CITY OF LOS ANGELES
CALIFORNIA

DEPARTMENT OF
BUILDING AND SAFETY
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RESEARCH REPORT: RR 25783
(CSI #06170)

BASED UPON ICC-ES EVALUATION
REPORT NO. ESR-2403

REEVALUATION DUE
DATE: May 1, 2012
Issued Date : May 1, 2010
Code: 2008 LABC

GENERAL APPROVAL – Reevaluation/Technical Modification - LP® SolidStart® Laminated Strand Lumber (LSL) and Laminated Veneer Lumber (LVL).

DETAILS

The above assemblies and/or products are approved when in compliance with the description, use, identification and findings of Evaluation Report No. ESR-2403, dated October 1, 2009, of the ICC Evaluation Service, Incorporated. The report in its entirely, is attached and made part of this general approval.

The parts of Evaluation Report No ESR-2403 marked by the asterisks are deleted or revised by the Los Angeles Building Department from this approval.

The approval is subject to the following conditions:

1. All stress adjustment factors specified in Section 8.3.1 of the 2005 National Design Specification shall apply to LP® Solid Start® Laminated Strand Lumber (LSL)) and Laminated Veneer Lumber (LVL) unless otherwise stated in the attached ICC-ES Evaluaton Report.

2. Depth to thickness ratio of all members manufactured for end-use applications shall not exceed 8. Members with a depth to thickness ratio exceeding 8 shall be used in multiple-piece applications only (2-ply or wider).

3. Fabrication of SolidStart® Laminated Strand Lumber (LSL) and Laminated Veneer Lumber (LVL) shall be done in the shop of a Los Angeles City licensed Type I fabricator and shall be in accordance with Chapter 23 of the 2008 Los Angeles City Building Code.

4. Structural Composite Lumber (SCL) materials shall conform to the specifications of ASTM D-5456. Test data verifying the properties of the SCL, by an approved testing agency, shall be obtained for each shipment. The data shall be kept on file and submitted to the Department upon request.

5. Mineral wool insulation used in the 1-hr fire resistive assemblies shall be 3-1/2" thick.

6. The minimum 5/8-in Type X gypsum wallboard specified for the 1-hr. fire resistive assembly for the engineered load bearing wall specified in section 4.5.1, item 2 of the attached ICC-ES report shall be applied to each side of the wall assembly.

DISCUSSION

The Technical Modification combines SolidStart® Laminated Veneer Lumber (LVL), previously approved by Research Report 25167, with this Research Report and adds fire resistive assemblies.

The report is in compliance with 2008 Los Angeles Building Code.

The approval is based on tests in accordance with ICC-ES Acceptance Criteria for Structural Composite Lumber (AC47), Acceptance Criteria for Wood-Based Studs (AC202), Acceptance Criteria for Rim-Board Products (AC124) and tests in accordance with ASTM E119.

This general approval will remain effective provided the Evaluation Report is maintained valid and unrevised with the issuing organization. Any revision to the report must be submitted to this Department for review with appropriate fee to continue the approval of the revised report.

Addressee to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this Approval have been met in the project in which it is to be used.

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WS:ws
RR25783/Word.2003
R04/28/2010
3D5/2303/2306

Attachment: ICC ES Report No. ESR-2403 (13 Pages)

ICC-ES Evaluation Report

ESR-2403

Reissued October 1, 2009

This report is subject to re-examination in one year.

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

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EVALUATION SUBJECT:

LP® SOLIDSTART® LAMINATED STRAND LUMBER (LSL) AND LAMINATED VENEER LUMBER (LVL)

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)~~
- * ~~Other Codes (see Section 8.0)~~

Properties evaluated:

- Structural
- Fire resistance

2.0 USES

LP SolidStart laminated strand lumber (LSL) and laminated veneer lumber (LVL) are used for structural applications, such as beams, headers, joists, rafters, columns, wall studs and rim board. They are also used as components in built-up structural members, such as flanges for I-joists and chords for trusses. LP SolidStart LVL is also used as lamination for glued-laminated members.

3.0 DESCRIPTION

3.1 General:

The LP SolidStart LSL and LVL described in this report comply with the requirements noted in Section 2303.1.9 of the IBC, for allowable stress design in accordance with IBC
* Section 2301.2(1). ~~They may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with IRC Section R301.1.3~~.

3.2 LP SolidStart LSL:

LP SolidStart LSL consists of wood strands bonded together using an exterior-type structural adhesive. The wood strand properties and species, adhesive, manufacturing parameters and finished product dimensions and tolerances are as specified in the approved quality documentation and manufacturing standard.

3.3 LP SolidStart LVL:

LP SolidStart LVL consists of layers of wood veneers laminated together using an exterior-type structural adhesive. The wood veneer properties and species, adhesive, manufacturing parameters and finished product dimensions and tolerances are as specified in the approved quality documentation and manufacturing standard.

LP SolidStart LVL "Billet Beams" are fabricated by face-laminating primary thicknesses of LP LVL.

LP SolidStart LVL designated as "Rim Board" is LP LVL with two or more veneers oriented 90 degrees (cross-ply) to the length. LP LVL Rim Board may be used for all applications applicable to LP LVL as defined in Section 2.0.

4.0 DESIGN AND INSTALLATION

4.1 General:

Design and installation of LP SolidStart LSL and LVL must be in accordance with this report, the applicable code provisions and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation. The requirements specified for allowable stress design in accordance with IBC Section 2301.2(1), and the design provisions for structural composite lumber in the ANSI/AF&PA National Design Specification for Wood Construction (NDS), are applicable to LP SolidStart LSL and LVL, except as modified within this report. Reference design values for each grade of LP SolidStart LSL and LVL are given in Table 1.

4.2 Connections:

The design of mechanical connections in LP SolidStart LSL and LVL must be in accordance with the NDS. Equivalent specific gravities for the design of nail, bolt and lag screw connections under dry use conditions are given in Table 2. Minimum nail spacing and end distance requirements are given in Table 3. Nailing requirements for the attachment of wall sheathing are given in Section 4.3.3.

* Deleted by the City of Los Angeles

Exception: Lag screw connections between LP SolidStart LSL and LVL rim board and lumber deck ledgers have allowable lateral loads as specified in Table 4, provided all of the following conditions are met:

1. Lag screws must have a minimum diameter of $^1/_2$ inch (12.7 mm), and sufficient length such that the lag screw shank penetrates through the rim board (not including the length of the tapered tip).
2. Deck ledgers must consist of lumber having a minimum thickness of 1.5 inches (38 mm) and a minimum assigned specific gravity of 0.42.
3. The sheathing between the rim board and the deck ledger must consist of wood structural panels meeting U.S. DOC PS-1 or PS-2, and be attached to the rim board in accordance with the applicable code.
4. One flat washer must be used between the deck ledger and the lag screw head.
5. 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.
6. Adjustment factors in accordance with the NDS must be applied as applicable.
7. Rim board and deck ledgers must be checked for load-carrying capacity at connections in accordance with Section 10.1.2 of the NDS.

4.3 Wall Studs:

Prescriptive Wall Framing: LP SolidStart LSL having a grade of 1.35E or 1.55E, and LP SolidStart LVL having a grade of 1.5E or greater, is considered equivalent to sawn lumber studs for prescriptive wall framing applications in accordance with Section 2308.9 of the IBC ~~and Section R602 of the IRC, subject to the following conditions:~~ *

1. LP SolidStart LSL and LVL studs must have a thickness of $1^1/_2$ inches (38 mm) or greater.
2. Cutting, notching, and boring of 3.5-inch-deep (89 mm) and 5.5-inch-deep (140 mm) LP SolidStart LSL and LVL studs used in prescriptive wall framing is permitted in accordance with Sections 2308.9.10 and 2308.9.11 of the IBC, ~~and Section R602.6 of the IRC~~. *
3. Connections between wall sheathing and LP SolidStart LSL and LVL framing must meet the requirements of Section 4.3.3.

