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DIVISION: 06—WOOD AND PLASTICS
Section: 06170—Prefabricated Structural Wood

REPORT HOLDER:

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EVALUATION SUBJECT:

LP SolidStart® LVL (LAMINATED VENEER LUMBER)

ADDITIONAL LISTEE:

MURPHY ENGINEERED WOOD DIVISION
412 WEST CENTRAL
SUTHERLIN, OREGON 97479

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)
- 1997 *Uniform Building Code*™ (UBC)

Property evaluated:

Structural

2.0 USES

LP SolidStart® LVL products are intended for structural applications: beams, headers, joists, rafters, columns, rim boards and wall studs. They are also used as components in built-up structural members such as flanges for I-joists, chords for trusses and laminations for glue-laminated members.

3.0 DESCRIPTION

3.1 General:

LP SolidStart® LVL are alternatives to the materials described in Chapter 23 of the UBC and comply with the requirements noted in Section 2303.1.9 of the IBC for allowable stress design (Section 2301.2.1). Chapters 5, 6, and 8 of the IRC are applicable to the LVL materials described in this report.

The wood veneer properties and species, adhesive, manufacturing parameters, and finished product thickness, width and length must meet the requirements noted in the quality manual that contains the manufacturing standard.

The grades and allowable stresses for LP SolidStart® LVL are given in Table 1.

3.2 LP SolidStart® LVL:

LP SolidStart® LVL is made up of layers of wood veneers laminated together using an exterior-type structural adhesive. LP SolidStart® LVL "Billet Beams" are fabricated by face-laminating primary thicknesses.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The design provisions for solid-sawn lumber in Chapter 23 of the UBC and the ANSI/AF&PA National Design Specification for Wood Construction (NDS), except as modified herein, are applicable to the LVL described in this evaluation report. The reference stresses for the products described in this report are given in Tables 1, 2 and 4.

4.1.2 Connections: The design of connections for the LVL described in this evaluation report must be in accordance with the NDS for a solid wood species with an equivalent specific gravity. The equivalent specific gravity characteristics for nail, bolt and screw design for dry-use conditions are found in Table 2. The nail spacing requirements are found in Table 3. Specific approval by the code official is required for connections other than those indicated in Tables 2 and 3.

Exception: Lag screw connections between LP SolidStart® LVL rim board and deck ledgers have an allowable lateral load of 350 pounds (1.56 kN) per lag screw for 1-inch thickness (25.4 mm), 400 pounds (1.78 kN) per lag screw for $1^1/_8$-inch thickness (28.6 mm), and 450 pounds (2.00 kN) per lag screw for thicknesses greater than or equal to $1^1/_4$ inches (31.8 mm), under the following conditions:

(a) Lag screws must have a minimum diameter of $^1/_2$ inch (12.7 mm), and sufficient length to penetrate through the rim board, not including the tip of the lag screw.

(b) Deck ledgers must consist of minimum nominally 2-by-6 lumber having a minimum assigned specific gravity of 0.42.

(c) Sheathing between the rim board and the deck ledger must consist of wood structural panels meeting PS-1 or PS-2, and be attached to the rim board in accordance with the applicable code.

(d) One flat washer must be used between the deck ledger and the lag screw head.

(e) Edge distances from the center of the lag screw to the edges of the rim board and deck ledger must be 2 inches (51 mm) or greater. End distances must be 4 inches (102 mm) or greater.

(f) Adjustment factors in accordance with the NDS must be applied as applicable.

(g) Rim board and deck ledgers must be checked for load carrying capacity at connections in accordance with Section 10.1.2 of the NDS.

4.1.3 Rim Board: LP SolidStart® LVL: Rim boards are defined as continuously supported structural members (except as noted in the last sentence of Section 4.1.3 of this report), located at the joist elevation either perpendicular to, or parallel to, the joist framing, that are the full depth of the joist and are used for the following purposes:

1. Transfer, from above to below, vertical loads at the rim board location. Allowable vertical loads are noted in Table 5.
2. Provide diaphragm attachment (sheathing to top edge of rim board).
3. Transfer in-plane lateral loads from the diaphragm to the wall plate below.
4. Provide lateral support to the joist or rafter (resistance against rotation) through attachments to the joist or rafter.
5. Provide closure for ends of joists or rafters.
6. Provide attachment base for siding or exterior deck ledger.

