APA PRODUCT REPORT®

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Tolko Laminated Strand Lumber (LSL) PR-L284
Tolko Industries, Ltd. Revised July 6, 2024

Products: Tolko LSL and LSL Rim Board

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1. Basis of the product report:
   - 2024 International Building Code (IBC): Sections 104.2.3 Alternative materials and 2303.1.10 Structural composite lumber
   - 2021, 2018, and 2015 IBC: Sections 104.11 Alternative materials and 2303.1.10 Structural composite lumber
   - 2024 International Residential Code (IRC): Sections R104.2.2 Alternative materials, and R502.1.5, R602.1.5, and R802.1.4 Structural composite lumber
   - 2021, 2018, and 2015 IRC: Sections R104.11 Alternative materials, and R502.1.5, R602.1.5, and R802.1.4 Structural composite lumber
   - ASTM D5456-21e1, ASTM D5456-18, ASTM D5456-14b, and ASTM D5456-13, recognized in the 2024 IBC and IRC, 2021 IBC and IRC, 2018 IBC and IRC, and 2015 IBC and IRC, respectively
   - ASTM D7672-19, ASTM D7672-14e1, ASTM D7672-14, and ASTM D7672-12 recognized in the 2024 IBC and IRC, 2021 IBC and IRC, 2018 IBC and IRC, and 2015 IBC and IRC, respectively
   - 2021 and 2015 ANSI/AWC Special Design Provisions for Wind and Seismic (SDPWS) recognized in the 2024 and 2021 IBC, and 2018 and 2015 IBC, respectively
   - APA Reports T2008P-08A, T2018P-10, T2018P-24, T2018P-28, T2018P-29A, T2018P-33, T2018P-34, T2019P-06, T2019P-21, T2019P-30, T2019P-37, T2019P-41, T2019P-44, T2020P-16, T2020P-18, T2020P-29, T2020P-30, T2020P-31, and T2020P-51, and other qualification data

2. Product description:

2.1 Tolko Laminated Strand Lumber (LSL)

Tolko LSL is made with strands of various species and strand classifications in accordance with the in-plant manufacturing standard approved by APA.

The LSL may be treated with an EPA-registered zinc borate for decay and termite resistance to a retention level equivalent to that specified in American Wood Protection Association (AWPA) Standard T1 for Use Category 2 (UC2). When treated, the LSL is designated as Tolko LSL with ZB. The efficacy of the preservative treatment of the Tolko LSL with ZB is outside the scope of this report and the APA certification program. For the purposes of this report, the designations of Tolko LSL and Tolko LSL with ZB can be used interchangeably.

Tolko LSL is available with thicknesses up to 3-1/2 inches, and a range of widths and lengths. Refer to the manufacturer's technical guide (www.tolko.com) and a local Tolko Industries Ltd. Distributor for product availability.

Tolko 1.35E LSL and 1.55E LSL can also be used as wall framing in conventional light-frame construction of the applicable codes and in engineered wall systems. The minimum thickness of the 1.35E LSL and 1.55E LSL for wall framing is 1-1/2 inches.

Tolko LSL shall be permitted for use as rim board with a thickness of 1-1/4 inches through 1-3/4 inches for 1.35E LSL. For 1.55E LSL used as rim board, the thickness is limited to 1-1/8 inches through 1-1/2 inches.

3. Design properties:
Table 1 lists the design properties for Tolko LSL, Table 2 lists the equivalent specific gravities for fastener design with Tolko LSL, Table 3 lists the allowable loads for Tolko LSL used as rim boards, Table 4 lists the minimum allowable nail spacing for Tolko LSL, and Table 5 lists the strength adjustment factors for notches and holes in Tolko 1.35E LSL and 1.55E LSL when used as wall studs.

3.1 Beams, headers, and columns:
The allowable loads for Tolko LSL beams, headers, and columns shall be in accordance with the recommendations provided by the manufacturer (see link above).