4.3.1 Engineered Wall Framing: LP SolidStart LSL having a grade of 1.35E or 1.55E, and LP SolidStart LVL having a grade of 1.5E or greater, may be used in engineered wall framing applications, subject to the following conditions:

1. LP SolidStart LSL and LVL studs are equivalent to sawn lumber studs with a maximum specific gravity of 0.50.
2. LP SolidStart LSL and LVL studs must have a thickness of $1^1/_2$ inches (38 mm) or greater.
3. Notching and boring of LP SolidStart LSL and LVL studs is permitted in engineered wall assemblies. The design must be based on net-section analysis in accordance with the NDS, and is subject to the following additional conditions and allowable stress reductions:
   a. One hole, with a diameter not to exceed $1^3/_8$ inches (35 mm) for 3.5-inch-deep (89 mm) studs and $2^3/_{16}$ inches (56 mm) for 5.5-inch-deep (140 mm) and deeper studs, is allowed anywhere along the stud length, except that the hole must not be placed within 6 inches (152 mm) of the ends of the stud. Two holes, up to 1 inch (25 mm) in diameter and spaced no closer than 12 inches (305 mm) on center, are permitted in 5.5-inch-deep (140 mm) and deeper studs. A minimum edge distance of $^5/_8$ inch (16 mm), measured from the edge of the hole to the edge of the member, must be maintained for all holes. See Figure 1.
   b. One notch, with a depth not to exceed $^7/_8$ inch (22 mm) for 3.5-inch-deep (89 mm) studs and $1^3/_8$ inches (35 mm) for 5.5-inch-deep (140 mm) and deeper studs, is allowed only in the upper or lower 3 feet (914 mm) of the stud length, except that a notch must not be placed within 6 inches (152 mm) of the ends of the stud. The notch length must not exceed 8 inches (203 mm).
   c. The reference design stresses for bending, axial compression, and axial tension must be multiplied by a stress reduction factor to account for stress concentrations at notches and holes, as given in Table 5.
4. Connections between wall sheathing and LP SolidStart LSL or LVL framing must meet the requirements of Section 4.3.3.

4.3.2 Nailing Requirements: When LP SolidStart LSL and LVL members are used as wall studs, the sheathing-to-stud and stud-to-stud connections must meet the following requirements:

1. A single $1^1/_2$-inch-thick (38 mm) stud may be used for framing at adjoining panel edges for wall sheathing attached as follows:
   a. For LP SolidStart LSL: 10d common nails [3 inches (76 mm) by 0.148 inch (3.76 mm) in diameter] spaced no closer than 6 inches (152 mm) on center, or 8d common nails [$2^1/_2$ inches (64 mm) by 0.131 inch (3.33 mm) in diameter] spaced no closer than 4 inches (102 mm) on center. See Detail A in Figure 2.
   b. For LP SolidStart LVL: 8d common nails spaced no closer than 6 inches (152 mm) on center; 10d common nails are not allowed where a single $1^1/_2$-inch-thick (38 mm) stud is used at adjoining panel edges. See Detail A in Figure 2.
2. A minimum $2^1/_2$-inch-thick (64 mm) single stud or a double $1^1/_2$-inch or thicker stud is required for framing at adjoining panel edges for wall sheathing attached as follows:
   a. For LP SolidStart LSL: 10d common or 8d common nails spaced no closer than 3 inches (76 mm) on center, and staggered a minimum of $^1/_4$ inch (6.4 mm) horizontally. See Detail B in Figure 2.
   b. For LP SolidStart LVL: 10d common nails spaced no closer than 4 inches (102 mm) on center, or 8d common nails spaced no closer than 3 inches (76mm) on center, staggered a minimum of $^1/_4$ inch (6.4 mm) horizontally. See Detail B in Figure 2.
3. Where double studs are required at adjoining panel edges, they must be connected together as follows:
   a. For stud wall applications in accordance with the ~~IRC and the~~ conventional light-frame provisions of the IBC (Section 2308 and Table 2304.9.1), double LP SolidStart LSL and LVL studs must be stitch-nailed together with a minimum of two *

staggered rows of 10d nails [$2^{7}/_{8}$ inches (73 mm) by 0.120 inch (3.05 mm) in diameter] spaced 8 inches (203 mm) on center in each row.

b. For engineered stud wall applications, double LP SolidStart LSL and LVL studs must be stitch-nailed together with a connection designed to transfer the required lateral shear, using an assumed equivalent specific gravity of 0.50. when stitch-nailing two $1^{3}/_{4}$-inch-thick (44 mm) studs, 3-inch (76 mm) or longer nails are used.

c. The stitch nails must be driven in two lines spaced approximately 1 inch (25 mm) from each stud edge.

4. Where double studs are required at adjoining panel edges, the 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 staggered a minimum of $^{1}/_{4}$ inch (6.35 mm) horizontally within each line of nails. For LP LSL, the minimum edge distance for panel-edge nails may be reduced to $^{3}/_{8}$ inch (9.5 mm).

5. Nails between sheathing and wall framing must not be spaced closer than as specified in Sections 4.3.3(1) and 4.3.3(2). Nails must also be staggered where required in Sections 4.3.3(1) and 4.3.3(2).

6. The maximum allowable nail size is 10d common [3 inches (76 mm) by 0.148 inch (3.76 mm) in diameter].

4.3.3 Wall Plates: LP SolidStart LSL and LVL may be used as bottom (sole) plates and top plates, except where preservative-treated wood is required by Section 2304.11 of the IBC ~~and Sections R319 and R320 of the IRC~~. Stresses resulting from applied loads must not exceed the adjusted design values determined in accordance with Section 4.1 of this report.

4.4 Rim Board and Blocking:

When used as rim board, LP SolidStart LSL and LVL must be continuously supported across the full width (except as noted in Section 4.4.2), and must be located at the joist elevation either perpendicular to, or parallel to, the joist framing. It must be the full depth of the joist space and be used for any combination of the following:

- To transfer, from above to below, all vertical loads at the rim board location. Allowable vertical loads are given in Table 4.
- To provide diaphragm attachment (sheathing to top edge of rim board).
- To transfer in-plane lateral loads from the diaphragm to the wall plate below. Allowable in-plane lateral loads are given in Table 4.
- To provide lateral support to the joist or rafter (resistance against rotation) through attachment to the joist or rafter.
- To provide closure for ends of joists or rafters.
- To provide an attachment base for siding and/or an exterior deck ledger.

Rim board must be installed in accordance with the prescriptive provisions of the applicable code, and design loads must not exceed those given in Table 4.

Installation of LP SolidStart LSL and LVL rim board over wall openings is permitted, provided the rim board is designed for all applicable stresses in accordance with Sections 4.1 and 4.2 adjusted by the applicable adjustment factors. Joints in the rim board are not allowed within 12 inches (305 mm) of the opening.

LP SolidStart LSL and LVL having minimum thicknesses as given in Table 4 may be used as direct replacements for the nominally 2-inch-thick (51 mm) solid blocking specified in Section 2308.8.2 of the IBC ~~and Section R502.7 of the IRC~~.

4.5 Fire-Resistance and Fire Blocking:

4.5.1 Fire resistance-rated Wall Construction: LP SolidStart LSL and LVL are permitted to be used in fire-resistance-rated wall construction as follows:

1. For conventional light-frame construction, LP SolidStart LSL and LVL may be used as direct replacements for non-fire-retardant-treated sawn lumber studs, of equivalent-sized No. 2 or lower grade, in the prescriptive 1-hour fire-resistance-rated wall assemblies listed in Table 720.1(2) of the IBC, subject to the following conditions:

   a. Minimum 2.5 pcf (40 kg/m^3) mineral wool insulation must be placed in each stud cavity.

   b. Tape and joint compound must be applied to fastener heads and gypsum wallboard joints on exposed surfaces.

2. For engineered, load-bearing wall construction, LP SolidStart LSL and LVL are permitted to be used in 1-hour fire-resistance-rated wall assemblies meeting the following conditions:

   a. The minimum stud size must be $1^{1}/_{2}$ inches (38 mm) by $3^{1}/_{2}$ inches (89 mm) or greater.

   b. Studs must be spaced no more than 24 inches (610 mm) on center.

   c. Minimum $^{5}/_{8}$-inch (15.9 mm) Type X gypsum wallboard must be attached with $2^{1}/_{4}$-inch-long (57 mm) Type S drywall screws spaced 7 inches (178 mm) on center along each stud.

   d. Minimum 2.5 pcf (40 kg/m^3) mineral wool insulation must be placed in each stud cavity.

   e. Tape and joint compound must be applied to fastener heads and gypsum wallboard joints on the exposed surface(s).

   f. The design axial compressive stress within the studs must not exceed the least of the following:

      i. 440 psi (3032 kPa) for LSL, and 550 psi (3790 kPa) for LVL.

      ii. $0.77F_c'$ for LSL, and $0.63F_c'$ for LVL; where F_c' is the compression design value parallel-to-grain, adjusted by all applicable adjustment factors in accordance with the NDS, including the column stability factor, C_P.

      iii. $0.77F_c'$ for LSL and $0.63F_c'$ for LVL; where F_c' is the compression design value parallel-to-grain, adjusted for all applicable adjustment factors in accordance with the NDS, and where C_P is evaluated at a slenderness ratio of 33.

