



## Mercer Cross-Laminated Timber Mercer, Inc.

Initial Acceptance: March 1, 2022

Expiration: February 28, 2023

Revision: October 11, 2022

### **TYPE OF ACCEPTANCE:**

**Product Material — Wood, Plastics and Composites**

CSI Specification Division: 06 00 00 and Section: 06 17 19 Cross-Laminated Timber

### **MANUFACTURER IDENTIFICATION**

**Mercer Mass Timber**

19202 Garland Ave.

Spokane Valley, WA 99027

[www.mercerint.com](http://www.mercerint.com)

### **DESCRIPTION OF THE PRODUCT EVALUATED**

**Mercer Cross-Laminated Timber (CLT)** uses Spruce-Pine-Fir (SPF) and Douglas-Fir-Larch (DF-L) laminations with ANSI 405 and CSA O112.9 approved structural adhesives to manufacture defined and custom CLT layouts in accordance with ANSI/APA PRG 320-2019. The SPF laminations shall be permitted to be replaced by DF-L of grades that are equal to or greater than the corresponding SPF laminations as described in Table 1 and Table 2 of this Report. The **Mercer CLT** layouts, described in Tables 3 through 6 in this Report, were developed by product qualification and the engineering model described in Appendix X3 of PRG 320-2019. Panels are layered and pressed and are manufactured with a maximum size of 12 ft. by 60 ft. (3.6m by 18.2m). **Mercer CLT** panels are used for floor, roof, and wall applications.

### **CODES AND STANDARDS APPLICABLE TO PRODUCT**

- 2012 International Building Code® (IBC®): Section 104.11 Alternative Materials
- 2015, 2018 IBC: Section 2303.1.4 Structural Glued Cross-Laminated Timber
- 2012 International Residential Code® (IRC®): Section R104.11 Alternative Materials
- 2015, 2018 IRC: Sections R502.1.6, R602.1.6 and R802.1.6 Cross-Laminated Timber
- ANSI/APA PRG 320-2019, *Standard for Performance-Rated Cross-Laminated Timber*
- 2015, 2018 National Design Specification® (NDS®) for Wood Construction
- 2015, 2020 National Building Code of Canada (NBCC): Clause 1.2.1.1 of Division A and Clauses 4.1, 4.3.1.1, and 9.23 of Division B
- Canadian Standards Association (CSA) O86-19, Engineering design in wood: Section 8 Cross-laminated timber, and May 2016 Update No. 1 supplement
- ANSI/APA PRG 320-2012 prescribed by CSA O86-14 May 2016 supplement

## **PROPERTIES REVIEWED**

Testing of **Mercer CLT** panels was conducted in accordance with the applicable Codes and Standards. The evaluation of the testing and analysis verified the **Mercer CLT** 3-, 5-, 7- and 9-layer panels, described in Tables 3 through 6 of this Report, comply with the requirements of PRG 320-2019. Specific design properties and capacities for the **Mercer CLT** panels are provided in Tables 1 through 6 in this Report.

Fire resistance of the **Mercer CLT** panels can be calculated using Section 16.2 of the NDS for the US and Annex B of CSA O86 for Canada.

## **DESIGN**

**Mercer CLT** panels can be used as elements in the design of floor, roof, and wall systems, although the design of such systems is beyond the scope of this Report. **Mercer CLT** panel properties and capacities are noted in Tables 3 through 6 in this Report.

## **LIMITATIONS OF ACCEPTANCE**

**Mercer CLT** panels described in this Report comply with the ANSI/APA PRG 320-2019 standard and with those codes listed in the 'Codes and Standards Applicable to Product' section of this Report, subject to the following conditions:

1. The product described in this Report is limited to dry service conditions where the average in-service equilibrium moisture content of solid wood is less than 16 percent in the United States and is 15 percent or less over a year without exceeding 19 percent in Canada.
2. Design calculations, shop drawings and installation instruction must be furnished to the building official or authority having jurisdiction, verifying that the **Mercer CLT** panels are used in compliance with this Report and the requirements of the registered design professional responsible for the reference building project utilizing Mercer CLT. The calculations must be prepared by a registered design professional.
3. **Mercer CLT** panels are permitted to be cut to width and length for the required applications, if approved by the manufacturer and registered design professional, but the thickness shall not be altered.
4. **Mercer CLT** panels are manufactured using layup combinations defined in Tables 3 and 4 of this Report at the Mercer CLT facility located in Spokane Valley, Washington, with quality control inspections performed by PFS TECO.