3.2 Wall framing:

3.2.1 Prescriptive Stud Wall Applications: Tolko 1.35E LSL and 1.55E LSL shall be permitted for use as wall studs in conventional construction in accordance with Section 2308.9 of the 2024 IBC, Section 2308.5 of the 2021, 2018, and 2015 IBC, and Section R602 of the 2024 through 2015 IRC.

3.2.2 Engineered Stud Wall Applications: Tolko 1.35E LSL and 1.55E LSL shall be permitted in engineered wall applications when designed based on net section analysis in accordance with the National Design Specification for Wood Construction (NDS) and the restrictions specified in Section 4.3.2. The allowable design stress for bending, axial compression, and axial tension shall be multiplied by the strength adjustment factors provided in Table 5 to account for stress concentrations in notches and holes.

The allowable shear values for nailed wood structural panel shear walls using Tolko 1.35E LSL and 1.55E LSL as the wall studs shall be determined using Table 4.3A of the 2021 and 2015 SDPWS where the Tolko 1.35E LSL and 1.55E LSL shall be considered to be equivalent to sawn lumber studs with a specific gravity of 0.50, when subjected to the nailing restrictions specified in Section 4.3.5. of 2021 SDPWS and Section 4.3.3 of 2015 SDPWS.

4. Product installation:

4.1 Beams and headers:
Tolko LSL shall be installed in accordance with the recommendations provided by the manufacturer (see link above). Permissible details and allowable hole sizes shall be in accordance with the recommendations provided by the manufacturer.

4.2 Columns:

4.2.1 Tolko LSL used as free-standing columns shall not be drilled or notched without the approval of a professional engineer or the manufacturer. Bolts, lag screws, and self-tapping screws shall only be inserted through the face of the column, perpendicular to the face of the strands in Tolko LSL.

4.2.2 Built-up columns: When used for built-up columns, Tolko LSL shall be constructed using connections specified by the manufacturer (see link above).

4.3 Wall framing:

4.3.1 Prescriptive Stud Wall Applications: Cutting, notching, and boring of Tolko 1.35E LSL and 1.55E LSL used as studs in conventional construction are permitted in accordance with Sections 2308.9 of the 2024 IBC, Sections 2308.5 of the 2021, 2018, and 2015 IBC, and Section R602.6 of the 2024 through 2015 IRC. Stud wall nailing restrictions and requirements are presented in Section 4.3.3.

4.3.2 Engineered Stud Wall Applications: Cutting, notching, and boring of Tolko 1.35E LSL and 1.55E LSL shall be permitted in engineered wall applications with the following restrictions:

a) Holes up to 40% of the stud depth are allowed anywhere in the stud height for bearing walls, except that a hole shall not be placed within 6 inches of either end of the stud. A minimum edge distance of 5/8 inch shall be maintained for all holes for stud depths of 5-1/2 inches (i.e., nominal 2x6) or less. For larger depths, a minimum edge distance of 12% of the stud depth shall be maintained for all holes.

b) Notches up to 20% of the stud depth are allowed anywhere in the stud height, except that a notch shall not be placed within 6 inches of either end of the stud. The notch length shall not exceed 8 inches.

c) Holes and notches shall not be cut at the same cross-section, and the minimum clear vertical space between hole and notch shall be 2 times the hole diameter or 2 times the notch length, whichever is greater.

d) Stud wall nailing restrictions and requirements are presented in Section 4.3.3.