4.5.2 Fire Blocking: LP SolidStart LSL and LVL having a minimum thickness of $1^{1}/_{4}$ inches (31.8 mm) is permitted to be used as an alternate to nominally 2-inch lumber fire blocking in accordance with Section 717.2.1 of the IBC ~~and Section R602.8.1 of the IRC~~. LP SolidStart LSL and LVL having a minimum thickness of 1 inch (25.4 mm) is permitted to be used as an alternate to 0.719-inch ($^{23}/_{32}$ inch) (18.3 mm) wood structural panel fire blocking in accordance with Section 717.2.1 of the IBC ~~and Section R602.8.1 of the IRC~~, provided the joints are backed accordingly.

4.6 Roof and Ceiling Framing:

LP SolidStart LSL may be used as ceiling joists and rafter framing in conventional light-frame construction in accordance with Section 2308.10 of the IBC ~~and Section R802 of the IRC~~. Spans for LP LSL rafters are given in Table 6.

5.0 CONDITIONS OF USE

The LP SolidStart LSL and LVL 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, design, installation, and connection restrictions must comply with this report and the manufacturer's published installation instructions. In the event of a conflict between the manufacturer's published installation instructions and this report, this report governs.

5.2 Use of LP SolidStart LSL and LVL must be limited to dry, well-ventilated interior applications in which the in-service equivalent moisture content of lumber will not exceed 16 percent.

5.3 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.

5.4 LP SolidStart LSL is produced by the Louisiana-Pacific Corporation at its Houlton, Maine, facility under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

5.5 LP SolidStart LVL is produced by the Louisiana-Pacific Corporation at its Golden, British Columbia, Canada, and Wilmington, North Carolina facilities; and by the Murphy Engineered Wood Division, in Sutherlin, Oregon; 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 Wood-based Products (AC47), dated June 2009.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Wood-based Studs (AC202), dated June 2009.

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

7.0 IDENTIFICATION

LP SolidStart LSL is identified with stamps noting the Louisiana-Pacific Corporation name, plant number, product designation, grade, production date and shift, evaluation report number (ESR-2403), and the inspection agency name (APA—The Engineered Wood Association).

~~8.0 LEGACY CODES~~

8.1 Evaluation Scope:

In addition to the codes referenced in Section 1.0, the LP SolidStart LSL described in this report was evaluated for compliance with the 1997 *Uniform Building Code*® (UBC). LP SolidStart LSL complies with, or is a suitable alternative to what is specified in, the UBC, subject to the provisions of Sections 8.2 through 8.7.

8.2 Uses:

See Section 2.0.

8.3 Description:

See Section 3.0, except replace the wording in Section 3.1 with the following: The LP SolidStart LSL described in this report is an alternative to sawn lumber, as described in Chapter 23 of the UBC, for allowable stress design in accordance with UBC Section 2301.2.1.

8.4 Design and Installation:

See Section 4.0, except replace the references to specific sections and tables of the IBC as follows:

IBC SECTION /TABLE REFERENCED	REPLACE WITH UBC SECTION / TABLE
IBC Section 717.2.1	UBC Section 708.2
IBC Section 2301.2(1)	UBC Section 2301.2.1
IBC Section 2304.11	UBC Section 2306
IBC Section 2308.8.2	UBC Section 2320.8.3
IBC Section 2308.9	UBC Section 2320.11
IBC Section 2308.9.10	UBC Section 2320.11.9
IBC Section 2308.9.11	UBC Section 2320.11.10
IBC Section 2308.10	UBC Section 2320.12
IBC Table 720.1(3)	UBC Table 7-C
IBC Table 720.1(2)	UBC Table 7-B

8.5 Conditions of Use:

See Section 5.0.

8.6 Evidence Submitted:

See Section 6.0.

8.7 Identification:

See Section 7.0.

* Deleted by the City of Los Angeles

TABLE 1—REFERENCE DESIGN VALUES FOR LP® SolidStart® LSL AND LVL [1, 2, 3, 4]

GRADE	BEAM ORIENTATION					PLANK ORIENTATION					AXIAL	
	Modulus of Elasticity		Bending[7]	Shear	Compression Perp-to-Grain	Modulus of Elasticity		Bending	Shear	Compression Perp-to-Grain	Compression	Tension
	E^5 ($x10^6$ psi)	E_{min}[6] ($x10^6$ psi)	F_b (psi)	F_v (psi)	$F_{c\perp}$ (psi)	E^5 ($x10^6$ psi)	E_{min}[6] ($x10^6$ psi)	F_b (psi)	F_v (psi)	$F_{c\perp}$ (psi)	F_c (psi)	F_t (psi)
LP SolidStart LSL												
$1730F_b$-1.35E	1.35	0.68	1730 [8]	410	750	1.35	0.68	1910	155	440	1650	1300 [11]
$2360F_b$-1.55E	1.55	0.78	2360 [8]	410	875	1.55	0.78	2620	155	440	2175	1750 [11]
$2500F_b$-1.75E	1.75	0.88	2500 [8]	410	950	1.75	0.88	2800	155	440	2450	2100 [11]
LP SolidStart LVL												
$2000F_b$-1.3E	1.30	0.67	2000 [9]	250	680	1.30	0.67	2000	140	450	2350	1200 [12]
$2250F_b$-1.5E	1.50	0.78	2250 [9]	285	750	1.40	0.73	2200	140	450	2350	1350 [12]
$2400F_b$-1.7E	1.70	0.88	2400 [9]	285	750	1.70	0.88	2300	140	450	2350	1350 [12]
$2600F_b$-1.7E	1.70	0.88	2600 [9]	285	750	1.70	0.88	2600	140	450	2350	1350 [12]
$2250F_b$-1.8E	1.80	0.93	2250 [9]	285	750	1.80	0.93	2200	140	550	2350	1600 [12]
$2650F_b$-1.8E	1.80	0.93	2650 [9]	285	550	1.80	0.93	2600	140	450	2350	1600 [12]
$2750F_b$-1.8E	1.80	0.93	2750 [9]	285	750	1.80	0.93	2600	140	550	2350	1600 [12]
$2650F_b$-1.9E	1.90	0.98	2650 [9]	285	750	1.80	0.93	2600	140	550	2350	1600 [12]
$2850F_b$-2.0E	2.00	1.04	2850 [9]	290	750	2.00	1.04	2850	140	550	3200	1800 [12]
$2950F_b$-2.0E	2.00	1.04	2950 [9]	290	750	2.00	1.04	2950	140	550	3200	1800 [12]
$3100F_b$-2.0E	2.00	1.04	3100 [9]	290	750	2.00	1.04	3100	140	550	3200	1800 [12]
$3400F_b$-2.1E	2.10	1.09	3400 [9]	350	750	2.10	1.09	3400	120	550	3350	1800 [12]
$3200F_b$-2.2E	2.20	1.14	3200 [9]	285	750	2.20	1.14	3200	140	550	2950	1800 [12]
LP SolidStart LVL Rim Board (with cross-ply)												
$1400F_b$-1.1E	1.10	0.57	1400 [10]	250	680	1.00	0.52	1400	95	450	1700	1200 [12]
$1650F_b$-1.3E	1.30	0.67	1650 [10]	250	680	1.10	0.57	1650	140	450	1700	1200 [12]
$1750F_b$-1.3E	1.30	0.67	1750 [10]	250	680	1.30	0.67	1750	140	450	1700	1200 [12]