## **DOCUMENTATION SUBMITTED**

Submitted data was provided in accordance with PFS TECO's *Certification and Inspection Policy: Cross-Laminated Timber (v1.0)*, and the product has been evaluated for compliance with ANSI/APA PRG 320-2019.

## **PRODUCT IDENTIFICATION**

**Mercer CLT** panels described in this Report must be identified by a mark bearing the product name, layup, production date, plant number (917), the PFS TECO Building Product Evaluation Report number (BPER 0141) and the PFS Certification Mark (Fig. 1).



**Fig. 1:** PFS Certification Mark with Canadian and United States country identifiers



**Table 1. ASD Reference Design Values<sup>(a)</sup> for Lumber Laminations Used in Mercer CLT**

CLT Grade	Laminations used in Major Strength Direction						Laminations used in Minor Strength Direction					
	F <sub>b,0</sub> (psi)	E (10 <sup>6</sup> psi)	F <sub>t,0</sub> (psi)	F <sub>c,0</sub> (psi)	F <sub>v,0</sub> (psi)	F <sub>s,0</sub> (psi)	F <sub>b,90</sub> (psi)	E (10 <sup>6</sup> psi)	F <sub>t,90</sub> (psi)	F <sub>c,90</sub> (psi)	F <sub>v,90</sub> (psi)	F <sub>s,90</sub> (psi)
1.4V <sup>(b)</sup>	875	1.4	450	1,150	135	45	500	1.2	250	650	135	45
1.8M <sup>(c)</sup>	2,100	1.8	1,575	1,875	160	50	500	1.2	250	650	135	45

For SI: 1 psi = 0.006895 MPa

- (a) Tabulated values are allowable design values and are not permitted to be increased for the lumber size adjustment factor in accordance with the NDS. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layup used in manufacturing the CLT panel (see Tables 3 and 5).
- (b) 1.4V grade design values are approved for SPF or DF-L alternative laminations. Major strength direction laminations for each species group shall be visually and/or electronically graded materials with design values that equal or exceed the 1.4V design values in Table 1. and
- (c) 1.8M grade design values are approved for SPF or DF-L alternative laminations. Major strength direction laminations for each species group shall be electronically graded materials with design values that equal or exceed the 1.8M design values in Table 1.



**Table 2. LSD Reference Design Values<sup>(a)</sup> for Lumber Laminations Used in Mercer CLT**

CLT Grade	Laminations used in Major Strength Direction						Laminations used in Minor Strength Direction					
	F <sub>b,0</sub> (MPa)	E (MPa)	F <sub>t,0</sub> (MPa)	F <sub>c,0</sub> (MPa)	F <sub>v,0</sub> (MPa)	F <sub>s,0</sub> (MPa)	F <sub>b,90</sub> (MPa)	E (MPa)	F <sub>t,90</sub> (MPa)	F <sub>c,90</sub> (MPa)	F <sub>v,90</sub> (MPa)	F <sub>s,90</sub> (MPa)
1.4V <sup>(b)</sup>	11.8	9,500	5.5	11.5	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50
1.8M <sup>(c)</sup>	30.4	12,400	17.7	19.9	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50

For Imperial System: 1 MPa = 145 psi

- (a) Tabulated values are limit state design values and are not permitted to be increased for the lumber size adjustment factor in accordance with the CSA O86. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layup used in manufacturing the CLT panel (see Tables 4 and 6).
- (b) 1.4V grade design values are approved for SPF or DF-L alternative laminations. Major strength direction laminations for each species group shall be visually and/or electronically graded materials with design values that equal or exceed the 1.4V design values in Table 2.
- (c) 1.8M grade design values are approved for SPF or DF-L alternative laminations. Major strength direction laminations for each species group shall be electronically graded materials with design values that equal or exceed the 1.8M design values in Table 2.



