



Tolko Laminated Strand Lumber (LSL) **Tolko Industries, Ltd.**

PR-L284C

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Products: Tolko 1.35E LSL and 1.35E LSL Rim Board

Tolko Industries Ltd., Athabasca Division, 6 km East Mitsue Industrial Park, PO Box 1400, Slave Lake, Alberta T0G 2A0 Canada

(780) 805-3800

www.tolko.com

1. Basis of the product report:

- 2015 National Building Code of Canada: Clause 1.2.1.1 of Division A and Clauses 4.1, 4.3.1.1, and 9.23 of Division B
- CSA O86-14 (Reprint May 2016) Engineering Design in Wood
- ASTM D5456-14b recognized by CAN/CSA O86-14 (Reprint 2016)
- ASTM D7672-14 Standard Specification for Evaluating Structural Capacities of Rim Board Products and Assemblies
- APA Report T2008P-08A, T2018P-10, T2018P-23, T2018P-24, T2018P-28, T2018P-29A, T2018P-33, T2018P-34, and T2018P-42, and other qualification data

2. Product description:

2.1 Tolko Laminated Strand Lumber (LSL)

Tolko 1.35E 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 89 mm (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 LSL can also be used as Part 9 wall framing in accordance with Clause 9.23.10 of the 2015 NBC and in Part 4 engineered wall systems subjected to limitations specified in this report. The minimum thickness of the LSL for wall framing is 38 mm (1-1/2 inches).

Tolko LSL may be used as rim board with a minimum thickness of 32 mm (1-1/4 inches).

3. Design properties:

Table 1 lists the Limit States Design (LSD) properties for Tolko LSL, Table 2 lists the equivalent relative densities for connection design with Tolko LSL, Table 3 lists the factored resistances for Tolko LSL used as rim boards, Table 4 lists the minimum nail spacing for Tolko LSL, and Table 5 lists the strength adjustment factors for notches in Tolko LSL when used as wall studs.

3.1 Beams, headers, and columns:

The factored 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 LSL shall be permitted for use as wall studs in accordance with the prescriptive requirements of Part 9 of the 2015 NBC, the conditions specified in Section 4.3.1 of this report, and the following requirements.

- 1) Braced wall panels utilizing Tolko LSL studs are subject to the limitations in Clause 9.23.1.1 of the 2015 NBC, as applicable,
- 2) Fasteners for sheathing shall conform to Tables 9.23.3.5.-A and 9.23.3.5.-B of the 2015 NBC,
- 3) Tolko LSL stud size and spacing shall conform to Table 9.23.10.1 of the 2015 NBC, and
- 4) Tolko LSL stud-braced walls shall be detailed in accordance with Clause 9.23.13 of the 2015 NBC and Section 4.3.1 of this report.

3.2.2 Engineered stud wall applications:

Tolko LSL shall be permitted when designed in accordance with Clause 4.3.1 of the 2015 NBC, the recommendations provided by the manufacturer (see link above), the conditions specified in Section 4.3.2 of this report, and the following requirements:

- 1) The factored shear resistance values for nailed wood structural panel shear walls using Tolko LSL as the wall studs shall be determined using CSA O86 where the Tolko 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 4.3.3.
- 2) Tolko LSL shall be permitted in engineered wall applications when designed based on net section analysis in accordance with the CSA O86. The factored resistance for bending, axial compression, and axial tension shall be reduced by the Strength Reduction Factors, as specified in Table 5 of this report, to account for stress concentrations.
- 3) Blocked shear walls with Tolko LSL studs can be used as lateral load resisting systems in wood construction in Canada. Unblocked shear walls are limited to a height of 4.88 m (16 feet) in accordance with Clause 11.4.4 of CSA O86-14.
- 4) Blocked shear walls shall be used in high seismic zones (i.e., Part 4, where $I_E F_a S_a(0.2) \geq 0.35$, and Part 9, where $S_a(0.2) \geq 0.7$ in the 2015 NBC).
- 5) For double-sided walls:
 - a) Tolko LSL studs shall be a minimum nominal 2x6 (38 mm x 140 mm) for connections with 10d nails spaced less than 100 mm (4 inches).
 - b) Stud size and sheathing attachment shall be in accordance with Clause 11.5.3.5 of CSA O86-14.
- 6) The nail diameter for sheathing-to-framing connections in any wall shall not exceed 3.7 mm (0.148 inch).
- 7) The nail spacing in any cases shall be equal to or greater than 76 mm (3 inches).
- 8) The size of the nail heads shall meet the requirement specified in CSA B111.
- 9) Maximum sheathing thickness shall not exceed 15.8 mm (5/8 inch).
- 10) The stud spacing shall not exceed 610 mm (24 inches) on center.
- 11) The 64-mm (2-1/2-inch) stud or double 38-mm (1-1/2-inch) stud requirements outlined in Clause 11.5.3.5 of CSA O86-14 shall be applied. The double wall studs shall be constructed by joining single studs by a sufficient number of either nails or screws. The connection between plies shall be designed with mechanical fasteners to resist the shear force at the stud interface and prevent separation of the studs.