Design of rim boards installed over wall openings must not exceed the reference stress noted in Table 1.

4.1.4 Wall Studs: LP SolidStart® LVL must be considered equivalent to sawn lumber studs for prescriptive design in accordance with Section 2308.9 of the IBC, Section R602 of the IRC, and Section 2320.11 of the UBC, subject to the following conditions:

1. LP SolidStart® LVL studs must be considered equivalent to sawn lumber studs with a specific gravity of 0.50.
2. Minimum LP SolidStart® LVL thickness must be $1^1/_2$ inches (38 mm).
3. Cutting, notching and boring of nominally 2-by-4 and 2-by-6 LP SolidStart® LVL studs is permitted in accordance with Sections 2308.9.10 and 2308.9.11 of the IBC, Section R602.6 of the IRC, and Sections 2326.11.9 and 2326.11.10 of the UBC.
4. Nailing requirements:
   a. For sheathing attached with 8d common nails or smaller, spaced a minimum of 6 inches (152 mm) on center, a single LP SolidStart® LVL stud may be used for framing at adjoining panel edges (see Detail A in Figure 1).
   b. For sheathing attached with nails larger than 8d common [2½ inches by 0.131 inch diameter (64 mm by 3.33 mm diameter)] or spaced closer than 6 inches (152 mm) on center, a double LP LVL stud is required for framing at adjoining panel edges as follows (see Detail B in Figure 1):
      - Double LP SolidStart® LVL studs must be stitch-nailed together with two staggered rows of 10d common nails spaced 8 inches (203 mm) on center in each row.
      - Panel-edge nails must be installed with a minimum $^1/_2$ inch (12.7 mm) edge distance from both the panel and stud edges, and must be staggered a minimum of $^1/_4$ inch (6.35 mm) horizontally within each line of nails.
      - Minimum nail spacing (box or common) is 3 inches (76 mm) on center for 8d and smaller nails, 4 inches (102 mm) for 10d nails.
      - Maximum nail size is 10d common [3 inches by 0.148 inch diameter (76 mm by 3.76 mm diameter)].
5. LP SolidStart® LVL wall studs are permitted to be used in fire-resistance-rated construction. LP SolidStart® LVL shall be considered a direct replacement for solid-sawn lumber, having the same dimensions, in any fire-resistance-rated wall assembly listed in Table 720.1(2) of the IBC or Table 7-B of the UBC. Minimum 2.5 pcf mineral wool insulation must be placed in the stud cavity.
6. Engineered design of LP SolidStart® LVL studs is outside the scope of this evaluation report.

4.2 Installation:

LP SolidStart® LVL must be installed in accordance with this evaluation report and applicable building codes, the specifications of the design professional responsible for the design of the structure and, in lieu of a project designer, the latest edition of LP Building Products installation guidelines. The installation guidelines are general recommendations only and must be superseded by any and all details specified by the design professional responsible for the design of the structure.

5.0 CONDITIONS OF USE

The LP SolidStart® LVL as described in this report comply with, or are suitable alternatives to what is specified in, those codes specifically listed in Section 1.0 of this report, subject to the following conditions:

5.1 Fabrication and connection restrictions comply with this report.

5.2 Design stresses are less than the reference stresses specified in this report.

5.3 The material is limited to areas in which its moisture content will not exceed 16 percent.

5.4 Calculations and drawings demonstrating compliance with this 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.

5.5 The LP SolidStart® LVL is produced by the Louisiana-Pacific Corporation at its Golden, British Columbia, Canada; Wilmington, North Carolina; and Murphy Engineered Wood Division, in Sutherlin, Oregon facilities under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Structural Composite Lumber (AC47), dated October 2006.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Rim Board Products (AC124), dated October 2004, (editorially revised January 2008).

6.3 Data in accordance with the ICC-ES Acceptance Criteria for Wood-based Studs (AC202), dated October 2003, (editorially revised December 2005).

7.0 IDENTIFICATION

LP SolidStart® LVL shall be identified with stamps noting the Louisiana-Pacific Corporation name or Listee name; plant number; product designation; grade; evaluation report number (ESR-1254); and the inspection agency name [APA—The Engineered Wood Association (AA-649)].

