# ICC-ES Evaluation Report

**ESR-2993**

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**DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES**
**Section: 06 17 13—Laminated Veneer Lumber**

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**EVALUATION SUBJECT:**

**STRUCTURAL COMPOSITE LUMBER: REDLAM™ LAMINATED VENEER LUMBER (LVL)**

## 1.0 EVALUATION SCOPE

**Compliance with the following codes:**

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)

**Properties evaluated:**

- Structural
- Fire resistance
- Fire blocking

## 2.0 USES

The structural composite lumber (SCL) products described in this evaluation report are used as alternatives to sawn lumber for wall, floor and roof structural members, and are as defined in Chapter 2 of the 2015 and 2012 IBC, Chapter 23 of the 2009 IBC, and Chapter 2 of the 2015 and 2012 IRC. These structural applications include use as beams, headers, joists, rafters, columns, and rim boards. The products are also used as components of built-up structural members, such as flanges for I-joists and chords for trusses, as detailed in a current ICC-ES evaluation report.

## 3.0 DESCRIPTION

### 3.1 General:

The structural composite lumber (SCL) described in this report is an alternative material to that described in Chapter 23 of the IBC, and complies with the requirements noted in Sections 2303.1.10 of the 2015 IBC and 2303.1.9 of the 2012 and 2009 IBC and Section 2301.2(1.) of the IBC for allowable stress design. Section 2308 of the IBC and Chapters 5, 6 and 8 of the IRC are applicable to the SCL described in this report.

### 3.2 Rim Board:

The rim board product described in this evaluation report is a continuously supported structural element located at the joist elevation in an end bearing wall or parallel to the joist framing that is the full depth of the joist space and manufactured in minimum continuous 8-foot-long (2.44 m) segments for the length of the wall. The rim boards may be used for any combination of the following:

a. To transfer, from above to below, all vertical loads at the rim board location. Allowable vertical loads are noted in Table 3.

b. To provide diaphragm attachment (sheathing to top edge of rim board).

c. To transfer in-plane lateral loads from the diaphragm to the wall plate below.

d. To provide lateral support to the joist or rafter (resistance against rotation) through attachment to the joist or rafter.

e. To provide closure for ends of joists or rafters.

f. To provide an attachment base for siding or an exterior deck ledger.

The rim board properties and species, adhesive, manufacturing parameters, and finished product thickness, width and length meet the requirements noted in the approved quality control manual that contains the manufacturing standard.

### 3.3 RedLam LVL:

RedLam LVL is manufactured from veneers of a single wood species, or species combination, and adhesives meeting the requirements specified in the approved quality control manual and manufacturing standard prepared by RedBuilt™. During manufacture, the veneers are placed in a continuous-feed press, and the veneers are bonded together with an approved adhesive. RedLam LVL is available in thicknesses from $^3/_4$ inch (19.1 mm) to 7 inches (178 mm), depths from $2^1/_2$ inches (63.5 mm) to 24 inches (610 mm), and lengths up to 80 feet (24 380 mm). 1.4E RedLam LVL is available in depths up to 48 inches (1219 mm).

### 3.4 RedLam LVL Rim Board:

RedLam LVL rim board may be used in rim board application, as defined in Section 3.2.

## 4.0 DESIGN AND INSTALLATION

### 4.1 General:

The design and installation of RedBuilt™ structural composite lumber must comply with this report and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation. Design of the structural composite lumber products described in this report is governed by the applicable code and the ANSI/AWC/AF&PA *National Design Specification® for Wood Construction* (NDS). This report governs if there are conflicts between the manufacturer's published installation instructions and this report.

### 4.2 RedLam LVL:

**4.2.1 Design and Allowable Stresses:** The design provisions for wood construction noted in Section 2301.2(1) of the IBC (for allowable stress design) and Section R301.1.3 of the IRC, are applicable to RedLam LVL, unless otherwise noted in this report. Reference design values, sizes and veneer species for RedLam LVL for dry conditions of use are specified in Table 1 of this report.

Unless otherwise noted, adjustment of the design stresses for duration of load must be in accordance with the applicable code.

Reference withdrawal and lateral design values for nails installed perpendicular or parallel to the wide face of RedLam LVL are as prescribed in the applicable code for sawn lumber having a minimum specific gravity of 0.50, such as for Douglas fir–larch. Minimum spacings of nails installed perpendicular to the glue lines on the wide face of RedLam LVL must be as prescribed in Chapter 12 of the ANSI/AWC *National Design Specification® for Wood Construction* (NDS) (Chapter 11 of the 2012 and 2005 NDS for the 2012 and 2009 NDS, respectively), for sawn lumber. Minimum spacing, end distance and edge distance of nails and staples installed parallel to the glue lines on the narrow face of the material must be as prescribed in Table 2 of this report. Other nail spacings for specific applications, such as prefabricated steel components or hangers, may be used as detailed for RedLam LVL in a current ICC-ES evaluation report.