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 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 Part 9 Stud wall applications:

Cutting, notching and boring of Tolko LSL used as studs in Part 9 construction is permitted in accordance with Clause 9.23.5.3 of the 2015 NBC with the exception that the notch shall not exceed 40% of the stud depth. Stud wall nailing restrictions and requirements are prescribed in Section 4.3.3 of this report.

4.3.2 Part 4 Engineered stud wall applications:

Design for cutting, notching, and boring of Tolko LSL shall be based on the recommendations provided by the manufacturer (see link above), a net section analysis in accordance with the provisions of CSA O86, and the following:

- 1) Hole size shall not exceed 40% of the stud depth.
- 2) The edge distance for holes shall have a minimum clear distance of 16 mm (5/8 inch) for stud depth of 140 mm (5-1/2 inches) and less. For larger studs, the minimum edge distance shall be 12% of the stud depth.
- 3) Notch depth shall not exceed 20% of the stud depth. The notch length shall not exceed 203 mm (8 inches).
- 4) Holes or notches shall not be placed within 152 mm (6 inches) of either end of the stud.
- 5) Holes and notches shall not be placed in the same cross-section. A clear vertical separation of at least twice the length of the notch or twice the diameter of the hole shall be maintained, whichever is greater.
- 6) Stud wall nailing restrictions and requirements are prescribed in Section 4.3.3 of this report.

4.3.3 Stud wall nailing restrictions and requirements

a) Tolko LSL Studs

- 1) For sheathing attached with 3.8 mm x 76 mm nails (10d common: 0.148 inch x 3 inches) with a spacing no closer than 152 mm (6 inches) on center, a single Tolko LSL stud shall be permitted for framing at adjoining panel edges. Nails shall be installed a minimum 10 mm (3/8 inch) from all panel edges.
- 2) For sheathing attached with 3.3 mm x 64 mm nails (8d common: 0.131 inch x 2-1/2 inches) or smaller with a spacing no closer than 102 mm (4 inches) on center, a single Tolko LSL stud shall be permitted for framing at adjoining panel edges. Nails shall be installed a minimum 10 mm (3/8 inch) from all panel edges.
- 3) For sheathing attached with 3.3 mm x 64 mm nails (8d common: 0.131 inch x 2-1/2 inches) spaced closer than 102 mm (4 inches) on center or 3.8 mm x 76 mm nails (10d common: 0.148 inch x 3 inches) spaced closer than 152 mm (6 inches) on center, a double, stitch-nailed, LSL stud or single 64 mm (2-1/2 inch) thick LSL stud is required at adjoining panel edges. Nails shall be installed a minimum

10 mm (3/8 inch) from all panel edges and shall be staggered a minimum of 12 mm (1/2 inch) for each row of nails.

- b) For Part 9 stud wall applications, the double LSL studs shall be stitch-nailed together with 2 staggered rows of nails [minimum 3.8 mm x 76 mm nails (10d common: 0.148 inch x 3 inches)] spaced 203 mm (8 inches) in each row.
- c) For Part 4 engineered stud wall applications, the stitch nailing of double LSL studs shall be designed to transfer the required lateral shear using an equivalent relative density of 0.50.
- d) Nails into the edge of LSL studs shall not be spaced closer than 76 mm (3 inches) on center.
- e) Maximum nail size is 3.8 mm x 76 mm nails (10d common: 0.148 inch x 3 inches).

4.4 Rim board:

- 4.4.1 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:

Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer and approved by the authority having jurisdiction (AHJ), and the following requirements:

- a) The specified strength in compression parallel to grain, f_c , shall not exceed 4.8 MPa (694 psi) for Tolko LSL.
- b) When the slenderness ratio, C_c , exceeds 33, the specified strength in compression parallel to grain determined in accordance with Clause 15.3.3.4 of CSA O86-14, shall be multiplied by 0.78 for Tolko LSL.

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, as defined in CSA O86, where the average equilibrium moisture content of solid-sawn lumber is 15 percent or less and does not exceed 19 percent.
- 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 (or PR-L284C), and a means of identifying the date of manufacture.