**Table 3. ASD Reference Flatwise Design Values <sup>(a)(b)</sup> for Mercer CLT**

CLT Grade	CLT Layup Designation	Thickness, $t_p$ (in.)	Lamination Thickness in CLT Layup (in.)									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$F_b S_{eff,0}$ (lbf-ft/ft)	$E_{eff,0}$ ( $10^6$ lbf-in <sup>2</sup> /ft)	$GA_{eff,0}$ ( $10^6$ lbf/ft)	$V_{s,0}$ (lbf/ft)	$F_b S_{eff,90}$ (lbf-ft/ft)	$E_{eff,90}$ ( $10^6$ lbf-in <sup>2</sup> /ft)	$GA_{eff,90}$ ( $10^6$ lbf/ft)	$V_{s,90}$ (lbf/ft)
1.4V <sup>(c)</sup>	CLT3-082	3.24	1.08	1.08	1.08							1,250	46	0.36	1,170	95	1.5	0.41	390
	CLT3-090	3.54	1.18	1.18	1.18							1,500	60	0.39	1,270	115	2.0	0.44	425
	CLT3-090T	3.54	1.08	1.38	1.08							1,460	59	0.37	1,270	160	3.2	0.51	495
	CLT3-097	3.84	1.38	1.08	1.38							1,790	78	0.45	1,380	95	1.5	0.42	390
	CLT3-100	3.94	1.38	1.18	1.38							1,870	83	0.45	1,420	115	2.0	0.45	425
	CLT3-105	4.14	1.38	1.38	1.38							2,050	96	0.46	1,490	160	3.2	0.52	495
	CLT5-137	5.40	1.08	1.08	1.08	1.08	1.08					2,875	176	0.72	1,940	845	39	0.81	1,170
	CLT5-150	5.90	1.18	1.18	1.18	1.18	1.18					3,450	229	0.78	2,120	1,010	51	0.89	1,270
	CLT5-152T	6.00	1.08	1.38	1.08	1.38	1.08					3,350	227	0.74	2,160	1,200	66	1.0	1,380
	CLT5-160	6.30	1.38	1.08	1.38	1.08	1.38					4,125	293	0.91	2,270	985	50	0.84	1,270
	CLT5-175	6.90	1.38	1.38	1.38	1.38	1.38					4,700	367	0.92	2,480	1,380	82	1.0	1,490
	CLT7-222	8.76	1.38	1.08	1.38	1.08	1.38	1.08	1.38			7,300	723	1.4	3,150	2,260	195	1.3	2,160
	CLT7-245	9.66	1.38	1.38	1.38	1.38	1.38	1.38	1.38			8,325	908	1.4	3,475	3,175	315	1.6	2,480
	CLT9-285	11.22	1.38	1.08	1.38	1.08	1.38	1.08	1.38	1.08	1.38	11,350	1,437	1.8	4,050	4,000	486	1.7	3,050
CLT9-315	12.42	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	12,900	1,810	1.8	4,475	5,625	782	2.1	3,475	
1.8M <sup>(d)</sup>	CLT3-097	3.84	1.38	1.08	1.38							4,300	100	0.46	1,380	95	1.5	0.53	430
	CLT3-105	4.14	1.38	1.38	1.38							4,925	123	0.47	1,490	160	3.2	0.65	550
	CLT5-160	6.30	1.38	1.08	1.38	1.08	1.38					9,875	377	0.93	2,270	985	50	1.1	1,420
	CLT5-175	6.90	1.38	1.38	1.38	1.38	1.38					11,275	471	0.93	2,480	1,380	82	1.3	1,660

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

- (a) Tabulated values are allowable design values and not permitted to be increased for the flat use or size adjustment factor in accordance with the NDS.
- (b) Tabulated values are based on the shear-analogy model as defined in PRG 320-2019 Appendix X3.
- (c) 1.4V grade design values are approved for SPF laminations and for DF-L alternative laminations. Major strength direction laminations for each species group shall be visually and/or electronically graded materials with design values that equal or exceed the 1.4V design values in Table 1.
- (d) 1.8M grade design values are approved for SPF laminations and DF-L alternative laminations. Major strength direction laminations for each species group shall be electronically graded materials with design values that equal or exceed the 1.8M design values in Table 1.



