	1,121	19.1	0.66	850
140 L5s	5.51	4,986	232.8	0.96	1,984	1,121	19.1	0.69	850
160 L5s	6.30	6,284	335.3	1.33	2,268	1,817	41.2	0.76	1,134
180 L5s	7.09	7,513	451.0	1.28	2,551	3,029	85.9	1.01	1,417
200 L5s	7.87	8,772	585.0	1.29	2,835	4,484	152.5	1.29	1,701
160 L5s-2	5.85	6,921	369.3	0.96	2,268	517	5.86	0.69	567
180 L7s	7.09	7,089	425.5	1.44	2,551	3,339	113.6	1.04	1,701
200 L7s	7.87	6,140	409.5	1.14	2,835	7,393	335.3	1.99	2,268
240 L7s	9.45	10,397	832.2	1.51	3,402	8,839	451.0	1.91	2,551
220 L7s-2	8.66	12,156	891.8	1.62	3,118	3,029	85.9	1.07	1,417
240 L7s-2	9.45	15,315	1,225.7	2.18	3,402	1,817	41.2	0.91	1,134
260 L7s-2	10.24	17,600	1,526.0	1.99	3,685	3,029	85.9	1.14	1,417
280 L7s-2	11.02	19,942	1,862.2	1.93	3,969	4,484	152.5	1.38	1,701
300 L7s-2 ³	11.81	22,729	2,274.0	2.82	4,252	5,188	205.9	1.29	1,984
320 L7s-2 ³	12.60	25,135	2,682.3	2.66	4,535	7,268	329.6	1.52	2,268

For **SI**: 1 in. = 25.4 mm; 1 ft. = 304.8 mm; 1 lb_f = 4.448 N

¹The tabulated values are reference design values intended for Allowable Stress Design (ASD) and must be adjusted in accordance with Section 4.3.

²The CLT layups are developed based on the ANSI/APA PRG 320, using visually graded sawn lumber noted in Section 3.2.1 of the evaluation report. 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.

³300 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—REFERENCE DESIGN VALUES FOR IN-PLANE SHEAR OF CLT BY STORA ENSO PANELS¹

CLT LAYUP ⁵	CLT PANEL THICKNESS t_p (in.)	FACE LAMINATION ORIENTATION ² (psi)		FACE LAMINATION ORIENTATION ³ (lbf/ft of width)	
		∥ ⁴	⊥ ⁴	∥ ⁴	⊥ ⁴
60 L3s	2.36	178	240	5,040	6,800
80 L3s	3.15	178	240	6,720	9,060
90 L3s	3.54	178	240	7,560	10,200
100 L3s	3.94	178	240	8,400	11,330
120 L3s	4.72	178	240	10,090	13,590
100 L5s	3.94	178	240	8,400	11,330
120 L5s	4.72	178	240	10,090	13,590
140 L5s	5.51	178	240	11,770	15,860
160 L5s	6.30	178	240	13,450	18,130
180 L5s	7.09	178	240	15,130	20,390
200 L5s	7.87	178	240	16,810	22,660
160 L5s-2 ⁵	5.85	178	240	12,500	16,850
180 L7s	7.09	178	240	15,130	20,390
200 L7s	7.87	178	240	16,810	22,660
400 L7s	9.45	178	240	20,170	27,190
220 L7s-2 ⁵	8.66	178	240	18,490	24,920
240 L7s-2 ⁵	9.45	178	240	20,170	27,190
260 L7s-2 ⁵	10.24	178	240	21,850	29,460
280 L7s-2 ⁵	11.02	178	240	23,530	31,720
300 L7s-2 ⁶	11.81	178	240	25,210	33,990
320 L7s-2 ⁶	12.60	178	240	26,900	36,250

For SI: 1 psi = 6,895 Pa

¹The tabulated values are reference design values intended for Allowable Stress Design (ASD) and must be adjusted in accordance with Section 4.3.