Table 1. Specific Strengths and MOE (Limit States Design for Use in Canada) for Tolko LSL^(a,b)

Property		1.35E LSL
Bending (f_b), MPa (psi)	Joist	23.6 (3,420) ^(c)
	Plank	26.3 (3,810)
Tension parallel to grain (f_t), MPa (psi)		14.7 (2,130) ^(d)
Longitudinal shear (f_v), MPa (psi)	Joist	4.0 (580)
	Plank	1.40 (205)
Compression parallel ($f_{c }$), MPa (psi)		18.2 (2,630)
Compression perpendicular ($f_{c\perp}$) ^(e) , MPa (psi)	Joist	9.4 (1,370)
	Plank ^(f)	8.6 (1,250)
Modulus of Elasticity (E) ^(g) , MPa (psi)	Joist	9,308 (1.35 x 10 ⁶)
	Plank	9,308 (1.35 x 10 ⁶)

- ^(a) The tabulated values are specified strengths and modulus of elasticity for standard-term load duration. All values, except for E, are permitted to be adjusted for other load durations as permitted by the code. The tabulated values are limited to dry service conditions.
- ^(b) The tabulated values 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 tabulated values for Tolko LSL are based on a reference depth of 305 mm (12 inches). For other depths, when loaded edgewise, the specified bending strength (f_b) shall be modified by $(305/d)^{0.125}$, where d = depth in mm. For depths less than 64 mm (2-1/2 inches), the factor for the 64 mm (2-1/2-inch) depth shall be used.
- ^(d) The tabulated values for Tolko LSL are based on a reference length of 6,096 mm (20 feet). For other lengths, the specified tensile strength shall be modified by $(6,096/L)^{(1/16)}$, where L = length in mm. For lengths less than 914 mm (3 feet), use the specified tensile strength in Table 1 unadjusted.
- ^(e) The size factor for bearing, K_{Zcp} , shall be equal to 1.0.
- ^(f) The tabulated compressive stress perpendicular to grain ($f_{c\perp}$) value is based on the average stress at the proportional limit or 1-mm (0.04-in.) deformation, whichever is less, in accordance with ASTM D5456-18.
- ^(g) 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:

$$\delta = \frac{5 \omega L^4}{32 E b d^3} \quad [1]$$

where δ = calculated deflection (mm), ω = uniform load (N/mm),
 L = design span (mm), b = beam width (mm)
 d = beam depth (mm), and E = apparent modulus of elasticity (MPa)

Table 2. Fastener Design for Tolko LSL^(a,b,c)

Equivalent Relative Density (G)					
Nails		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 values calculated using the tabulated equivalent relative densities given above are for standard-term load duration and are permitted to be adjusted for other load durations as permitted by the code.
- (c) Fastener spacing, and end and edge distances shall be as specified in CSA O86, except that nail spacing and end distances shall be as specified in Table 4.
- (d) Bolts and lag screws shall only be installed into the face (plank orientation) of the LSL.
- (e) The capacities for 12.7 mm (½-inch) diameter lag screws installed into Tolko LSL Rim Board for ledge attachment shall be in accordance with Table 3.

Table 3. Factored Resistances for Tolko Rim Boards^(a)

Grade	Thickness, mm (in.)	Lateral Load ^(b,c) , kN/m (lbf/ft)	Uniform Vertical Load ^(d) , kN/m (lbf/ft)		Concentrated Vertical Load, kN (lbf)	Lateral Resistance for 13 mm (1/2-inch dia. Lag Screws, kN (lbf)
			Depth ≤ 16 in.	16 in. < Depth ≤ 24 in.		
1.35E	32 (1-1/4)	4.8 (326)	131 (9,007)	106 (7,256)	28.2 (6,338)	4.5 (1,017)

