

DRJ Cross-Laminated Timber
D.R. Johnson Wood Innovations

PR-L320

Revised January 25, 2021

Products: DRJ Cross-Laminated Timber
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1. Basis of the product report:
 - 2018 and 2015 International Building Code (IBC): Section 2303.1.4 Structural glued cross-laminated timber
 - 2012 IBC: Section 104.11 Alternative materials
 - 2018 and 2015 International Residential Code (IRC): Sections R502.1.6, R602.1.6, and R802.1.6 Cross-laminated timber
 - 2012 IRC: Section R104.11 Alternative materials
 - ANSI/APA PRG 320-2019 Standard for Performance-Rated Cross-Laminated Timber
 - ANSI/APA PRG 320-2017, PRG 320-2012, and PRG 320-2011 Standard for Performance-Rated Cross-Laminated Timber, recognized in the 2018 IBC and IRC, 2015 IRC, and 2015 IBC, respectively
 - APA Reports T2015P-27, T2017P-01, T2019P-53, and T2020P-15, and other qualification data
2. Product description:

DRJ cross-laminated timber (CLT) is manufactured with Douglas fir-Larch lumber in accordance with ANSI/APA PRG 320 through product qualification and/or mathematical models using principles of engineering mechanics. Allowable design properties for lumber laminations used in DRJ CLT are provided in Table 1. DRJ CLT is permitted for use in floor, roof, and wall applications, and is manufactured with nominal widths of 12 to 120 inches, thicknesses of 3-3/8 to 9-5/8 inches, and lengths up to 42 feet.
3. Design properties:

DRJ CLT shall be designed with the design properties and capacities provided in Tables 2 and 3. The design adjustment factors shall be based on Chapter 10 of the 2018 National Design Specification for Wood Construction (NDS) and approved by the engineer of record. The lateral resistance of DRJ CLT, when used as shearwalls or diaphragms, depends on the panel-to-panel connection and anchorage designs, and shall be consulted with the CLT manufacturer and approved by the engineer of record.
4. Product installation:

DRJ CLT shall be installed in accordance with the recommendations provided by the manufacturer (www.drjwoodinnovations.com/) and the engineering drawing approved by the engineer of record. Permissible details shall be in accordance with the engineering drawing.
5. Fire-rated assemblies:

Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer (see link above). Procedures specified in Chapter 16 of the 2018 NDS shall be permitted for use in designing DRJ CLT for a fire exposure up to 2 hours.
6. Limitations:
 - a) DRJ CLT shall be designed in accordance with principles of mechanics using the design properties specified in this report or provided by the manufacturer.

- b) DRJ CLT products shall be limited to dry service conditions where the average equilibrium moisture content of solid-sawn lumber is less than 16 percent.
 - c) Design properties for DRJ CLT, when used as beams or lintels with loads applied parallel to the face-bond gluelines, are beyond the scope of this report.
 - d) DRJ CLT shall be manufactured in accordance with ANSI/APA PRG 320 for the grades and layups specified in this report and documented in the D.R. Johnson Wood Innovations' in-plant manufacturing standard approved by APA.
 - e) DRJ CLT is produced at the facilities of D.R. Johnson Wood Innovations, Riddle, Oregon, under a quality assurance program audited by APA.
 - f) This report is subject to re-examination in one year.
7. Identification:
DRJ CLT described in this report is identified by a label bearing the manufacturer's name (D.R. Johnson Wood Innovations) and/or trademark, the APA assigned plant number (1117), the product standard (ANSI/APA PRG 320), the APA logo, the CLT grade, the report number PR-L320, and a means of identifying the date of manufacture.