**Table 4. LSD Reference Flatwise Design Values <sup>(a)(b)</sup> for Mercer CLT**

CLT Grade	CLT Layup Designation	Thickness, $t_p$ (mm)	Lamination Thickness in CLT Layup (mm)									Major Strength Direction				Minor Strength Direction			
			=	⊥	=	⊥	=	⊥	=	⊥	=	$F_{bSeff,0}$ ( $10^6$ N-mm/m)	$E_{eff,0}$ ( $10^9$ N-mm <sup>2</sup> /m)	$GA_{eff,0}$ ( $10^6$ N/m)	$V_{s,0}$ (kN/m)	$F_{bSeff,90}$ ( $10^6$ N-mm/m)	$E_{eff,90}$ ( $10^9$ N-mm <sup>2</sup> /m)	$GA_{eff,90}$ ( $10^6$ N/m)	$V_{s,90}$ (kN/m)
1.4V <sup>(c)</sup>	CLT3-082	82.5	27.5	27.5	27.5							11	429	5.7	28	0.88	16	5.9	9.2
	CLT3-090	90.0	30	30	30							13	556	6.2	30	1.1	20	6.4	10
	CLT3-090T	90.0	27.5	35	27.5							13	544	5.8	30	1.4	32	7.4	12
	CLT3-097	97.5	35	27.5	35							16	718	7.1	33	0.88	16	6.1	9.2
	CLT3-100	100.0	35	30	35							16	771	7.1	33	1.1	20	6.6	10
	CLT3-105	105.0	35	35	35							18	884	7.2	35	1.4	32	7.5	12
	CLT5-137	137.5	27.5	27.5	27.5	27.5	27.5					25	1,643	11	46	7.7	406	12	28
	CLT5-150	150.0	30	30	30	30	30					30	2,134	12	50	9.1	527	13	30
	CLT5-152T	152.5	27.5	35	27.5	35	27.5					29	2,113	12	51	11	680	15	33
	CLT5-160	160.0	35	27.5	35	27.5	35					36	2,717	14	53	8.9	516	12	30
	CLT5-175	175.0	35	35	35	35	35					41	3,388	14	58	12	837	15	35
	CLT7-222	222.5	35	27.5	35	27.5	35	27.5	35			64	6,696	21	74	20	2,004	18	51
	CLT7-245	245.0	35	35	35	35	35	35	35			72	8,388	22	82	29	3,213	23	58
	CLT9-285	285.0	35	27.5	35	27.5	35	27.5	35	27.5	35	99	13,321	29	95	36	4,986	24	72
CLT9-315	315.0	35	35	35	35	35	35	35	35	35	112	16,724	29	105	51	7,958	30	82	
1.8M <sup>(d)</sup>	CLT3-097	97.5	35	27.5	35							40	937	7.3	33	0.88	16	7.8	9.2
	CLT3-105	105.0	35	35	35							46	1,153	7.3	35	1.4	32	10	12
	CLT5-160	160.0	35	27.5	35	27.5	35					92	3,541	15	53	9	516	16	30
	CLT5-175	175.0	35	35	35	35	35					105	4,414	15	58	12	838	19	35

For Imperial System: 1 mm = 0.03937 in.; 1 m = 3.28 ft.; 1 N = 0.2248 lbf

- (a) Tabulated values are allowable design values and not permitted to be increased for the flat use or size adjustment factor in accordance with the CSA O86.
- (b) Tabulated values are based on the shear-analogy model as defined in PRG 320-2019 Appendix X3.
- (c) 1.4V grade design values are approved for SPF laminations and for DF-L alternative laminations. Major strength direction laminations for each species group shall be visually and/or electronically graded materials with design values that equal or exceed the 1.4V design values in Table 2.
- (d) 1.8M grade design values are approved for SPF laminations and DF-L alternative laminations. Major strength direction laminations for each species group shall be electronically graded materials with design values that equal or exceed the 1.8M design values in Table 2.