TABLE 1—REFERENCE STRESS DESIGN VALUES LP SolidStart® LVL[4,5]

GRADE	BENDING STRENGTH, F_b (psi)		TENSILE STRENGTH PARALLEL TO GRAIN, F_t[3] (psi)	COMPRESSION STRENGTH PARALLEL TO GRAIN, $F_{c\|\|}$ (psi)	COMPRESSIVE STRENGTH PERPENDICULAR TO GRAIN, $F_{c\perp}$ (psi)		HORIZONTAL SHEAR STRENGTH, F_v (psi)		MODULUS OF ELASTICITY ($\times 10^6$ psi)	
	Beam	Plank			Beam	Plank	Beam	Plank	Beam	Plank
1400F_b-1.1E	1400[1]	1400	1200[5]	1700	680	450	250	95	1.10	1.00
1650F_b-1.3E	1650[1]	1650	1200[5]	1700	680	450	250	140	1.30	1.10
1750F_b-1.3E	1750[1]	1750	1200[5]	1700	680	450	250	140	1.30	1.30
2000F_b-1.3E	2000[2]	2000	1200[5]	2350	680	450	250	140	1.30	1.30
2250F_b-1.5E	2250[2]	2200	1350[5]	2350	750	450	285	140	1.50	1.40
2400F_b-1.7E	2400[2]	2300	1350[5]	2350	750	450	285	140	1.70	1.70
2600F_b-1.7E	2600[2]	2600	1350[5]	2350	750	450	285	140	1.70	1.70
2250F_b-1.8E	2250[2]	2200	1600[5]	2350	750	550	285	140	1.80	1.80
2650F_b-1.8E	2650[2]	2600	1600[5]	2350	550	450	285	140	1.80	1.80
2750F_b-1.8E	2750[2]	2600	1600[5]	2350	750	550	285	140	1.80	1.80
2650F_b-1.9E	2650[2]	2600	1600[5]	2350	750	550	285	140	1.90	1.80
2850F_b-2.0E	2850[2]	2850	1800[5]	3200	750	550	290	140	2.00	2.00
2950F_b-2.0E	2950[2]	2950	1800[5]	3200	750	550	290	140	2.00	2.00
3100F_b-2.0E	3100[2]	3100	1800[5]	3200	750	550	290	140	2.00	2.00
3400F_b-2.1E	3400[2]	3400	1800[5]	3350	750	550	350	120	2.10	2.10
3200F_b-2.2E	3200[2]	3200	1800[5]	2950	750	550	285	140	2.20	2.20

For **SI:** 1 psi = 6.89 kPa, 1 inch = 25.4 mm.

NOTES:

1. The allowable bending strength, F_b, is assigned for a standard depth of 12 inches. For other depths, multiply F_b as follows:
   - For thicknesses < $1^1/_4$ inches: multiply F_b by $(12/\text{depth})^{0.323}$. For depths less than $3^1/_2$ inches, multiply F_b by 1.488.
   - For thicknesses ≥ $1^1/_4$ inches: multiply F_b by $(12/\text{depth})^{0.261}$. For depths less than $3^1/_2$ inches, multiply F_b by 1.379.
2. The allowable bending strength, F_b, is assigned for a standard depth of 12 inches. For depths greater than 12 inches, multiply F_b by $(12/\text{depth})^{0.143}$. For depths less than 12 inches, multiply F_b by $(12/\text{depth})^{0.111}$. For depths less than $3^1/_2$ inches, multiply F_b by 1.147. Note: "Depth" is the depth of the member in inches.
3. The allowable tension strength, F_t, is assigned for a standard length of 3 feet. For lengths other than 3 feet, multiply F_t by $(3/\text{length})^{0.111}$. For lengths less than 3 feet, use the design tension stresses in the table above, unadjusted.
4. Allowable design stresses in the above table are for normal load duration and must be adjusted (with the exception of modulus of elasticity and compressive strength perpendicular to grain) using the load duration factors found in the NDS.
5. Allowable design stresses in the above table shall apply to product installation conditions of use that are dry, well ventilated and covered. Dry conditions are product installation conditions where ambient moisture content is 16% or less.