4.3.3 Stud wall nailing restrictions and requirements

a) Tolko 1.35E LSL and 1.55E LSL Studs

- For sheathing attached with 10d common nails (0.148 inch x 3 inches) with a spacing no closer than 6 inches on center, a single Tolko 1.35E LSL or 1.55E LSL stud shall be permitted for framing at adjoining panel edges. Nails shall be installed a minimum 3/8 inch from all panel edges.
- For sheathing attached with 8d common nails (0.131 inch x 2-1/2 inches) or smaller with a spacing no closer than 4 inches on center, a single Tolko 1.35E LSL or 1.55E LSL stud shall be permitted for framing at adjoining panel edges. Nails shall be installed a minimum 3/8 inch from all panel edges.
- For sheathing attached with 8d common nails (0.131 inch x 2-1/2 inches) spaced closer than 4 inches (but not closer than 2 inches) on center or 10d common nails (0.148 inch x 3 inches) spaced closer than 6 inches (but not closer than 3 inches) on center, a double, stitch-nailed, Tolko 1.35E LSL or 1.55E LSL stud or a single 2-1/2 inch thick Tolko 1.35E LSL or 1.55E LSL stud is required at adjoining panel edges. Nails shall be installed a minimum 3/8 inch from all panel edges and shall be staggered a minimum of 1/2 inch for each row of nails.

b) For stud wall applications in accordance with the IRC and the conventional light-frame construction provisions of the IBC [Sections 2308, Table 2304.10.2 (2024 and 2021 IBC), and Table 2304.10.1 (2018 and 2015 IBC)], double LSL studs shall be stitch-nailed together with 2 staggered rows of nails (minimum 0.120 inch x 2-7/8 inches) spaced 8 inches in each row. For engineered stud wall applications, the stitch nailing of double LSL studs shall be designed to transfer the required lateral shear using an assumed equivalent specific gravity of 0.50.

c) 10d common nails (0.148 inch x 3 inches) shall not be spaced closer than 3 inches on center, and 8d common nails (0.131 inch x 2-1/2 inches) shall not be spaced closer than 2 inches on center.

d) Maximum nail size is 10d common (0.148 inch x 3 inches).

4.4 Rim board:
Tolko LSL rim boards shall be installed in accordance with the recommendations provided by the manufacturer (see link above) and the code.

5. Fire-rated assemblies:

5.1 Design of fire-resistant exposed wood members in accordance with Chapter 16 of the NDS, Section 722.1 of the 2024 through 2015 IBC shall be applicable to Tolko LSL. Fire-rated assemblies shall be constructed in accordance with the recommendations provided by APA *Fire-Rated Systems*, Form W305 (www.apawood.org/resource-library), and the manufacturer.

5.2 When used as joists/rafters, Tolko LSL is permitted to be used as a direct replacement for solid-sawn lumber having the same dimensions, in any fire-resistance-rated floor/roof assemblies listed in Table 721.1(3) of the 2024 through 2015 IBC.

5.3 The provisions of Section R302.13, Exception 4 of the 2024 through 2015 IRC for fire protection of floors shall be applicable to floor assemblies constructed with Tolko LSL having a nominal 2x10 dimension (i.e., 1-1/2 inches by 9-1/4 inches net dimension) or greater.

5.4 When used as wall studs, Tolko 1.35E LSL and 1.55E LSL are permitted to be used as a direct replacement for solid-sawn lumber of No. 2 or lower grades, having the same dimensions, in fire-resistance-rated wall assemblies listed in Table 721.1(2) of the 2024 through 2015 IBC. A minimum of 2.5 lbf/ft^3 mineral wool insulation shall be placed in the stud cavity.

5.5 As an alternative to the prescriptive fire-resistance-rated wall assemblies listed in Table 721.1(2) of the 2024 through 2015 IBC, a one-hour fire-resistance-rated wall assembly shall be permitted to be designed and constructed with the restrictions listed below, provided that the applied axial stress on each stud does not exceed 435 psi for Tolko 1.35E LSL and 1.55E LSL studs. When the slenderness ratio exceeds 33, the F_c', which is the $F_{c||}$ value tabulated in Table 1 for Tolko 1.35E LSL and 1.55E LSL studs adjusted for all applicable adjustment factors, including column stability factor, in accordance with NDS, shall be multiplied by 0.78 for Tolko 1.35E LSL and 0.76 for Tolko 1.55E LSL.

a) The stud spacing shall be no greater than 24 inches on center,
b) The top and bottom plates of the wall shall be constructed in accordance with the nailing schedule specified in Table 2304.10.2 and Table 2304.10.1 of the 2024 and 2021 IBC, and 2018 and 2015 IBC, respectively or Table R602.3(1) of the 2024 through 2015 IRC,
c) The wall shall be covered with one layer of 5/8-inch Type X gypsum wall board attached to studs with 2-1/4-inch long Type S drywall screws at 7 inches on center on the perimeter and in the field, and
d) A minimum of 2.5 lbf/ft^3 mineral wool insulation shall be placed in the stud cavity.