Reference lateral design values for machine bolts installed perpendicular to the wide face of RedLam LVL (perpendicular to the glue lines), with loads applied parallel or perpendicular to the grain of the wood veneers, are as prescribed in the applicable code for sawn lumber having a minimum specific gravity of 0.50, such as for Douglas fir–larch.

**4.2.2 Fire-Resistance:** For applications under the 2015, 2012 and 2009 IBC, the fire-resistance of exposed RedLam LVL members may be calculated in accordance with Chapter 16 of the NDS.

**4.2.3 RedLam LVL Rim Board:** Toenailed connections are not limited by the 150 plf (2189 N/m) lateral load capacity noted for Seismic Design Categories D, E and F in Section 2305.1.4 of the 2006 IBC and Section 4.1.7 of the ANSI/AF&PA Special Design Provisions for Wind and Seismic (SDPWS). The ability of RedLam LVL to transfer shear is as described in Footnote 1 to Table 3 of this report.

**4.2.4 Fire-Blocking:** RedLam LVL Rim Board, having a minimum thickness of 1.25 inches (32 mm), may be used in lieu of sawn lumber for fire blocking.

## 5.0 CONDITIONS OF USE

The RedLam LVL Structural Composite Lumber products described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0, subject to the following conditions:

**5.1** Design stresses must comply with the values noted in this report.

**5.2** Design calculations and details must be furnished to the code official, verifying that the material is used in compliance with this report. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

**5.3** RedLam LVL products described in this report must be limited to covered end-use installations with dry conditions of use. Dry conditions of use are those environmental conditions represented by sawn lumber in which the equilibrium moisture content is equal to or less than 16 percent. The use of these products in covered installations, where the moisture content exceeds 16 percent, has not been reviewed and is beyond the scope of this evaluation report.

**5.4** Increases for duration of load, as provided for wood members and their connections, must be in accordance with the limitations specified in the applicable code and as set forth in this report, unless specifically prohibited by this report.

**5.5** Where flexural bending members qualify as repetitive members, as defined in the NDS, an increase of 4 percent is permitted in reference bending design values.

**5.6** Concentrated vertical load capacity for RedBuilt LVL rim board has not been evaluated. Concentrated vertical loads being transmitted through the rim board assembly require squash blocking or other load transfer means of evaluation.

**5.7** Length dimensions of RedLam LVL may be cut to size for required application. Depth must not be cut to less than $3^1/_2$ inches (89 mm). For all material used in structural applications, the product identification described in Section 7.0 must be maintained on all material, or the material must be re-stamped with the appropriate identification.Additionally, RedLam LVL may be notched, drilled, or tapered-end cut provided the design for such is by a registered design professional.

**5.8** Installation, fabrication, identification, and connection details must be in accordance with this report, the manufacturer's published installation instructions and the applicable code.

**5.9** 1.6E through 2.6E RedLam LVL is produced at the RedBuilt™ plant in Stayton, Oregon, under a quality control program with inspections by ICC-ES and PFS Corporation (AA-652).

**5.10** 1.4E RedLam LVL is produced at the Boise Cascade Wood Products plant in White City, Oregon, under a quality control program with inspections by ICC-ES and PFS Corporation (AA-652).

## 6.0 EVIDENCE SUBMITTED

**6.1** Data in accordance with the ICC-ES Acceptance Criteria for Structural Wood-based Products (AC47), dated June 2016 (editorially revised August 2016).

**6.2** Data in accordance with the ICC-ES Acceptance Criteria for Rim Board Products (AC124), dated October 2016.

**6.3** Reports of fire tests conducted in accordance with ASTM E119.

## 7.0 IDENTIFICATION

RedLam LVL is identified with a stamp bearing the manufacturer's name (RedBuilt™) and/or logo (see Figure 1), the name or logo of the inspection agency (PFS Corporation), as applicable, the evaluation report number (ESR-2993), the plant number, the product designation or type, the production date, the grade, and the species or species group designation. The product designation may be either RedLam LVL or RedBoard™. RedLam LVL is also identified with the marking "AGS" following the grade designation, if the advanced grading system specified in the approved quality control manual was used in the manufacturing process.