Table 1. ASD Reference Design Values^(a) for Lumber Laminations Used in DRJ CLT (for Use in the U.S.)

| CLT Grade | Laminations Used in Major Strength Direction | | | | | | | Laminations Used in Minor Strength Direction | | | | | | |
|--------------|--|-------------------------|----------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--|-------------------------|----------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | Grade & Species | F _b (psi) | E (10 ⁶ psi) | F _t (psi) | F _c (psi) | F _v (psi) | F _s (psi) | Grade & Species | F _b (psi) | E (10 ⁶ psi) | F _t (psi) | F _c (psi) | F _v (psi) | F _s (psi) |
| E2, E2.1 | 1650f-1.5E DF | 1,650 | 1.5 | 1,020 | 1,700 | 180 | 60 | No. 3 DF | 525 | 1.4 | 325 | 775 | 180 | 60 |
| E2M1 | 2250F _b -2.0E- 1600F _t DF | 2,250 | 2.0 | 1,600 | 1,925 | 180 | 60 | 2250F _b -2.0E- 1600F _t DF | 2,250 | 2.0 | 1,600 | 1,925 | 180 | 60 |
| E2M3, E2M3.1 | 2250F _b -2.0E- 1600F _t DF | 2,250 | 2.0 | 1,600 | 1,925 | 180 | 60 | No. 2 DF | 900 | 1.6 | 575 | 1,350 | 180 | 60 |
| E2M4, E2M4.1 | 2250F _b -2.0E- 1600F _t DF | 2,250 | 2.0 | 1,600 | 1,925 | 180 | 60 | No. 3 DF | 525 | 1.4 | 325 | 775 | 180 | 60 |
| V1, V1.1 | No. 2 DF | 900 | 1.6 | 575 | 1,350 | 180 | 60 | No. 3 DF | 525 | 1.4 | 325 | 775 | 180 | 60 |
| V1M1, V1M1,1 | No. 2 DF | 900 | 1.6 | 575 | 1,350 | 180 | 60 | No. 2 DF | 900 | 1.6 | 575 | 1,350 | 180 | 60 |

For SI: 1 psi = 0.006895 MPa

^(a) Tabulated values are allowable design values and not permitted to be increased for the lumber flat use or size 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 Table 2).

Table 2. ASD Reference Design Values^(a) for DRJ CLT (for Use in the U.S.)