6. Limitations:
a) Tolko LSL shall be designed in accordance with the code using the design properties and installation requirements specified in this report.

b) Tolko LSL is limited to dry service conditions where the equivalent moisture content of sawn lumber is less than 16 %.
c) The efficacy of the preservative treatment of the Tolko LSL with ZB is outside the scope of this report and the APA certification program.
d) Tolko LSL is produced by the Tolko Industries, Ltd. facility in Slave Lake, Alberta, Canada under a quality assurance program audited by APA.
e) This report is subject to re-examination in one year.

7. Identification:
The Tolko LSL described in this report is identified by a label bearing the manufacturer's name (Tolko Industries, Ltd.) and/or trademark, the APA assigned plant number (1094), the product type and grade, the APA logo, the report number PR-L284, and a means of identifying the date of manufacture.

Table 1. Design Properties (Allowable Stress Design) for Tolko LSL[a,b]

Product Grade	Modulus of Elasticity[c] (10^6 psi)		Flexural Stress, F_b[d] (psi)		Tension Parallel to Grain, F_t (psi)[f]	Comp. Parallel to Grain, F_c (psi)	Compression Perpendicular to Grain, $F_{c\perp}$[g] (psi)		Horizontal Shear, F_v (psi)	
	Joist	Plank	Joist[e]	Plank			Joist	Plank[h]	Joist	Plank
1.35E	1.35	1.35	1,850	2,060	1,300	1,650	750	690	330	115
1-1/8-inch 1.55E LSL	1.55	1.55	2,360	2,620	1,650	1,950	900	775	445	140
1-1/4-inch & 1-1/2-inch 1.55E LSL	1.55	1.55	2,360	2,620	1,750	2,175	900	775	525	155

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 lbf = 4.448 N, 1 psi = 6.9 kPa.

[a] The tabulated values are design values for normal duration of load. All values, except for E and $F_{c\perp}$, are permitted to be adjusted for other load durations as permitted by the code. The design stresses are limited to conditions in which the average equivalent moisture content of sawn lumber does not exceed 16%.

[b] Allowable stresses for "Joist" refer to loads applied parallel to the wide face of the strands (the edge of the member). "Plank" refers to loads applied perpendicular to the wide face of the strands (the face of the member).

[c] The values are the apparent modulus of elasticity (MOE) and include the effect of shear deformations. For uniformly loaded simple-span beams, deflection is calculated using the tabulated apparent MOE as follows:

$$\delta = \frac{270\ \omega L^4}{Ebd^3} \quad [1]$$

where δ = calculated deflection (in.), ω = uniform load (lbf/ft), L = design span (ft), b = beam width (in.) d = beam depth (in.), and E = apparent modulus of elasticity (psi)

[d] Tabulated flexural stress (F_b) shall be permitted to be increased by 4 percent when the member qualifies as a repetitive member as defined in the NDS.

[e] The tabulated values for Tolko LSL are based on a reference depth of 12 inches. For other depths, when loaded edgewise, the allowable bending stress (F_b) shall be modified by $(^{12}/_{d})^{(1/8)}$, where d = depth in inches. For depths less than 2-1/2 inches, the factor for the 2-1/2-inch depth shall be used.

[f] The tabulated values for Tolko LSL are based on a reference length of 3 feet. For other lengths, the allowable tensile stress shall be modified by $(3/L)^{(1/16)}$, where L = length in feet. For lengths less than 3 feet, use the allowable tension stress in Table 1 unadjusted.