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

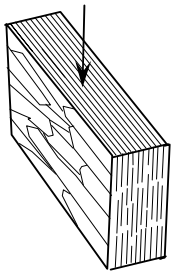
[1]Reference design values in the above table apply only to dry, well ventilated interior applications where the equivalent moisture content in lumber is less than 16 percent.
[2]Reference design values in the above table are for normal load duration. Tabulated values must be adjusted by the applicable adjustment factors in accordance with the NDS. Modulus of elasticity and compression perpendicular-to-grain must not be adjusted for duration of load.
[3]Reference design values given for Beam Orientation refer to loads applied parallel to the wide face of the strands or veneers (applied to the edge of the member). Plank Orientation refers to loads applied perpendicular to the wide face of the strands or veneers (applied to the face of the member). See diagrams on following page.
[4]Reference design values for bending, axial compression and axial tension for studs with notches or holes in engineered wall framing must be multiplied by the strength reduction factors in Table 5.
[5]The reference E values given for LP LSL are the shear-free modulus of elasticity. When calculating deflection, both bending and shear deformations must be included. Equations for various span and load conditions are available in engineering references. For example, the deflection equation for a simply-supported beam under uniform load is:

where:

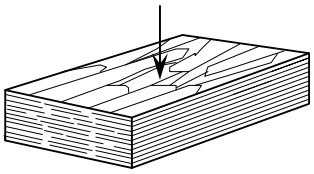
$$\Delta = \frac{270\,w\,L^4}{Ebd^3} + \frac{28.8\,w\,L^2}{Ebd}$$

Δ = Deflection in inches (in).
w = Uniform load in pounds per lineal foot (plf).
L = Design span in feet (ft).
b = Beam width in inches (in).
d = Beam depth in inches (in).
E = Shear Free Modulus of Elasticity in pounds per square inch (psi).

The reference E values given for LP LVL are the apparent modulus of elasticity, which include the effects of shear deformation. When calculating deflection, standard engineering formulae for pure bending deflection are sufficient, and the second term of the above equation may be ignored.
[6]E_{min} is the reference modulus of elasticity for beam stability and column stability calculations.
[7]Reference bending design values in the beam orientation, F_b, may be increased by 4% when the member qualifies as a repetitive member, in accordance with Section 8.3.7 of the NDS-05.
[8]Reference bending design values in the beam orientation, F_b, for LP LSL are assigned for a standard depth of 12 inches. For other depths greater than $3^1/_2$ inches, multiply F_b by a volume factor of $(12/d)^{0.143}$, where *d* is the depth of the member in inches. For depths $3^1/_2$ inches or less, multiply F_b by 1.192.
[9]Reference bending design values in the beam orientation, F_b, for LP LVL are assigned for a standard depth of 12 inches. For depths greater than 12 inches, multiply F_b by a volume factor of $(12/d)^{0.143}$, where *d* is the depth of the member in inches. For depths less than 12 inches but greater than $3^1/_2$ inches, multiply F_b by $(12/d)^{0.111}$. For depths $3^1/_2$ inches or less, multiply F_b by 1.147.
[10]Reference bending design values in the beam orientation, F_b, for LP LVL Rim Board (cross-ply) are assigned for a standard depth of 12 inches. For other depths, adjust F_b as follows, based on the LVL thickness:
- For thickness < $1^1/_4$ inches, multiply F_b by a volume factor of $(12/d)^{0.323}$, where *d* is the depth of the member in inches, except where *d* is less than $3^1/_2$ inches, multiply F_b by 1.488.
- For thickness ≥ $1^1/_4$ inches, multiply F_b by a volume factor of $(12/d)^{0.261}$, where *d* is the depth of the member in inches, except where *d* is less than $3^1/_2$ inches, multiply F_b by 1.379.
[11]Reference tension design values, F_t, are assigned for a standard length of 3 feet. For lengths longer than 3 feet, multiply F_t by $(3/L)^{0.092}$, where *L* is the length in feet. For lengths less than 3 feet, use the reference tension design value given in the table above.
[12]Reference tension design values, F_t, are assigned for a standard length of 3 feet. For lengths longer than 3 feet, multiply F_t by $(3/L)^{0.111}$, where *L* is the length in feet. For lengths less than 3 feet, use the reference tension design value given in the table above.



Beam Orientation



Plank Orientation

TABLE 2—EQUIVALENT SPECIFIC GRAVITY FOR FASTENER DESIGN[1, 2, 3]

GRADE	EQUIVALENT SPECIFIC GRAVITY					
	Nails and Screws				Bolts and Lag Screws [4, 5]	
	Withdrawal		Dowel Bearing		Dowel Bearing (Installed in Face)	
	Installed in Edge	Installed in Face	Installed in Edge	Installed in Face	Load Applied Parallel to Grain	Load Applied Perpendicular to Grain
LP SolidStart LSL						
1730F_b-1.35E and Above	0.46	0.50	0.50	0.55	0.50	0.58
LP SolidStart LVL						
2000F_b-1.3E	0.42	0.48	0.49	0.50	0.41	0.48
2250F_b-1.5E and Above	0.46	0.50	0.50	0.50	0.46	0.50
LP SolidStart LVL Rim Board (cross-ply)						
1400F_b-1.1E	0.42	0.48	0.49	0.50	0.41	0.48
1650F_b-1.3E	0.46	0.50	0.50	0.50	0.46	0.50
1750F_b-1.3E	0.46	0.50	0.50	0.50	0.46	0.50

[1]Fastener types and orientation not specifically described above are outside the scope of this report.
[2]Fastener design values calculated using the tabulated equivalent specific gravities given above must be adjusted by the applicable adjustment factors specified in the *NDS* for connections.
[3]Minimum nail spacing and end distance must be as specified in Table 3. Minimum spacing, end and edge distances for bolts and lag screws must be as specified in the NDS.
[4]Equivalent specific gravity values apply only to bolts and lag screws installed into the face of the LSL and LVL, such that the bolt axis is perpendicular to the wide faces of the strands or veneers.
[5]The allowable lateral loads for lag screw connections between LP SolidStart LSL and LVL rim board and deck ledgers complying with the exception to Section 4.2 are given in Table 4.

TABLE 3—NAIL SPACING REQUIREMENTS FOR LP® SolidStart® LSL AND LVL[1, 2]

MEMBER THICKNESS (in.)	FASTENER ORIENTATION[5]	COMMON NAIL SIZE[6, 7]	MINIMUM END DISTANCE (in.)	MINIMUM NAIL SPACING (in.)	
				Single Row	Multiple Rows[3, 4]
LP SolidStart LSL					
1″ ≤ thickness < $1^1/_4$″	Edge[8]	8d & smaller	2	4	NA
		10d & 12d	2	4	
		16d	NA[(10)]	NA[(10)]	
	Face[9]	8d & smaller	$^7/_8$	1	1
		10d & 12d	$^7/_8$	1	1
		16d	$^7/_8$	$1^1/_2$	$1^1/_2$
$1^1/_4$″ ≤ thickness < $1^1/_2$″	Edge[8]	8d & smaller	2	4	NA
		10d & 12d	2	4	
		16d	$2^1/_2$[(11)]	5[(12)]	
	Face[9]	8d & smaller	$^7/_8$	1	1
		10d & 12d	$^7/_8$	1	1
		16d	$^7/_8$	$1^1/_2$	$1^1/_2$
$1^1/_2$″ ≤ thickness < $1^3/_4$″	Edge[8]	8d & smaller	2	3	3
		10d & 12d	2	3	4
		16d	$2^1/_2$[(11)]	4	6
	Face[9]	8d & smaller	$^7/_8$	1	1
		10d & 12d	$^7/_8$	1	1
		16d	$^7/_8$	$1^1/_2$	$1^1/_2$
≥ $1^3/_4$″	Edge[8]	8d & smaller	2	3	3
		10d & 12d	2	3	4
		16d	$2^1/_2$[(11)]	3	6
	Face[9]	8d & smaller	$^7/_8$	1	1
		10d & 12d	$^7/_8$	1	1
		16d	$^7/_8$	$1^1/_2$	$1^1/_2$
LP SolidStart LVL					
< $1^1/_2$″	Edge[8]	8d & smaller	$2^1/_2$	4	
		10d & 12d	$2^1/_2$	4	
		16d	$3^1/_2$	5	
	Face[9]	8d & smaller	$1^1/_2$	3	
		10d & 12d	$1^1/_2$	3	
		16d	$1^1/_2$	5	
≥ $1^1/_2$″	Edge[8]	8d & smaller	$2^1/_2$	3	
		10d & 12d	$2^1/_2$	4	
		16d	$3^1/_2$	5	
	Face[9]	8d & smaller	$1^1/_2$	3	
		10d & 12d	$1^1/_2$	3	
		16d	$1^1/_2$	5	