TABLE 2—EQUIVALENT SPECIFIC GRAVITY FOR FASTENER DESIGN[1,2,5,]

PRODUCT	EQUIVALENT SPECIFIC GRAVITY							
	Nails				Bolts Installed in Face[3]			
	Withdrawal Load		Lateral Load		Lateral Load ($^1/_2$" Dia.)		Lateral Load ($^3/_4$" Dia.)	
	Installed in Edge	Installed in Face	Installed in Edge	Installed in Face	Load Applied Parallel to Grain	Load Applied Perpendicular to Grain	Load Applied Parallel to Grain	Load Applied Perpendicular to Grain
1.1E LP SolidStart® LVL Rim[4] 1.3E LP SolidStart® LVL	0.42	0.48	0.49	0.50	0.43	0.45	0.39	0.50
1.3E LP SolidStart® LVL Rim[4] 1.5E - 2.2E LP SolidStart® LVL	0.46	0.50	0.50	0.50	0.46	0.50	0.46	0.50

For **SI:** 1 psi = 6.89 kPa, 1 in. = 25.4 mm.

NOTES:

1. Fastener sizes and orientation not specifically described above are beyond the scope of this report.
2. Fastener values based on the equivalent specific gravities in the above table are for normal load duration and must be adjusted using the load duration factors found in the NDS.
3. The bolt edge distance bolts, when loaded parallel and perpendicular to the grain, must be a minimum of four times the bolt diameter.
4. Lag screw connections between LP SolidStart® LVL rim board and deck ledgers must be in accordance with the Exception to Section 4.1.2.
5. Equivalent specific gravities for fastener design for LP SolidStart® LVL manufactured with aspen and yellow poplar species veneers must be as follows:

VENEER SPECIES	EQUIVALENT SPECIFIC GRAVITY							
	Nails				Bolts Installed in Face[3]			
	Withdrawal Load		Lateral Load		Lateral Load ($^1/_2$" Dia.)		Lateral Load ($^3/_4$" Dia.)	
	Installed in Edge	Installed in Face	Installed in Edge	Installed in Face	Load Applied Parallel to Grain	Load Applied Perpendicular to Grain	Load Applied Parallel to Grain	Load Applied Perpendicular to Grain
Aspen	0.43	0.43	0.42	0.43	0.42	0.43	0.39	0.43
Yellow poplar	0.46	0.46	0.50	0.50	0.42	0.55	0.42	0.55

TABLE 3—NAIL SPACING REQUIREMENTS FOR LP SolidStart® LVL

THICKNESS (inches)	ORIENTATION	FASTENER	CLOSEST END DISTANCE (inches)	CLOSEST ON- CENTER SPACING (inches)
< 1 1/2	Edge	8d & smaller	2 1/2	4
		10d & 12d	2 1/2	4
		16d	3 1/2	5
	Face[1]	8d & smaller	1 1/2	3
		10d & 12d	1 1/2	3
		16d	1 1/2	5
≥ 1 1/2	Edge	8d & smaller	2 1/2	3
		10d & 12d	2 1/2	4
		16d	3 1/2	5
	Face[1]	8d & smaller	1 1/2	3
		10d & 12d	1 1/2	3
		16d	1 1/2	5

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

NOTES:

1. Tabulated closest on-center spacing for face orientation is applicable to nails that are installed in rows that are parallel to the direction of the grain (length) of the LVL. For nails that are installed in rows that are perpendicular to the direction of the grain (width/depth) of the LVL, the closest on-center spacing for face orientation must be sufficient to prevent splitting of the wood.
2. Fastener sizes and closest spacing not specifically described above are beyond the scope of this report.
3. Fasteners are common wire or box nails.
4. Edge distance shall be sufficient to prevent splitting.
5. Nail penetration for edge nailing shall not exceed 2 inches for 16d nails and 2 1/2 inches for 10d and 12d nails.
6. 16d sinkers (3 1/4" × 0.148") may be spaced the same as a 12d common wire nail.
7. For multiple rows of nails, the rows must be offset 1/2 inch or more from each other, and staggered.
8. For multiple rows of nails, rows must be equally spaced from the centerline of the product edge or face (whichever applies).