[g] When designing with the tabulated compressive stress perpendicular to grain ($F_{c\perp}$), the Bearing Area Factor (C_b) stipulated in Section 3.10.4 of the NDS shall be permitted to be applied.

[h] The tabulated compressive stress perpendicular to grain ($F_{c\perp}$) value is based on the average stress at the proportional limit or 0.04-in. deformation, whichever is less, in accordance with ASTM D5456.

Table 2. Fastener Design for Tolko LSL[a,b,c]

Equivalent Specific Gravity (S.G.)					
Nails and Wood Screws				Bolts and Lag Screws[d,e]	
Withdrawal Load		Lateral Load		Lateral Load	
Installed in Edge	Installed in Face	Installed in Edge	Installed in Face	Installed in Face	
				Parallel to Grain	Perpendicular to Grain
0.42	0.44	0.47	0.50	0.50	0.50

[a] Fastener types and orientation not specifically described above are beyond the scope of this report.
[b] 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.
[c] Fastener spacing, and end and edge distances must be as specified in the NDS.
[d] Bolts and lag screws shall only be installed into the face (plank orientation) of the LSL.
[e] The capacities for ½-inch (12.7 mm) diameter lag screws installed into Tolko LSL Rim Board for ledge attachment shall be in accordance with Table 3.

Table 3. Allowable Loads for Tolko Rim Boards[a]

Grade	Thickness (in.)	Lateral Load[b,c] (lbf/ft)	Uniform Vertical Load[d] (lbf/ft)		Concentrated Vertical Load (lbf)	Lateral Resistance for 1/2-inch-dia. Lag Screws (lbf)
			Depth ≤ 16 in.	16 in. < Depth ≤ 24 in.	Depth ≤ 24 in.	
1.35E	1-1/4	250	5,400	4,350	3,800	560
	1-1/2	225	6,450	5,500	5,000	560
	1-3/4	200	7,550	7,550	7,000	560
1.55E	1-1/8	220	4,850	3,400	4,600	440
	1-1/4	230	5,400	5,150	4,600	600
	1-1/2	200	6,450	6,000	4,600	600

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 lbf = 4.448 N, 1 lbf/ft = 14.6 N/m.

[a] The tabulated design values are applicable to the normal load duration (10 years) for wood products, except for the lateral load capacity, which is based on the short-term load duration (10 minutes). Design values shall be adjusted for other load durations in accordance with the applicable building code except that the vertical uniform load capacity and vertical concentrated load capacity are not permitted to be increased for any load durations shorter than the normal load duration (10 years).
[b] Toe-nailed connections are not limited by the 150 lbf/ft lateral load capacity noted for Seismic Design Categories D, E, and F in Section 4.1.10 of the 2021 SDPWS or Section 4.1.7 of the 2015 SDPWS.
[c] The nailing schedule for sheathing to rim and rim board to sill plate (toe-nailed) is based on 8d box (0.113 x 2-1/2 in.) nails at 6 inches on center. Lateral load capacity is permitted to be increased by a factor of 1.4 when subjected to wind loads. Commercial framing connectors may be used to achieve lateral load capacities exceeding the values shown in this table. Calculations shall be based on the equivalent specific gravity values listed in Table 2 subjected to the nailing spacing provided in Table 4.
[d] 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.

Table 4. Minimum Allowable Nail Spacings for Tolko LSL[a]

LSL Thickness (in.)	Orientation[d]	Common Nail Size[e,f]	Minimum End Distance (in.)	Minimum Nail Spacing per Row (in.)	
				Single Row	Multiple Rows [b,c]
1-1/8	Edge[g]	8d & smaller	2	4	NR[i]
		10d & 12d	2-1/2	5	
		16d	3	6	
	Face[h]	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[g]	8d & smaller	2	4	NR[i]
		10d & 12d	2	4	
		16d	2-1/2	5	
	Face[h]	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 ≤ 3-1/2	Edge[g]	8d & smaller	1 (1-1/2)[j]	2	3
		10d & 12d	2	3	4
		16d	2-1/2	3	6
	Face[h]	8d & smaller	1/2	1	1
		10d & 12d	1/2	1	1
		16d	7/8	1-1/2	1-1/2

For SI: 1 inch = 25.4 mm.