**TABLE 1—REFERENCE DESIGN VALUES FOR REDLAM™ LVL (ALLOWABLE STRESS DESIGN)[1,2] (pounds per square inch)**

| BILLET MATERIAL THICKNESS | GRADE SPECIES[3] | AXIAL | | JOIST/BEAM | | | | | PLANK | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $F_t$[4] | $F_c$ | $F_b$[5,6] | $F_v$[7] | E (x10^6) | $E_{min}$[10] (x10^6) | $F_{c\perp}$[8] | $F_b$[9] | $F_v$[9] | $F_{c\perp}$[8] |
| * | ~~1.4E DF/LP/WH~~ | ~~935~~ | ~~2500~~ | ~~1800~~ | ~~225~~ | ~~1.4~~ | ~~0.8~~ | ~~525~~ | ~~1800~~ | ~~150~~ | ~~450~~ |
| | 1.6E DF/LP/WH | 1240 | 2100 | 2140 | 285 | 1.6 | 0.9 | 750 | 2530 | 190 | 480 |
| | 1.8E DF/LP/WH | 1450 | 2375 | 2445 | 285 | 1.8 | 0.9 | 750 | 2890 | 190 | 480 |
| | 1.9E DF/LP/WH | 1555 | 2510 | 2600 | 285 | 1.9 | 1.0 | 750 | 3075 | 190 | 480 |
| | 2.0E DF/LP/WH | 1660 | 2635 | 2750 | 285 | 2.0 | 1.0 | 750 | 3255 | 190 | 480 |
| 3/4 inch to 7 inches | 2.0E-2900$F_b$ DF/LP/WH | 1660 | 2635 | 2900 | 285 | 2.0 | 1.0 | 750 | 3430 | 190 | 480 |
| * | ~~2.1E DF/LP/WH~~ | ~~1760~~ | ~~2755~~ | ~~2980~~ | ~~285~~ | ~~2.1~~ | ~~1.1~~ | ~~750~~ | ~~3525~~ | ~~190~~ | ~~480~~ |
| | 2.2E DF/LP/WH | 1865 | 2870 | 3060 | 285 | 2.2 | 1.1 | 750 | 3615 | 190 | 480 |
| * | ~~2.3E DF/LP/WH~~ | ~~1970~~ | ~~2975~~ | ~~3215~~ | ~~285~~ | ~~2.3~~ | ~~1.2~~ | ~~750~~ | ~~3800~~ | ~~190~~ | ~~480~~ |
| | 2.4E DF/LP/WH | 2075 | 3080 | 3365 | 285 | 2.4 | 1.2 | 750 | 3980 | 190 | 480 |
| | 2.6E DF/LP/WH | 2285 | 3270 | 3675 | 285 | 2.6 | 1.3 | 750 | 4345 | 190 | 480 |

For **SI:** 1 psi = 0.00689 MPa, 1 inch = 25.4 mm.

[1]Reference design values are based on covered, dry conditions of use and normal load duration. Dry conditions of use are those environmental conditions represented by sawn lumber at which the moisture content is less than or equal to 16%.

[2]For uniformly loaded simple span beams, deflection is calculated as follows:

$$\Delta = \frac{270WL^4}{Ebd^3} + \frac{28.8WL^2}{Ebd}$$

where: W = Uniform load, plf; Δ = Deflection, inches; L = Span, feet; b = Beam width, inches; d = Beam depth, inches; E = Modulus of Elasticity, psi

[3]DF = Douglas fir–larch; LP = lodgepole pine; WH = Western hemlock; DF, LP and WH are permitted to be combined as Western Species (WS).

[4]The $F_t$ values in the table are reduced to reflect the volume effects of length, width and thickness for a range of common application conditions. Therefore the $F_t$ values in the Table do not apply to RedLam LVL when used as a component of engineered products manufactured by RedBuilt™ which are listed in ICC-ES evaluation reports.

[5]$F_b$ includes allowances for variations in span to depth ratio and method of loading and must be used without further adjustment except as noted below. For depths other than 12 inches, regardless of thickness, table values must be multiplied by $(12/d)^{0.136}$. Adjustments for common depths are shown below. For depths less than 3.5 inches, the factor for the 3.5-inch depth must be used.

| Depth | 3.5 | 5.5 | 7.25 | 9.25 | 12 | 16 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|
| Multiplier | 1.18 | 1.11 | 1.07 | 1.04 | 1.00 | 0.96 | 0.93 | 0.91 |

[6]When structural members qualify as repetitive members in accordance with the applicable code, a 4 percent increase in accordance with NDS is permitted, in addition to the increases permitted in Footnote 5, above. This increase does not apply to field assembled multi-member beams.

[7]For simplicity, use 285 psi for depths up to 24 inches and 260 psi for depths greater than 24 inches. When a more accurate analysis is desired, the reference horizontal shear design value for all depths greater than 12 inches is Fv = 285 $(12/d)^{0.065}$ psi.

[8]Compression perpendicular to grain values ($F_{c\perp}$) may not be increased for duration of load.

[9]Values shown are for thicknesses up to 3.5 inches (in the direction perpendicular to the veneer faces). Tabulated plankwise bending, $F_b$, and shear, $F_v$, do not apply to LVL thicker than 3.5 inches.