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

[1]Spacing requirements and maximum nail size for panel edge nailing of wall sheathing at adjoining panels must be in accordance with Section 4.3.3 and Figure 2.
[2]Edge distance must be sufficient to prevent splitting.
[3]For multiple rows of nails, the rows must be offset $^1/_2$ inch or more from each other, and staggered.
[4]For multiple rows of nails, the rows must be equally spaced about the centerline of the edge or face (whichever applies).
[5]Face orientation applies to nails driven into the face of the LSL or LVL member, such that the long axis of the nail is perpendicular to the wide faces of the strands or veneers. Edge orientation applies to nails driven into the edge of the LSL or LVL member.
[6]16d sinkers ($3^1/_4$ in. x 0.148 in. diameter) are considered equivalent to 12d common nails for the purpose of this table.
[7]Nails listed are common wire nails. For box nails, the spacing and end distance requirements of the next shorter common nail may be used (e.g., a 16d box nail may be spaced the same as a 10d and 12d common nail). Larger nail sizes and shank types not specifically described above are outside the scope of this report.
[8]Nail penetration for edge nailing must not exceed 2 inches for 16d common nails ($3^1/_2$ in. by 0.162 in. diameter) and $2^1/_2$ inches for all nails with a smaller shank diameter.
[9]Minimum nail spacing for the face orientation is applicable to nails that are installed in rows that are parallel to the direction of the grain (length) of the LSL or LVL. For nails driven into the face in rows that are perpendicular to the direction of the grain (width/depth) of the LSL or LVL, the minimum spacing must be sufficient to prevent splitting of the wood.
[10]For LSL thicknesses of $1^1/_8$-inch or greater, 16d common nails are permitted to be driven into the edge, with a minimum end distance of $2^1/_2$ inches and a minimum spacing of 5 inches. For LSL thicknesses less than $1^1/_8$-inch, 16d common nails are not permitted to be driven into the edge.
[11]Minimum end distance may be reduced to 2 inches when the nail penetration into the edge of the LSL does not exceed $1^3/_8$ inches.
[12]Minimum nail spacing may be reduced to 4 inches when the nail penetration into the edge of the LSL does not exceed $1^3/_8$ inches.

TABLE 4—ALLOWABLE DESIGN LOADS FOR LP® SolidStart® LSL AND LVL RIM BOARD [1, 2]

GRADE	THICKNESS, t (in.)	LATERAL LOAD CAPACITY [3, 4] (lb/ft)	VERTICAL LOAD CAPACITY			$^1/_2$″ DIA. LAG SCREW CAPACITY FOR DECK LEDGER [6]
			Uniform Load [5] (lb/ft)		Concentrated (lbs)	
			Depth ≤ 16″	16″< Depth ≤ 24″	Depth ≤ 24″	
LP SolidStart LSL RIM BOARD						
1730F_b-1.35E and higher	$1^1/_4 \le t < 1^1/_2$	250	6000	3800	3800	450
	$t \ge 1^1/_2$	280	7000	4500	4500	475
LP SolidStart LVL RIM BOARD (cross-ply)						
1400F_b-1.1E	$t \ge 1^1/_4$	250	8000	5070	4210	450
1650F_b-1.3E	1 and $1^1/_8$	190	7210	4990	3870	300 (t = 1″) 400 (t = $1^1/_8$″)
1750F_b-1.3E	$t \ge 1^1/_4$	250	9350	5070	4210	450
LP SolidStart LVL (no cross-ply)						
2000F_b-1.3E and higher	$1^1/_2 \le t < 1^3/_4$	250	4000	2500	2700	450
	$t \ge 1\ ¾$	250	4500	3450	3200	450

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

[1]Allowable design loads in the above table cannot be increased for load duration.
[2]See Table 3 for minimum nail spacing requirements.
[3]Toe-nailed connections are not limited by the 150 lb/ft lateral load capacity noted for Seismic Design Categories D, E, and F in Section 2305.1.4 of the IBC, ~~or Seismic Zones 3 and 4 in Section 2318.3.1 of the UBC~~. *
[4]The nailing schedule for sheathing-to-rim and rim-to-sill plate (toe-nailed) is based on minimum 8d box nails ($2^1/_2$ in x 0.113 in. diameter) at 6 inches on center. Commercial framing connectors fastened to the face of the rim board and wall plates may be used to achieve lateral load capacities exceeding values in this table. Calculations must be based on equivalent specific gravity listed in Table 2, and must not exceed the nail spacing requirements of Table 3.
[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 or the attached floor sheathing.
[6]Lag screw connections between LP SolidStart LSL and LVL rim board and deck ledgers have allowable lateral loads as specified in the table above, provided the conditions under the exception to Section 4.2 are met.

TABLE 5—STRENGTH REDUCTION FACTORS FOR NOTCHES AND HOLES IN LP® SolidStart® LSL AND LVL STUDS [1, 2, 3]

MATERIAL	NOTCHES			HOLES		
	Bending	Compression	Tension	Bending	Compression	Tension
LP LSL	0.95	0.90	0.75	1.00	1.00	1.00
LP LVL	0.80	0.90	0.60	0.95	0.95	0.95

[1]Design of LP LSL and LP LVL studs with notches and holes used in engineered wall framing must be based on a net-section analysis in accordance with the NDS. See Section 4.3.2 of this report for limitations on the allowed size and placement of notches and holes.
[2]The reference design values for bending, axial compression and axial tension from Table 1 must be multiplied by the strength reduction factors given above for studs with notches or holes in engineered wall framing.
[3]See Section 4.3.1 for notching and boring of holes in LP LSL and LP LVL studs used in prescriptive wall framing.