[a] Edge distance shall be sufficient to prevent splitting.
[b] Multiple rows must be spaced 1/2 inch or more from each other and offset one-half of the tabulated minimum nail spacing, as shown in Figure 1.
[c] Multiple rows must be equally spaced about the centerline of the edge or face (whichever applies).
[d] Face orientation applies to nails driven into the face of the LSL member, such that the long axis of the nail is perpendicular to the wide faces of the strands. Edge orientation applies to nails driven into the edge of the LSL member.
[e] 16d sinkers (0.148" x 3-1/4") may be spaced the same as a 12d common wire nail (0.148" x 3-1/4").
[f] 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 beyond the scope of this report.
[g] Nail penetration for edge nailing shall not exceed 2 inches for 16d common nails (0.162" x 3-1/2") and 2-1/2 inches for all nails with a smaller shank diameter.
[h] Tabulated closest on-center spacing for face orientation is applicable to nails that are installed in rows parallel to the grain (length) of the LSL. For nails installed in rows perpendicular to the direction of grain (width/depth) of the LSL, the closest on-center spacing for face orientation shall be sufficient to prevent splitting of the LSL.
[i] Not Recommended.
[j] The multiple row end spacing is 1-1/2-inches.

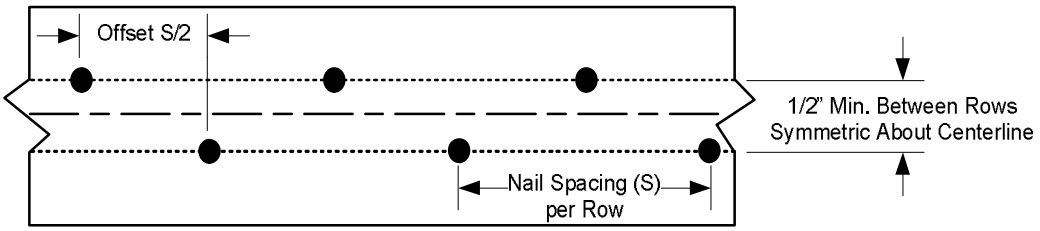

Figure 1. Spacing of multiple rows of nails.

Table 5. Strength Adjustment Factors for Notches and Holes in Tolko 1.35E LSL and 1.55E LSL Studs[a,b,c]

Material	Notches			Holes		
	Bending	Compression	Tension	Bending	Compression	Tension
1.35E LSL	0.90	1.00	0.75	1.00	1.00	1.00
1.55E LSL	0.85	0.98	0.70	0.90	0.90	0.90

(a) Design of Tolko LSL studs with notches 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 up to 40% of the stud depth.

(b) The reference design stresses for bending, compression, and tension from Table 1 must be multiplied by the strength adjustment factors in this table in addition to other adjustment factors required in NDS Table 8.3.1.

(c) See Section 4.3.1 for notching in Tolko 1.35E LSL and 1.55E LSL studs used in prescriptive wall framing.

APA – The Engineered Wood Association is an approved national standards developer accredited by American National Standards Institute (ANSI). APA publishes ANSI standards and Voluntary Product Standards for wood structural panels and engineered wood products. APA is an accredited certification body under ISO/IEC 17065 by Standards Council of Canada (SCC), an accredited inspection agency under ISO/IEC 17020 by ANSI National Accreditation Board (ANAB), and an accredited testing organization under ISO/IEC 17025 by ANAB. APA is also an approved Product Certification Agency, Testing Laboratory, Quality Assurance Entity, Validation Entity, and Product Evaluation Entity by the State of Florida, and an approved testing laboratory by City of Los Angeles.

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