| CLT Grade ^(b) | Layup ID ^(c) | Thick-ness, t_p (in.) | Lamination Thickness (in.) in CLT Layup | | | | | | | Major Strength Direction | | | | Minor Strength Direction | | | |
|--------------------------|-------------------------|-------------------------|---|-------|-------|-------|-------|-------|-------|--|--|--|-------------------|---|---|---|--------------------|
| | | | = | ⊥ | = | ⊥ | = | ⊥ | = | (F_cS) _{eff,f,0} (lb-ft/ft) | (EI) _{eff,f,0} (10 ⁶ lbf-in. ² /ft) | (GA) _{eff,f,0} (10 ⁶ lbf/ft) | $V_{s,0}$ (lb/ft) | (F_cS) _{eff,f,90} (lb-ft/ft) | (EI) _{eff,f,90} (10 ⁶ lbf-in. ² /ft) | (GA) _{eff,f,90} (10 ⁶ lbf/ft) | $V_{s,90}$ (lb/ft) |
| E2 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 3,825 | 102 | 0.53 | 1,980 | 165 | 3.6 | 0.56 | 660 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 8,825 | 389 | 1.1 | 3,300 | 1,440 | 95 | 1.1 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 15,600 | 963 | 1.6 | 4,625 | 3,300 | 364 | 1.7 | 3,300 |
| E2.1 | 3 | 3 3/8 | 1 3/8 | 5/8 | 1 3/8 | | | | | 2,650 | 57 | 0.56 | 1,620 | 35 | 0.34 | 0.31 | 300 |
| | 5 | 5 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | | | 6,100 | 210 | 1.1 | 2,575 | 520 | 22 | 0.62 | 1,260 |
| | 7 | 7 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 10,850 | 513 | 1.7 | 3,550 | 1,170 | 87 | 0.94 | 2,220 |
| E2M1 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 5,225 | 135 | 0.75 | 1,980 | 710 | 5.2 | 0.75 | 660 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 12,025 | 519 | 1.5 | 3,300 | 6,150 | 135 | 1.5 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 21,300 | 1,286 | 2.2 | 4,625 | 14,150 | 519 | 2.3 | 3,300 |
| E2M3 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 5,225 | 135 | 0.61 | 1,980 | 285 | 4.2 | 0.73 | 660 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 12,025 | 518 | 1.2 | 3,300 | 2,460 | 108 | 1.5 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 21,225 | 1,282 | 1.8 | 4,625 | 5,675 | 416 | 2.2 | 3,300 |
| E2M3.1 | 3 | 3 3/8 | 1 3/8 | 5/8 | 1 3/8 | | | | | 3,600 | 76 | 0.65 | 1,620 | 60 | 0.39 | 0.41 | 300 |
| | 5 | 5 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | | | 8,325 | 280 | 1.3 | 2,575 | 890 | 25 | 0.83 | 1,260 |
| | 7 | 7 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 14,775 | 684 | 2.0 | 3,550 | 2,020 | 100 | 1.2 | 2,220 |
| E2M4 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 5,225 | 135 | 0.54 | 1,980 | 165 | 3.6 | 0.72 | 660 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 12,000 | 518 | 1.1 | 3,300 | 1,440 | 95 | 1.4 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 21,200 | 1,281 | 1.6 | 4,625 | 3,325 | 365 | 2.2 | 3,300 |
| E2M4.1 | 3 | 3 3/8 | 1 3/8 | 5/8 | 1 3/8 | | | | | 3,600 | 76 | 0.58 | 1,620 | 35 | 0.34 | 0.41 | 300 |
| | 5 | 5 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | | | 8,300 | 280 | 1.2 | 2,575 | 520 | 22 | 0.82 | 1,260 |
| | 7 | 7 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 14,775 | 684 | 1.7 | 3,550 | 1,180 | 88 | 1.2 | 2,220 |
| V1 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 2,090 | 108 | 0.53 | 1,980 | 165 | 3.6 | 0.59 | 660 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 4,800 | 415 | 1.1 | 3,300 | 1,440 | 95 | 1.2 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 8,500 | 1,027 | 1.6 | 4,625 | 3,300 | 364 | 1.8 | 3,300 |
| V1.1 | 3 | 3 3/8 | 1 3/8 | 5/8 | 1 3/8 | | | | | 1,440 | 61 | 0.56 | 1,620 | 35 | 0.34 | 0.33 | 300 |
| | 5 | 5 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | | | 3,325 | 224 | 1.1 | 2,575 | 520 | 22 | 0.66 | 1,260 |
| | 7 | 7 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5,925 | 547 | 1.7 | 3,550 | 1,180 | 87 | 1.0 | 2,220 |

(Footnotes on the following page)

Table 2. ASD Reference Design Values^(a) for DRJ CLT (for Use in the U.S.) (Continues)

| CLT Grade ^(b) | Layup ID ^(c) | Thick-ness, t_p (in.) | Lamination Thickness (in.) in CLT Layup | | | | | | | Major Strength Direction | | | | Minor Strength Direction | | | |
|--------------------------|-------------------------|-------------------------|---|-----------|-------|-------|-------|-------|-------|-----------------------------------|--|--------------------------------------|-----------------------|------------------------------------|---|---------------------------------------|------------------------|
| | | | = | ⊥ | = | ⊥ | = | ⊥ | = | $(F_bS)_{eff,f,0}$ (lbf-ft/ft) | $(EI)_{eff,f,0}$ (10^6 lbf-in. ² /ft) | $(GA)_{eff,f,0}$ (10^6 lbf/ft) | $V_{s,0}$ (lbf/ft) | $(F_bS)_{eff,f,90}$ (lbf-ft/ft) | $(EI)_{eff,f,90}$ (10^6 lbf-in. ² /ft) | $(GA)_{eff,f,90}$ (10^6 lbf/ft) | $V_{s,90}$ (lbf/ft) |
| V1M1 | 3 | 4 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | | | 2,090 | 108 | 0.60 | 1,980 | 285 | 4.2 | 0.60 | 660 |
| | 4 | 5-1/2 | 1 3/8 | 1 3/8 x 2 | 1 3/8 | | | | | 3,400 | 234 | 0.71 | 2,650 | 1,130 | 33 | 1.2 | 1,320 |
| | 5 | 6 7/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | | | 4,825 | 415 | 1.2 | 3,300 | 2,460 | 108 | 1.2 | 1,980 |
| | 7 | 9 5/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 3/8 | 8,525 | 1,029 | 1.8 | 4,625 | 5,675 | 415 | 1.8 | 3,300 |
| V1M1.1 | 3 | 3 3/8 | 1 3/8 | 5/8 | 1 3/8 | | | | | 1,440 | 61 | 0.63 | 1,620 | 60 | 0.39 | 0.33 | 300 |
| | 5 | 5 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | | | 3,325 | 225 | 1.3 | 2,575 | 890 | 25 | 0.67 | 1,260 |
| | 7 | 7 3/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5/8 | 1 3/8 | 5,925 | 548 | 1.9 | 3,550 | 2,010 | 99 | 1.0 | 2,220 |