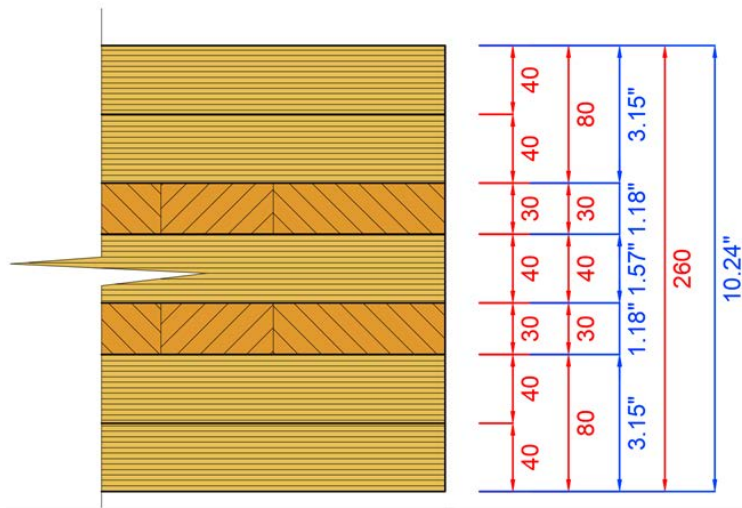
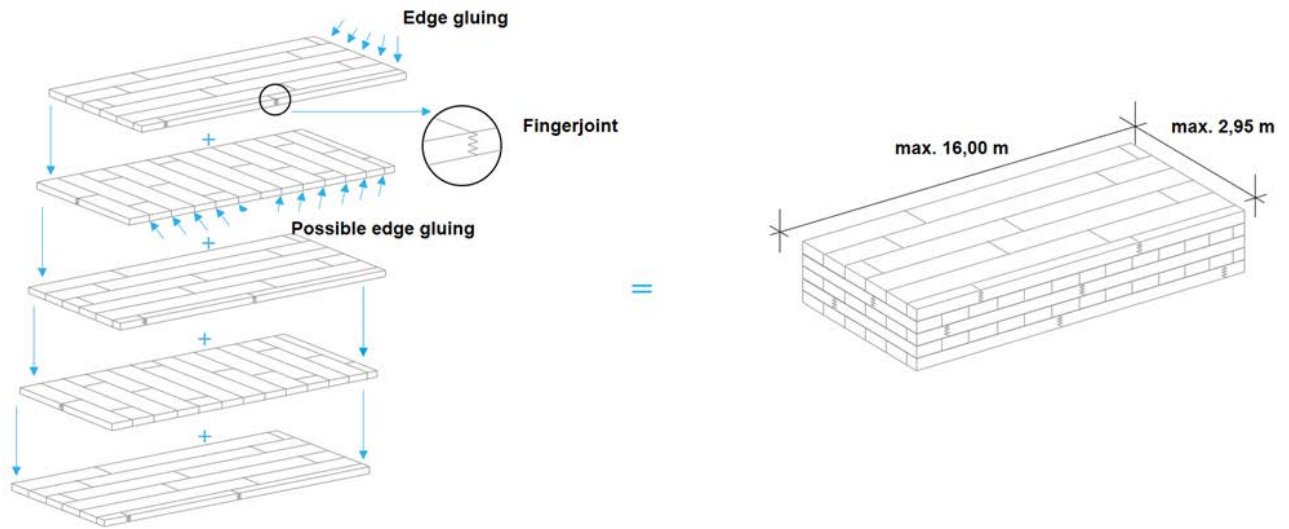
²The tabulated values are ASD reference edgewise shear stress of CLT in the major strength direction ($F_{v,e,0}$) and minor strength direction ($F_{v,e,90}$).

³The tabulated values are ASD 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“∥” 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.

⁵The CLT layups are developed based on the ANSI/APA PRG 320, using visually graded sawn lumber noted in Section 3.2.1 of the evaluation report. 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.

⁶300 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

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

REPORT HOLDER:

STORA ENSO OYJ

EVALUATION SUBJECT:

CLT BY STORA ENSO

1.0 REPORT PURPOSE AND SCOPE**Purpose:**

The purpose of this evaluation report supplement is to indicate that the CLT by Stora Enso, described in ICC-ES evaluation report [ESR-4381](#), has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The CLT by Stora Enso, described in Sections 2.0 through 7.0 of the evaluation report [ESR-4381](#), complies with the LABC Chapters 6 and 23, and the LARC, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The CLT by Stora Enso, described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report [ESR-4381](#).
- The design, installation, conditions of use and identification are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report [ESR-4381](#).
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

This evaluation report supplement expires concurrently with the evaluation report [ESR-4381](#), reissued October 2022.

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

REPORT HOLDER:

STORA ENSO OYJ

EVALUATION SUBJECT:

CLT BY STORA ENSO

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the CLT by Stora Enso, described in ICC-ES evaluation report ESR-4381, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2019 *California Building Code (CBC)*

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) aka: California Department of Health Care Access and Information (HCAI) and Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2019 *California Residential Code (CRC)*

2.0 CONCLUSIONS

2.1 CBC:

The CLT by Stora Enso, described in Sections 2.0 through 7.0 of the evaluation report ESR-4381, complies with CBC Chapters 6 and 23, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of the CBC Chapters 6, 16, 17 and 23, as applicable.

2.1.1 OSHPD: The applicable OSHPD Sections of the CBC are beyond the scope of this supplement.

2.1.2 DSA: The applicable DSA Sections of the CBC are beyond the scope of this supplement.

2.2 CRC:

The CLT by Stora Enso, described in Sections 2.0 through 7.0 of the evaluation report ESR-4381, complies with CRC Chapters 5, 6 and 8, provided the design and installation are in accordance with the 2018 *International Residential Code*® (IRC) provisions noted in the evaluation report.

This supplement expires concurrently with the evaluation report ESR-4381, reissued October 2022.