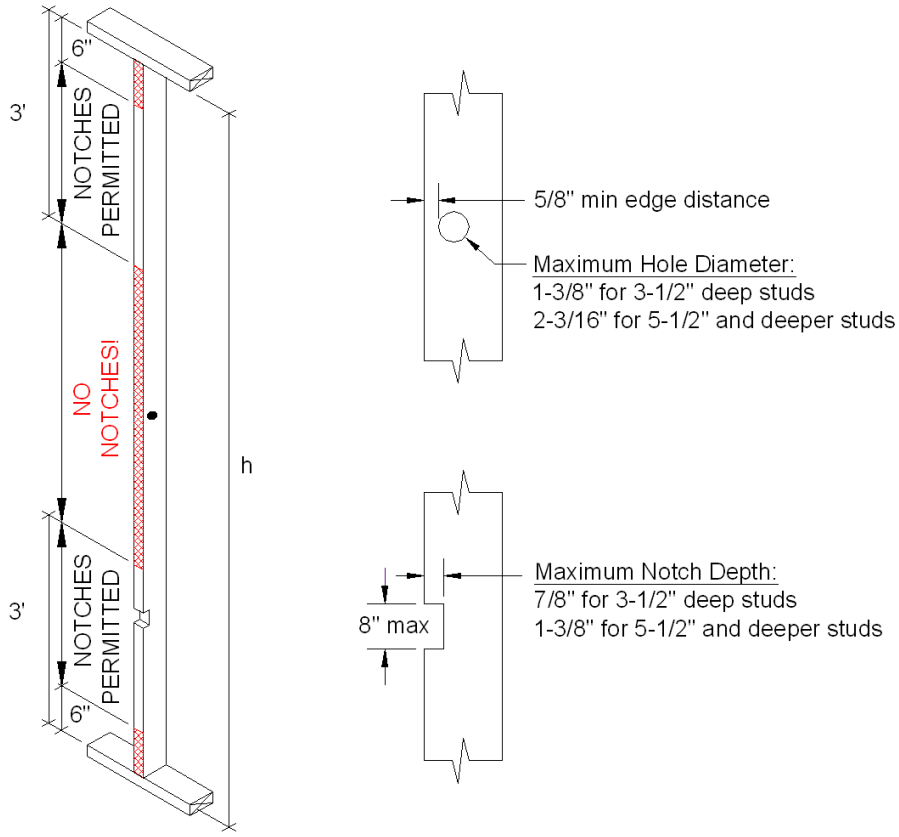
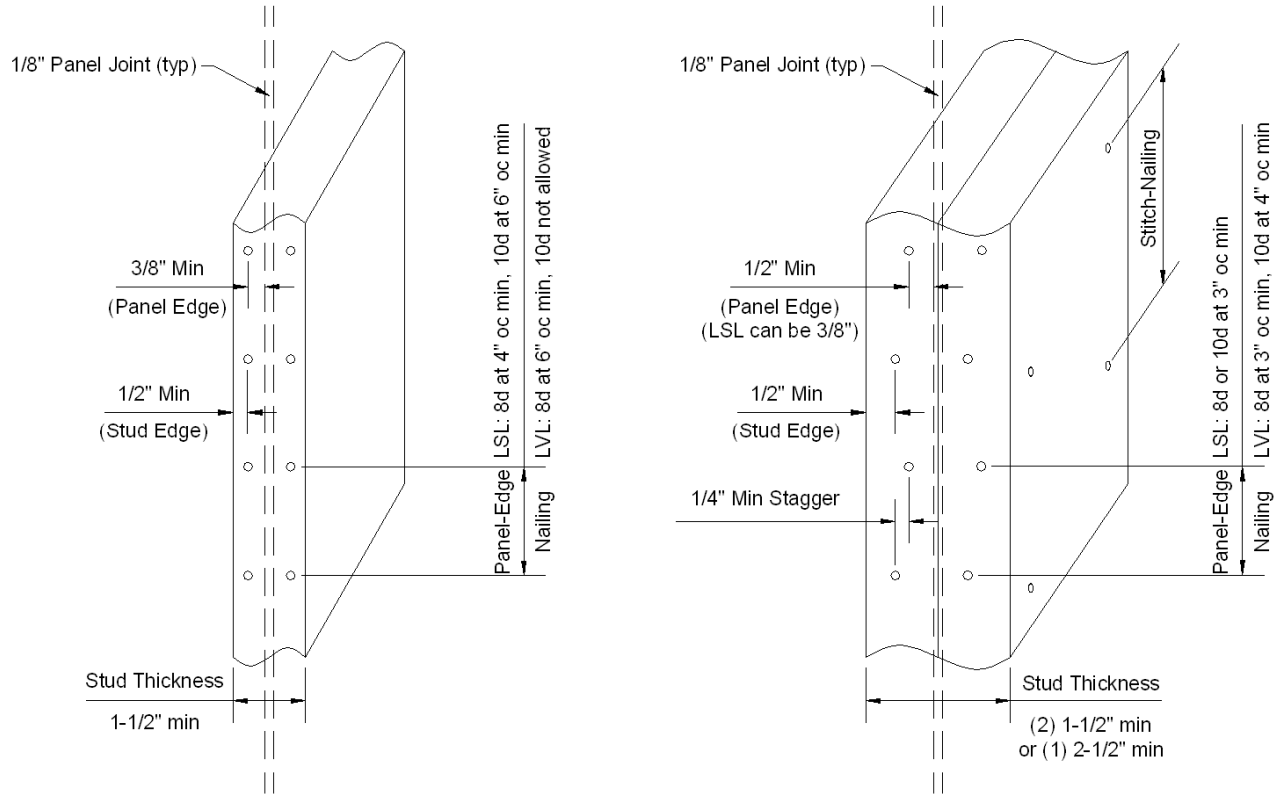


FIGURE 1—NOTCHING AND BORING REQUIREMENTS FOR LP® SolidStart® LSL AND LVL STUDS IN ENGINEERED APPLICATIONS



DETAIL A: Single Stud at Adjoining Panel Edges

DETAIL B: Double Stud at Adjoining Panel Edges

FIGURE 2—PANEL EDGE NAILING REQUIREMENTS FOR LP® SolidStart® LSL AND LVL STUDS

TABLE 6—RAFTER SPANS FOR LP® SolidStart® LSL[1,2]

ROOF LIVE LOAD = 20 psf (C_D = 1.25)																
CEILING NOT ATTACHED TO RAFTERS, L/Δ = 180																
RAFTER SPACING (inches)	**GRADE**	**DEAD LOAD = 10 psf**							**DEAD LOAD = 20 psf**							
		2 x 4	**2 x 6**	**2 x 8**	**2 x 10**	**1 1/2 x 9 1/2**	**2 x 12**	**1 1/2 x 11 7/8**	**2 x 4**	**2 x 6**	**2 x 8**	**2 x 10**	**1 1/2 x 9 1/2**	**2 x 12**	**1 1/2 x 11 7/8**
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	10-2	16-0	21-1	26-0	26-0	26-0	26-0	9-3	14-6	19-2	24-5	25-1	26-0	26-0
	2360F_b-1.55E	10-8	16-9	22-1	26-0	26-0	26-0	26-0	9-8	15-2	20-0	25-7	26-0	26-0	26-0
	2500F_b-1.75E	11-1	17-5	23-0	26-0	26-0	26-0	26-0	10-1	15-10	20-11	26-0	26-0	26-0	26-0
16	1730F_b-1.35E	9-3	14-6	19-2	24-5	25-1	26-0	26-0	8-4	13-2	17-4	22-2	22-9	26-0	26-0
	2360F_b-1.55E	9-8	15-2	20-0	25-7	26-0	26-0	26-0	8-9	13-9	18-2	23-3	23-10	26-0	26-0
	2500F_b-1.75E	10-1	15-10	20-11	26-0	26-0	26-0	26-0	9-2	14-4	18-11	24-2	24-10	26-0	26-0
19.2	1730F_b-1.35E	8-8	13-8	18-0	22-11	23-7	26-0	26-0	7-10	12-4	16-4	20-10	21-5	25-4	26-0
	2360F_b-1.55E	9-1	14-3	18-10	24-1	24-8	26-0	26-0	8-3	12-11	17-1	21-10	22-5	26-0	26-0
	2500F_b-1.75E	9-6	14-11	19-8	25-1	25-9	26-0	26-0	8-7	13-6	17-10	22-9	23-4	26-0	26-0
24	1730F_b-1.35E	8-0	12-8	16-8	21-3	21-10	25-11	26-0	7-3	11-6	15-1	19-4	19-10	23-6	24-10
	2360F_b-1.55E	8-5	13-3	17-6	22-4	22-11	26-0	26-0	7-8	12-0	15-10	20-3	20-9	24-7	26-0
	2500F_b-1.75E	8-9	13-10	18-2	23-3	23-10	26-0	26-0	7-11	12-6	16-6	21-1	21-8	25-8	26-0
CEILING ATTACHED TO RAFTERS, L/Δ = 240																
RAFTER SPACING (inches)	**GRADE**	**DEAD LOAD = 10 psf**							**DEAD LOAD = 20 psf**							
		2 x 4	**2 x 6**	**2 x 8**	**2 x 10**	**1 1/2 x 9 1/2**	**2 x 12**	**1 1/2 x 11 7/8**	**2 x 4**	**2 x 6**	**2 x 8**	**2 x 10**	**1 1/2 x 9 1/2**	**2 x 12**	**1 1/2 x 11 7/8**
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	8-10	13-11	18-5	23-6	24-1	26-0	26-0	8-0	12-8	16-8	21-3	21-10	25-11	26-0
	2360F_b-1.55E	9-3	14-7	19-3	24-7	25-3	26-0	26-0	8-5	13-3	17-6	22-4	22-11	26-0	26-0
	2500F_b-1.75E	9-8	15-2	20-1	25-7	26-0	26-0	26-0	8-9	13-10	18-2	23-3	23-10	26-0	26-0
16	1730F_b-1.35E	8-0	12-8	16-8	21-3	21-10	25-11	26-0	7-3	11-6	15-1	19-4	19-10	23-6	24-10
	2360F_b-1.55E	8-5	13-3	17-6	22-4	22-11	26-0	26-0	7-8	12-0	15-10	20-3	20-9	24-7	26-0
	2500F_b-1.75E	8-9	13-10	18-2	23-3	23-10	26-0	26-0	7-11	12-6	16-6	21-1	21-8	25-8	26-0
19.2	1730F_b-1.35E	7-7	11-11	15-8	20-0	20-7	24-4	25-8	6-10	10-9	14-3	18-2	18-8	22-1	23-4
	2360F_b-1.55E	7-11	12-5	16-5	21-0	21-6	25-6	26-0	7-2	11-4	14-11	19-0	19-6	23-2	24-5
	2500F_b-1.75E	8-3	13-0	17-1	21-10	22-5	26-0	26-0	7-6	11-9	15-6	19-10	20-4	24-1	25-6
24	1730F_b-1.35E	7-0	11-0	14-6	18-7	19-1	22-7	23-10	6-4	10-0	13-2	16-10	17-3	20-6	21-7
	2360F_b-1.55E	7-4	11-7	15-3	19-5	20-0	23-8	25-0	6-8	10-6	13-10	17-8	18-1	21-5	22-8
	2500F_b-1.75E	7-8	12-0	15-10	20-3	20-10	24-8	26-0	6-11	10-11	14-5	18-4	18-10	22-4	23-7

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kPa.