TABLE 4—ALLOWABLE STRESS DESIGN VALUES FOR LP SolidStart® LVL RIM BOARDS[1,2,3]

GRADE	THICKNESS (inches)	MATERIAL	LATERAL LOAD CAPACITY[4] (lb./ft)	VERTICAL UNIFORM LOAD CAPACITY[5] (lb./ft)		VERTICAL CONCENTRATED LOAD CAPACITY (lbs.)	CROSS-PLY
				d ≤ 16 in.	16 in. < d ≤ 24 in.	d≤ 24 in.	
1400F_b-1.1E	1 1/4	LVL	250	8000	5070	4210	Yes
1650F_b-1.3E	1 and 1 1/8	LVL	190	7210	4990	3870	Yes
1750F_b-1.3E	1 1/4	LVL	250	9350	5070	4210	Yes
2000F_b-1.3E and better	1 1/2	LVL	250	4000	2500	2700	No
	1 3/4	LVL	250	4500	3450	3200	No

For **SI:** 1 inch = 25.4 mm, 1 lb. = 4.45 N, 1 lb./ft = 14.6 N/m.

NOTES:

1. Toe-nailed connections are not limited by the 150 plf lateral load capacity noted for Seismic Zones 3 and 4 in Section 2318.3.1 of the UBC, or Seismic Design Categories D, E and F in Section 2305.1.4 of the IBC.
2. Allowable design loads in the above table cannot be increased for load duration.
3. See Table 3 for minimum nail spacing requirements.
4. The nailing schedule for sheathing to rim and rim board and for rim board to sill plate (toe-nailed) is based on minimum 8d box nails at 6 inches on center. Commercial framing connectors may be used to achieve lateral load capacities exceeding the values in this table. Calculations must be based on the equivalent specific gravity listed in Table 2 and must not exceed the nail spacing requirements of Table 3 (LVL).
5. The allowable Vertical Uniform Load Capacity is based on the strength of the rim board and may need to be reduced based on the bearing capacity of the supporting wall plate. For example, bearing capacity for an SPF plate is limited to 5100 lb./ft for 1-inch-thick rim board (425 psi × 12 in. × 1 in.), 5700 lb./ft for 1 1/8-inch-thick rim board (425 psi × 12 in. × 1 1/8 in.), and 6350 lb./ft for 1 1/4-inch-thick rim board (425 psi × 12 in. × 1 1/4 in.). The 425 psi compression perpendicular to grain design value for SPF is found in Table 4A of the NDS Supplement.

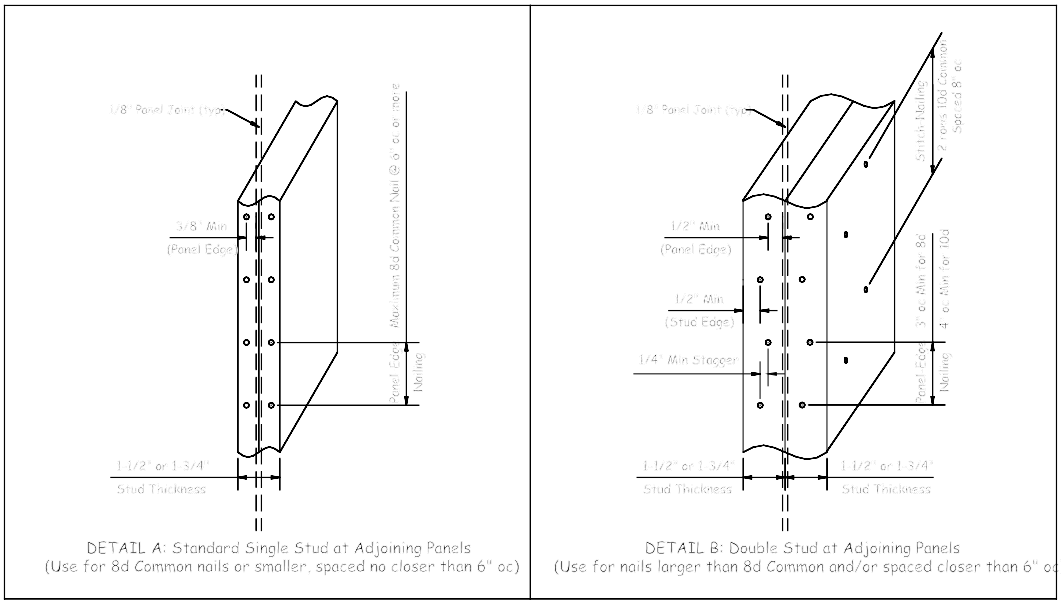

FIGURE 1—NAILING REQUIREMENTS FOR LP SolidStart® LVL STUDS