- (a) The tabulated lateral load factored resistance is based on the short-term load duration. The vertical uniform and vertical concentrated load are not permitted to be increased for any load durations. The tabulated values are limited to dry service conditions.
- (b) The horizontal lateral load transfer resistance is for shear forces parallel to the rim joist under short-term loading and dry service conditions only. **For compliance with the 2015 NBC, the value shall be multiplied by 0.93.** The fastening of the floor shall meet or exceed Part 9 of the 2015 NBC.
- (c) The nailing schedule for sheathing to rim is based on 64 mm (8d, 2-1/2 inches) nails at 150 mm (6 inches) on center and for rim board to sill plate (toe-nailed) is based on 64 mm (8d, 2-1/2 in.) nails at 150 mm (6 inches) on center. Values assume that floor joists or blocking are fastened to the rim board and sill plate at a maximum of 610 mm (24 inches) on center in accordance with Part 9 of the 2015 NBC. 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 relative density values listed in Table 2 subjected to the nailing spacing provided in Table 4.
- (d) The factored 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	Orientation ^(d)	Common Nail Size ^(e,f)	Minimum End Distance, mm (in.)	Minimum Nail Spacing per Row, mm (in.)	
				Single Row	Multiple Rows ^(b,c)
32mm ≤ t < 38mm (1-1/4 in. ≤ thickness < 1-1/2 in.)	Edge ^(g)	64 mm (2-1/2 in.) (8d) & smaller	51 (2)	102 (4)	NR ⁽ⁱ⁾
		76 mm (3 in.) (10d) & 83 mm (3-1/4 in.) (12d)	51 (2)	102 (4)	
		89 mm (3-1/2 in.) (16d)	64 (2-1/2)	127 (5)	
	Face ^(h)	64 mm (2-1/2 in.) (8d) & smaller	22 (7/8)	25 (1)	25 (1)
		76 mm (3 in.) (10d) & 83 mm (3-1/4 in.) (12d)	22 (7/8)	25 (1)	25 (1)
		89 mm (3-1/2 in.) (16d)	22 (7/8)	38 (1-1/2)	38 (1-1/2)
38mm ≤ t ≤ 89mm (1-1/2 in. ≤ thickness ≤ 3-1/2 in.)	Edge ^(g)	64 mm (2-1/2 in.) (8d) & smaller	25 (1)	51 (2)	76 (3)
		76 mm (3 in.) (10d) & 83 mm (3-1/4 in.) (12d)	51 (2)	76 (3)	102 (4)
		89 mm (3-1/2 in.) (16d)	64 (2-1/2)	76 (3)	102 (4)
	Face ^(h)	64 mm (2-1/2 in.) (8d) & smaller	13 (1/2)	25 (1)	25 (1)
		76 mm (3 in.) (10d) & 83 mm (3-1/4 in.) (12d)	13 (1/2)	25 (1)	25 (1)
		89 mm (3-1/2 in.) (16d)	22 (7/8)	38 (1-1/2)	38 (1-1/2)

- (a) Edge distance shall be sufficient to prevent splitting, but not less than permitted in CSA O86.
- (b) Multiple rows must be spaced 13 mm (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) 83 mm (3-1/4 in.) (16d sinkers) may be spaced the same as a 83 mm (3-1/4 in.) (12d common) wire nail.
- (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., an 89 mm (3-1/2 in.) (16d box) nail may be spaced the same as a 76 mm (3 in.) (10d) and 83 mm (3-1/2 in.) (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 51 mm (2 in.) for 89 mm (3-1/2 in.) (16d common) nails and 64 mm (2-1/2 in.) 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.

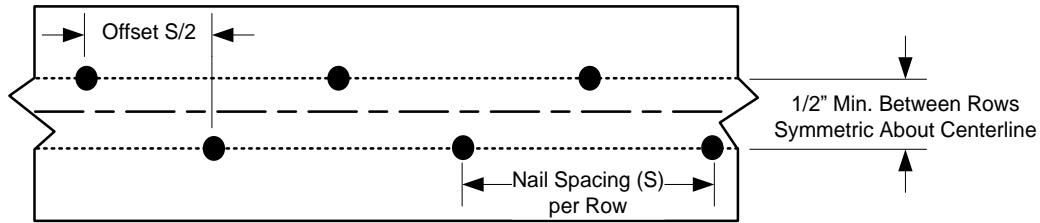


Figure 1. Spacing of multiple rows of nails.

Table 5. Strength Adjustment Factors for Notches in Tolko LSL Studs^(a,b,c)

Material	Strength Adjustment Factors for Notches		
	Bending	Compression	Tension
1.35E LSL	0.90	1.00	0.75

- (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 CSA O86. See Section 4.3.2 of this report for limitations on the allowed size and placement of notches up to 20% of the stud depth.
- (b) The factored resistances for bending, compression and tension from Table 1 must be multiplied by the strength adjustment factors in this table.
- (c) See Section 4.3.1 for notching in Tolko 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 International Code Council (ICC) International Accreditation Service (IAS), and an accredited testing organization under ISO/IEC 17025 by IAS. APA is also an approved Product Certification Agency, Testing Laboratory, Quality Assurance Entity, and Validation Entity by the State of Florida, and an approved testing laboratory by City of Los Angeles.

APA – THE ENGINEERED WOOD ASSOCIATION

HEADQUARTERS

7011 So. 19th St. • Tacoma, Washington 98466

Phone: (253) 565-6600 • Fax: (253) 565-7265 • Internet Address: www.apawood.org

PRODUCT SUPPORT HELP DESK

(253) 620-7400 • E-mail Address: help@apawood.org

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