[1]The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. When ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the factors given below:

H_C/H_R	Rafter Span Adjustment Factor
1/3	0.67
1/4	0.76
1/5	0.83
1/6	0.90
1/7.5 or less	1.00

where:

H_C = Height of ceiling joists or rafter ties measured vertically above the top of the rafter support walls.
H_R = Height of roof ridge measured vertically above the top of the rafter support walls.

[2]Rafter sizes are given in nominal lumber dimensions except the 1 1/2 x 9 1/2 and 1 1/2 x 11 7/8 rafter sizes are standard LP LSL dimensions.

TABLE 6—RAFTER SPANS FOR LP® SolidStart® LSL[1,2] (continued)

GROUND SNOW LOAD = 30 psf (C_D = 1.15)																
CEILING NOT ATTACHED TO RAFTERS, L/Δ = 180																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	8-10	13-11	18-5	23-6	24-1	26-0	26-0	8-7	13-5	17-9	22-8	23-3	26-0	26-0
	2360F_b-1.55E	9-3	14-7	19-3	24-7	25-3	26-0	26-0	8-11	14-1	18-7	23-9	24-4	26-0	26-0
	2500F_b-1.75E	9-8	15-2	20-1	25-7	26-0	26-0	26-0	9-4	14-8	19-4	24-9	25-5	26-0	26-0
16	1730F_b-1.35E	8-0	12-8	16-8	21-3	21-10	25-11	26-0	7-9	12-2	16-1	20-7	21-1	25-0	26-0
	2360F_b-1.55E	8-5	13-3	17-6	22-4	22-11	26-0	26-0	8-1	12-9	16-10	21-6	22-1	26-0	26-0
	2500F_b-1.75E	8-9	13-10	18-2	23-3	23-10	26-0	26-0	8-6	13-4	17-7	22-5	23-0	26-0	26-0
19.2	1730F_b-1.35E	7-7	11-11	15-8	20-0	20-7	24-4	25-8	7-3	11-6	15-1	19-4	19-10	23-5	24-8
	2360F_b-1.55E	7-11	12-5	16-5	21-0	21-6	25-6	26-0	7-8	12-0	15-10	20-3	20-9	24-7	26-0
	2500F_b-1.75E	8-3	13-0	17-1	21-10	22-5	26-0	26-0	7-11	12-6	16-6	21-1	21-8	25-8	26-0
24	1730F_b-1.35E	7-0	11-0	14-6	18-7	19-1	22-7	23-10	6-9	10-7	13-11	17-5	17-11	20-11	22-0
	2360F_b-1.55E	7-4	11-7	15-3	19-5	20-0	23-8	25-0	7-1	11-2	14-8	18-9	19-3	22-10	24-1
	2500F_b-1.75E	7-8	12-0	15-10	20-3	20-10	24-8	26-0	7-5	11-7	15-4	19-7	20-1	23-9	25-1
CEILING ATTACHED TO RAFTERS, L/Δ = 240																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	8-0	12-8	16-8	21-3	21-10	25-11	26-0	7-5	11-9	15-6	19-9	20-3	24-0	25-4
	2360F_b-1.55E	8-5	13-3	17-6	22-4	22-11	26-0	26-0	7-10	12-3	16-2	20-8	21-3	25-2	26-0
	2500F_b-1.75E	8-9	13-10	18-2	23-3	23-10	26-0	26-0	8-2	12-10	16-11	21-7	22-2	26-0	26-0
16	1730F_b-1.35E	7-3	11-6	15-1	19-4	19-10	23-6	24-10	6-9	10-7	14-0	17-11	18-5	21-9	23-0
	2360F_b-1.55E	7-8	12-0	15-10	20-3	20-9	24-7	26-0	7-1	11-2	14-8	18-9	19-3	22-10	24-1
	2500F_b-1.75E	7-11	12-6	16-6	21-1	21-8	25-8	26-0	7-5	11-7	15-4	19-7	20-1	23-9	25-1
19.2	1730F_b-1.35E	6-10	10-9	14-3	18-2	18-8	22-1	23-4	6-4	10-0	13-2	16-10	17-3	20-6	21-7
	2360F_b-1.55E	7-2	11-4	14-11	19-0	19-6	23-2	24-5	6-8	10-6	13-10	17-8	18-1	21-5	22-8
	2500F_b-1.75E	7-6	11-9	15-6	19-10	20-4	24-1	25-6	6-11	10-11	14-5	18-4	18-10	22-4	23-7
24	1730F_b-1.35E	6-4	10-0	13-2	16-10	17-3	20-6	21-7	5-11	9-3	12-2	15-7	16-0	19-0	20-0
	2360F_b-1.55E	6-8	10-6	13-10	17-8	18-1	21-5	22-8	6-2	9-8	12-10	16-4	16-9	19-11	21-0
	2500F_b-1.75E	6-11	10-11	14-5	18-4	18-10	22-4	23-7	6-5	10-1	13-4	17-0	17-6	20-9	21-11

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kPa.

[1]The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. When ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the factors given below:

H_C/H_R	Rafter Span Adjustment Factor
1/3	0.67
1/4	0.76
1/5	0.83
1/6	0.90
1/7.5 or less	1.00

where:

H_C = Height of ceiling joists or rafter ties measured vertically above the top of the rafter support walls.
H_R = Height of roof ridge measured vertically above the top of the rafter support walls.

[2]Rafter sizes are given in nominal lumber dimensions except the $1^1/_2$ x $9^1/_2$ and $1^1/_2$ x $11^7/_8$ rafter sizes are standard LP LSL dimensions.

TABLE 6—RAFTER SPANS FOR LP® SolidStart® LSL[1,2] (continued)

GROUND SNOW LOAD = 50 psf (C_D = 1.15)																
CEILING NOT ATTACHED TO RAFTERS, L/Δ = 180																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)													
12	$1730F_b$-1.35E	7-5	11-9	15-6	19-9	20-3	24-0	25-4	7-5	11-9	15-6	19-9	20-3	24-0	25-4
	$2360F_b$-1.55E	7-10	12-3	16-2	20-8	21-3	25-2	26-0	7-10	12-3	16-2	20-8	21-3	25-2	26-0
	$2500F_b$-1.75E	8-2	12-10	16-11	21-7	22-2	26-0	26-0	8-2	12-10	16-11	21-7	22-2	26-0	26-0
16	$1730F_b$-1.35E	6-9	10-7	14-0	17-11	18-5	21-9	23-0	6-9	10-7	14-0	17-11	18-5	21-8	22-10
	$2360F_b$-1.55E	7-1	11-2	14-8	18-9	19-3	22-10	24-1	7-1	11-2	14-8	18-9	19-3	22-10	24-1
	$2500F_b$-1.75E	7-5	11-7	15-4	19-7	20-1	23-9	25-1	7-5	11-7	15-4	19-7	20-1	23-9	25-1
19.2	$1730F_b$-1.35E	6-4	10-0	13-2	16-10	17-3	20-6	21-7	6-4	10-0	13-2	16-6	16-11	19-9	20-10
	$2360F_b$-1.55E	6-8	10-6	13-10	17-8	18-1	21-5	22-8	6-8	10-6	13-10	17-8	18-1	21-5	22-8
	$2500F_b$-1.75E	6-11	10-11	14-5	18-4	18-10	22-4	23-7	6-11	10-11	14-5	18-4	18-10	22-4	23-7
24	$1730F_b$-1.35E	5-11	9-3	12-2	15-7	16-0	19-0	20-0	5-11	9-1	11-9	14-9	15-1	17-8	18-7
	$2360F_b$-1.55E	6-2	9-8	12-10	16-4	16-9	19-11	21-0	6-2	9-8	12-10	16-4	16-9	19-11	21-0
	$2500F_b$-1.75E	6-5	10-1	13-4	17-0	17-6	20-9	21-11	6-5	10-1	13-4	17-0	17-6	20-9	21-11
CEILING ATTACHED TO RAFTERS, L/Δ = 240																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)													
12	$1730F_b$-1.35E	6-9	10-7	14-0	17-11	18-5	21-9	23-0	6-8	10-5	13-9	17-7	18-1	21-5	22-7
	$2360F_b$-1.55E	7-1	11-2	14-8	18-9	19-3	22-10	24-1	7-0	10-11	14-5	18-5	18-11	22-5	23-8
	$2500F_b$-1.75E	7-5	11-7	15-4	19-7	20-1	23-9	25-1	7-3	11-5	15-1	19-3	19-9	23-5	24-8
16	$1730F_b$-1.35E	6-1	9-8	12-8	16-3	16-8	19-9	20-10	6-0	9-6	12-6	15-11	16-5	19-5	20-6
	$2360F_b$-1.55E	6-5	10-1	13-4	17-0	17-6	20-8	21-10	6-4	9-11	13-1	16-9	17-2	20-4	21-6
	$2500F_b$-1.75E	6-8	10-6	13-11	17-9	18-2	21-7	22-9	6-7	10-4	13-8	17-5	17-11	21-3	22-5
19.2	$1730F_b$-1.35E	5-9	9-1	11-11	15-3	15-8	18-7	19-7	5-8	8-11	11-9	15-0	15-5	18-3	19-3
	$2360F_b$-1.55E	6-0	9-6	12-6	16-0	16-5	19-5	20-6	5-11	9-4	12-4	15-9	16-2	19-2	20-2
	$2500F_b$-1.75E	6-3	9-11	13-1	16-8	17-1	20-3	21-5	6-2	9-9	12-10	16-5	16-10	19-11	21-1
24	$1730F_b$-1.35E	5-4	8-5	11-1	14-1	14-6	17-2	18-2	5-3	8-3	10-10	13-11	14-3	16-11	17-10
	$2360F_b$-1.55E	5-7	8-9	11-7	14-10	15-2	18-0	19-0	5-6	8-8	11-5	14-7	14-11	17-9	18-8
	$2500F_b$-1.75E	5-10	9-2	12-1	15-5	15-10	18-9	19-10	5-9	9-0	11-11	15-2	15-7	18-6	19-6