**Table 5. ASD Edgewise Design Values for Mercer CLT 1.4V Grade Panels**

CLT Grade	No. of Layers	CLT Layup Designation	Thickness, $t_p$ (in.)	Edgewise Shear Stress <sup>(a)(b)</sup>	
				$F_{v,e,0}$ (psi)	$F_{v,e,90}$ (psi)
1.4V	3	CLT3-082	3.24	190	215
		CLT3-090	3.54	190 <sup>(c)</sup>	215 <sup>(c)</sup>
		CLT3-090T	3.54	190 <sup>(c)</sup>	215 <sup>(c)</sup>
		CLT3-097	3.84	190 <sup>(c)</sup>	215 <sup>(c)</sup>
		CLT3-100	3.94	190 <sup>(c)</sup>	215 <sup>(c)</sup>
		CLT3-105	4.14	190 <sup>(c)</sup>	215 <sup>(c)</sup>
	5	CLT5-137	5.40	240	235
		CLT5-150	5.91	240 <sup>(d)</sup>	235 <sup>(d)</sup>
		CLT5-152T	6.00	240 <sup>(d)</sup>	235 <sup>(d)</sup>
		CLT5-160	6.30	240 <sup>(d)</sup>	235 <sup>(d)</sup>
		CLT5-175	6.90	240 <sup>(d)</sup>	235 <sup>(d)</sup>
	7	CLT7-222	8.76	240 <sup>(d)</sup>	235 <sup>(d)</sup>
		CLT7-245	9.66	240 <sup>(d)</sup>	235 <sup>(d)</sup>
	9	CLT9-285	11.22	240 <sup>(d)</sup>	235 <sup>(d)</sup>
CLT9-315		12.42	240 <sup>(d)</sup>	235 <sup>(d)</sup>	

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

- (a) Tabulated values shall be multiplied by the gross cross section area (in.<sup>2</sup>) of the CLT element under consideration to attain the ASD edgewise shear strength (lbf).
- (b) Values are applicable for 1.4V and better CLT Grades.
- (c) Based on test results for CLT3-082
- (d) Based on test results for CLT5-137



**Table 6. LSD Edgewise Design Values for Mercer CLT 1.4V Grade Panels**

CLT Grade	No. of Layers	CLT Layup Designation	Thickness, $t_p$ (mm)	Edgewise Shear Stress <sup>(a)(b)</sup>	
				$F_{v,e,0}$ (MPa)	$F_{v,e,90}$ (MPa)
1.4V	3	CLT3-082	82.5	2.9	3.2
		CLT3-090	90.0	2.9 <sup>(c)</sup>	3.2 <sup>(c)</sup>
		CLT3-090T	90.0	2.9 <sup>(c)</sup>	3.2 <sup>(c)</sup>
		CLT3-097	97.5	2.9 <sup>(c)</sup>	3.2 <sup>(c)</sup>
		CLT3-100	100.0	2.9 <sup>(c)</sup>	3.2 <sup>(c)</sup>
		CLT3-105	105.0	2.9 <sup>(c)</sup>	3.2 <sup>(c)</sup>
	5	CLT5-137	137.5	3.6	3.5
		CLT5-150	150.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
		CLT5-152T	152.5	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
		CLT5-160	160.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
		CLT5-175	175.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
	7	CLT7-222	222.5	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
		CLT7-245	245.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
	9	CLT9-285	285.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>
CLT9-315		315.0	3.6 <sup>(d)</sup>	3.5 <sup>(d)</sup>	

For Imperial System: 1 mm = 0.03937 in.; 1 m = 3.28 ft.; 1 N = 0.2248 lbf

- (a) Tabulated values shall be multiplied by the gross cross section area ( $\text{mm}^2$ ) of the CLT element under consideration to attain the LSD edgewise shear strength (N).
- (b) Values are applicable for 1.4V and better CLT Grades.
- (c) Based on test results for CLT3-082.
- (d) Based on test results for CLT5-137.