[10]$E_{min}$ is the reference modulus of elasticity for beam stability and column stability calculations.

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**TABLE 2—MINIMUM ON-CENTER SPACING OF NAILS AND STAPLES DRIVEN INTO THE EDGE OF REDLAM LVL[1,2,3]**
**(For Fasteners Oriented Parallel to the Gluelines)**

| FASTENER | MINIMUM SPACING (inches) | | | | |
|---|---|---|---|---|---|
| | RedLam LVL Thickness, t (inches) | | | | |
| | $^3/_4 \le t < 1^1/_2$ | $1^1/_2 \le t < 2^1/_2$ | | $2^1/_2 \le t \le 3^1/_2$ | |
| | 1 Row | 1 Row | 2 Rows [4,5] | 1 Row | 4 Rows [4,5] |
| 8d Common Nail | 3 | 3 | 3 | 3 | 3 |
| 10d Common Nail | 4 | 4 | 4 | 4 | 5 |
| 12d Common Nail | 4 | 4 | 4 | 4 | 5 |
| 16d Common Nail | -- | 8 [6] | 8 [6] | 8 [6] | ( 6 |
| No. 14 gage staple | 4 | 4 | -- | 4 | -- |

For **SI:** 1 inch = 25.4 mm.

[1]Minimum end distances must be $2^1/_2$ inches for 8d common nails, and 3 inches for all other sizes.
[2]Minimum edge distance must be $^3/_8$ inch.
[3]Minimum spacings apply to LVL members having a minimum depth (dimension parallel to fastener axis) of $3^1/_2$ inches for one fastener row and $5^1/_2$ inches for multiple fastener rows.
[4]Multiple rows of fasteners must be staggered by half the distance between fasteners in a row, and the minimum spacing between rows must be $^1/_2$ inch.
[5]Multiple rows must be equally spaced about the centerline.
[6]Spacing may be reduced to 5 inches on center where nail penetration does not exceed $1^3/_8$ inches into the edge of the LVL.

**TABLE 3—REDLAM LVL RIM BOARD [1,2,3,4,6]**

| GRADE | MINIMUM THICKNESS (inches) | DEPTH RANGE (inches) | CONTAINS CROSS PLIES[7] | ALLOWABLE VERTICAL LOAD (plf) [4] |
|---|---|---|---|---|
| 1.6E and Higher [5] | 1.25 | $\le 11^7/_8$ | No | 4250 |
| | 1.50 | d ≤ 16 | No | 4160 |
| 1.4E | 1.50 | d ≤ 16 | Yes | 6480 |
| * ~~1.50~~ | ~~1.50~~ | ~~d ≤ 24~~ | ~~Yes~~ | ~~5600~~ |

For **SI:** 1 inch = 25.4 mm; 1 plf + 14.59 N/m.

[1]The allowable shear values in pounds per foot for horizontal wood structural panel diaphragms with framing of nominally 2-inch-thick Douglas fir–larch or Southern pine sawn lumber noted in Table 4.2A and Table 4.2C of the AWC Special Design Provisions for Wind and Seismic (SPDWS) for the 2015 IBC, Table 2306.2(1) of the 2012 IBC and Table 2306.2.1(1) of the 2009 IBC are applicable to: (1) 1.25-inch-thick RedLam LVL rim board for unblocked diaphragms only, and (2) 1.50-inch-thick and thicker RedLam LVL rim board for unblocked and blocked diaphragms. Nail spacing must be sufficient to prevent splitting, or as specified in Table 2, whichever is more restrictive.
[2]RedLam LVL rim board must be laterally supported at the top and continuously supported at the bottom, and the gravity loads must be uniformly applied along the top, in lieu of design by a design professional or other conditions
[3]Fastener capacities for RedLam LVL rim board are as recognized in Section 4.2.1 of this report, except as provided in footnote 5, below.
[4]Compression perpendicular to grain capacities of the sill plate and floor sheathing must be checked.
[5]The allowable perpendicular-to-grain lateral load capacity of a $^1/_2$-inch-diameter lag screw connection installed perpendicular to the veneers, with full penetration through RedLam LVL having a grade of 1.6E or higher, and supporting a $1^1/_2$-inch-thick deck ledger having a minimum specific gravity of 0.50, is 350 lbs.
[6]Toe-nailed connections between the rim board and supporting member are not limited by the 150 plf lateral load capacity noted for Seismic Design Categories D, E and F in Section 4.1.7 of the ANSI/AWC/AF&PA SDPWS.
[7]LVL members with cross plies consist of veneers oriented 90 degrees from the main orientation of veneers.


**FIGURE 1—MANUFACTURER LOGO**

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