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kPa.

[1]The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. When ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the factors given below:

H_C/H_R	Rafter Span Adjustment Factor
1/3	0.67
1/4	0.76
1/5	0.83
1/6	0.90
1/7.5 or less	1.00

where:

H_C = Height of ceiling joists or rafter ties measured vertically above the top of the rafter support walls.
H_R = Height of roof ridge measured vertically above the top of the rafter support walls.

[2]Rafter sizes are given in nominal lumber dimensions except the $1^1/_2$ x $9^1/_2$ and $1^1/_2$ x $11^7/_8$ rafter sizes are standard LP LSL dimensions.

TABLE 6—RAFTER SPANS FOR LP® SolidStart® LSL[1,2] (continued)

GROUND SNOW LOAD = 70 psf (C_D = 1.15)																
CEILING NOT ATTACHED TO RAFTERS, L/Δ = 180																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	6-8	10-5	13-9	17-7	18-1	21-5	22-7	6-8	10-5	13-9	17-7	18-1	21-5	22-7
	2360F_b-1.55E	7-0	10-11	14-5	18-5	18-11	22-5	23-8	7-0	10-11	14-5	18-5	18-11	22-5	23-8
	2500F_b-1.75E	7-3	11-5	15-1	19-3	19-9	23-5	24-8	7-3	11-5	15-1	19-3	19-9	23-5	24-8
16	1730F_b-1.35E	6-0	9-6	12-6	15-11	16-5	19-5	20-6	6-0	9-6	12-6	15-11	16-4	19-1	20-1
	2360F_b-1.55E	6-4	9-11	13-1	16-9	17-2	20-4	21-6	6-4	9-11	13-1	16-9	17-2	20-4	21-6
	2500F_b-1.75E	6-7	10-4	13-8	17-5	17-11	21-3	22-5	6-7	10-4	13-8	17-5	17-11	21-3	22-5
19.2	1730F_b-1.35E	5-8	8-11	11-9	15-0	15-5	18-3	19-3	5-8	8-11	11-7	14-6	14-11	17-5	18-4
	2360F_b-1.55E	5-11	9-4	12-4	15-9	16-2	19-2	20-2	5-11	9-4	12-4	15-9	16-2	19-2	20-2
	2500F_b-1.75E	6-2	9-9	12-10	16-5	16-10	19-11	21-1	6-2	9-9	12-10	16-5	16-10	19-11	21-1
24	1730F_b-1.35E	5-3	8-3	10-10	13-10	14-2	16-7	17-5	5-3	8-0	10-4	13-0	13-4	15-7	16-5
	2360F_b-1.55E	5-6	8-8	11-5	14-7	14-11	17-9	18-8	5-6	8-8	11-5	14-7	14-11	17-9	18-8
	2500F_b-1.75E	5-9	9-0	11-11	15-2	15-7	18-6	19-6	5-9	9-0	11-11	15-2	15-7	18-6	19-6
CEILING ATTACHED TO RAFTERS, L/Δ = 240																
RAFTER SPACING (inches)	GRADE	DEAD LOAD = 10 psf							DEAD LOAD = 20 psf							
		2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$	2 x 4	2 x 6	2 x 8	2 x 10	$1^1/_2$ x $9^1/_2$	2 x 12	$1^1/_2$ x $11^7/_8$
		Maximum Rafter Spans[1] (feet – inches)														
12	1730F_b-1.35E	6-0	9-6	12-6	15-11	16-5	19-5	20-6	6-0	9-6	12-6	15-11	16-5	19-5	20-6
	2360F_b-1.55E	6-4	9-11	13-1	16-9	17-2	20-4	21-6	6-4	9-11	13-1	16-9	17-2	20-4	21-6
	2500F_b-1.75E	6-7	10-4	13-8	17-5	17-11	21-3	22-5	6-7	10-4	13-8	17-5	17-11	21-3	22-5
16	1730F_b-1.35E	5-5	8-7	11-4	14-5	14-10	17-7	18-7	5-5	8-7	11-4	14-5	14-10	17-7	18-7
	2360F_b-1.55E	5-9	9-0	11-10	15-2	15-7	18-5	19-6	5-9	9-0	11-10	15-2	15-7	18-5	19-6
	2500F_b-1.75E	6-0	9-5	12-5	15-10	16-3	19-3	20-4	6-0	9-5	12-5	15-10	16-3	19-3	20-4
19.2	1730F_b-1.35E	5-1	8-1	10-8	13-7	13-11	16-6	17-5	5-1	8-1	10-8	13-7	13-11	16-6	17-5
	2360F_b-1.55E	5-4	8-5	11-2	14-3	14-7	17-4	18-3	5-4	8-5	11-2	14-3	14-7	17-4	18-3
	2500F_b-1.75E	5-7	8-10	11-8	14-10	15-3	18-1	19-1	5-7	8-10	11-8	14-10	15-3	18-1	19-1
24	1730F_b-1.35E	4-9	7-6	9-10	12-7	12-11	15-4	16-2	4-9	7-6	9-10	12-7	12-11	15-4	16-2
	2360F_b-1.55E	5-0	7-10	10-4	13-2	13-6	16-1	16-11	5-0	7-10	10-4	13-2	13-6	16-1	16-11
	2500F_b-1.75E	5-2	8-2	10-9	13-9	14-1	16-9	17-8	5-2	8-2	10-9	13-9	14-1	16-9	17-8

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kPa.

[1]The tabulated rafter spans assume that ceiling joists are located at the bottom of the attic space or that some other method of resisting the outward push of the rafters on the bearing walls, such as rafter ties, is provided at that location. When ceiling joists or rafter ties are located higher in the attic space, the rafter spans shall be multiplied by the factors given below:

H_C/H_R	Rafter Span Adjustment Factor
1/3	0.67
1/4	0.76
1/5	0.83
1/6	0.90
1/7.5 or less	1.00

where:

H_C = Height of ceiling joists or rafter ties measured vertically above the top of the rafter support walls.
H_R = Height of roof ridge measured vertically above the top of the rafter support walls.

[2]Rafter sizes are given in nominal lumber dimensions except the $1^1/_2$ x $9^1/_2$ and $1^1/_2$ x $11^7/_8$ rafter sizes are standard LP LSL dimensions.