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 lumber flat use or size factor in accordance with the NDS.
- ^(b) The CLT grades are developed based on ANSI/APA PRG 320, as permitted by the standard.
- ^(c) The layup identification (ID) refers to the number of layers.

Table 3. ASD Reference Design Values^(a) for In-Plane Shear of DRJ CLT (for Use in the U.S.)

| CLT Grade | Layup ID | Thickness, t_p (in.) | In-Plane Shear Stress | | In-Plane Shear Capacity ^(b) | |
|-----------|----------|------------------------|-----------------------|--------------------|--|------------------------------------|
| | | | $F_{v,e,0}$ (psi) | $F_{v,e,90}$ (psi) | $F_{v,e,0} t_p$ (lbf/ft of width) | $F_{v,e,90} t_p$ (lbf/ft of width) |
| E2 | 3 | 4 1/8 | 210 ^(c) | 210 ^(c) | 10,400 ^(c) | 10,400 ^(c) |
| | 5 | 6 7/8 | 210 ^(d) | 210 ^(d) | 17,300 ^(d) | 17,300 ^(d) |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |
| E2M1 | 3 | 4 1/8 | 210 ^(c) | 210 ^(c) | 10,400 ^(c) | 10,400 ^(c) |
| | 5 | 6 7/8 | 210 ^(d) | 210 ^(d) | 17,300 ^(d) | 17,300 ^(d) |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |
| E2M3 | 3 | 4 1/8 | 210 ^(c) | 210 ^(c) | 10,400 ^(c) | 10,400 ^(c) |
| | 5 | 6 7/8 | 210 ^(d) | 210 ^(d) | 17,300 ^(d) | 17,300 ^(d) |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |
| E2M4 | 3 | 4 1/8 | 210 ^(c) | 210 ^(c) | 10,400 ^(c) | 10,400 ^(c) |
| | 5 | 6 7/8 | 210 ^(d) | 210 ^(d) | 17,300 ^(d) | 17,300 ^(d) |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |
| V1 | 3 | 4 1/8 | 210 | 210 | 10,400 | 10,400 |
| | 5 | 6 7/8 | 210 | 210 | 17,300 | 17,300 |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |
| V1M1 | 3 | 4 1/8 | 210 ^(c) | 210 ^(c) | 10,400 ^(c) | 10,400 ^(c) |
| | 5 | 6 7/8 | 210 ^(d) | 210 ^(d) | 17,300 ^(d) | 17,300 ^(d) |
| | 7 | 9 5/8 | 210 ^(d) | 210 ^(d) | 24,300 ^(d) | 24,300 ^(d) |

For SI: 1 psi = 0.006895 MPa

^(a) The tabulated values are allowable design values.

^(b) The tabulated values are for the full thickness (t_p) of the CLT. The values shall be reduced when the CLT panel thickness is less than the full thickness.

^(c) Based on test results from 4-1/8-inch V1 grade CLT.

^(d) Based on test results from 6-7/8-inch V1 grade CLT.

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