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ICC-ES Evaluation Report

ESR-1053*

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

REPORT HOLDER:

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EVALUATION SUBJECT:

STRUCTURAL COMPOSITE LUMBER: 1.7E DURASTRAND® LAMINATED STRAND LUMBER (LSL); 1.5E DURASTRAND® ORIENTED STRAND LUMBER (OSL); 1.3E DURASTRAND® ORIENTED STRAND LUMBER (OSL); AND 0.8E DURASTRAND® ORIENTED STRAND LUMBER (OSL)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)

Properties evaluated:

Structural

2.0 USES

The Ainsworth Durastrand structural composite lumber (SCL) described in this evaluation report is used as an alternative to sawn lumber for wall, floor and roof structural members. These structural applications include use as rim board, beams, headers, joists and rafters.

3.0 DESCRIPTION

3.1 General:

Durastrand is a structural composite lumber product composed of wood strands bonded together utilizing heat, pressure and adhesives. The finished product is available in thicknesses ranging from $1^3/_4$ inches (44 mm) to $5^1/_4$ inches (133 mm), except for the 0.8E Durastrand OSL, which has a thickness of $1^1/_4$ inches (32 mm).

3.2 Material:

Durastrand consists of three layers: two face layers having strands oriented in the longitudinal direction of the member, and a core with strands oriented in the same plane perpendicular or parallel to the face layers. Durastrand is manufactured from strands of a combination of wood species including aspen, lodgepole pine and birch. During fabrication, the strands are dried, resinated with adhesives having bond durability complying with ASTM D 5456 for Exposure 1 conditions, and formed into loose mats with three oriented layers. The loose mats of 1.7E LSL, 1.5E OSL and 1.3E OSL are pressed into billets in a continuous press. Loose mats of 0.8E OSL are pressed in a multi-opening press. The approved quality control manuals specify proprietary production parameters such as flake quality, flake grading, resin formulation, resin content, lay-up procedures, pressing parameters and quality control issues.

Durastrand is available in depths up to 24 inches (610 mm) and lengths up to 48 feet (14.63 m) for 1.7E LSL, 1.5E OSL and 1.3E OSL. The 0.8E Durastrand OSL is available in depths up to 24 inches (610 mm) and lengths up to 24 feet (7.32 m).

4.0 DESIGN AND INSTALLATION

4.1 General:

Durastrand may be installed in engineered or conventional wood-framed construction. Application and installation of Durastrand must comply with this report and the applicable building code. Drawings and/or manufacturer's published installation instructions for the erection and installation of Durastrand products must be available on the project jobsite during installation.

4.2 Design and Allowable Stresses:

For Durastrand used as beams, headers, joists or rafters, the design provisions for wood construction noted in Chapter 23 of the IBC, and in the ANSI/AF & PA National Design Specification for Wood Construction (NDS), are applicable, unless otherwise noted in this report. Table 1 presents allowable unit stresses for dry conditions of use in engineered applications. With the exception of those values given for 0.8E OSL, values given in Table 1 for edgewise bending, F_b, and tension parallel-to-grain, F_t, must be adjusted for depth and length effects in accordance with Footnotes 4 and 6, respectively. Table 2 presents allowable spacing for nails. Unless otherwise noted, adjustment to the design stresses must be in accordance with the applicable code.

Durastrand used as rim board must be designed and installed in accordance with Section 4.3.

Allowable withdrawal values for nails installed into Durastrand are as provided in the NDS for solid-sawn

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lumber species with the equivalent specific gravity as given in Table 3. Allowable lateral load values (perpendicular and parallel to the long axis of Durastrand) for nails are equivalent to those for solid-sawn lumber species with the equivalent specific gravity as shown in Table 3.

The allowable lateral load value for machine bolts installed into the wide face of the product is as provided in the NDS for solid-sawn lumber species with the equivalent specific gravity as given in Table 3. Use of the machine bolts must be limited to design procedures set forth in the applicable code for solid-sawn wood.

4.3 Rim Board:

When Durastrand is used as rim board, it is an alternative material to the solid blocking details for light-framed wood construction given in Section 2308.8.2 of the IBC and Section R502.7 of the IRC. When it is used in light-framed wood construction complying with Section 2308 of the IBC or Section R502 of the IRC, Durastrand is permitted to be used where the IBC and the IRC permit nominally 2-inch-thick solid-sawn lumber at the boundaries of floor diaphragms.

4.3.1 Design Values for Rim Board: Values for allowable vertical, and in-plane lateral load transfer capacity of Durastrand rim board are given in Table 4. Toe-nailed connections required in Section 4.3.2 are not limited by the 150 plf (2189 N/m) lateral load capacity noted for Seismic Design Categories D, E and F in IBC Section 2305.1.4. No duration of load increase is permitted to be applied to these design values.

For design of connections other than those required in Section 4.3.2, mechanical connections in Durastrand rim board have allowable lateral and withdrawal design values as provided by the NDS for lumber having equivalent specific gravities as given in Table 3. Minimum allowable nail spacing values are given in Table 2. Adjustment factors in accordance with the NDS must be applied as applicable.

Exception: Lag screw connections between Durastrand rim board and deck ledgers have an allowable lateral load of 400 pounds (1.78 kN) per lag screw, under the following conditions:

(a) Lag screws must have a minimum nominal diameter of $^1/_2$ inch (12.7 mm), and sufficient length such that the full diameter of the lag screw penetrates through the rim board (the tapered tip must pass completely through the rim board).

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

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

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

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

4.3.2 Installation of Rim Board: Durastrand rim board must be laterally supported by floor sheathing at the top, and continuously supported across the full width at the bottom. The rim board must be located at the joist elevation parallel or perpendicular to the joist framing. Durastrand rim board must be the full depth of the joist space and installed in minimum continuous 8-foot-long (2.44 m) segments for the length of the wall. It must be secured to the top of the sill plate with 8d common nails toe-nailed along the base of the rim board at 6 inches (152 mm) on center. Where the rim board is installed perpendicular to the floor joists, a minimum of two 8d common nails must be driven through the rim board into each joist, one each at the top and bottom. Additionally, one 8d common nail must be driven through the bottom of the joist on each side, into the sill plate. Floor sheathing must be applied over the rim board and floor joists, such that the edge of the sheathing is flush with the exterior face of the rim board, and must be nailed to the top edge of the rim board with 8d common nails at 6 inches (152 mm) on center. Notches are not permitted in Durastrand rim board. Holes are permitted in accordance with the rim board hole specifications provided in APA Performance Rated I-joists, Form Z725. Durastrand rim board is used for any combination of the following rim board applications:

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

5.0 CONDITIONS OF USE

The Durastrand described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Installation must comply with the applicable code, the manufacturer's published installation instructions, and this report. If there is a conflict between the manufacturer's installation instructions and this report, this report governs.

5.2 Durastrand must be limited to use in interior applications where the maximum moisture content of sawn lumber will not exceed 16 percent.

5.3 When application is made for a permit, design calculations and details for specific applications, based on design values published within this report, must be furnished to the code official to verify compliance with this report and the applicable code. The documents 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 0.8E OSL Durastrand is manufactured by Ainsworth Lumber Co. Ltd. at their facility located at 100 Mile House, British Columbia, Canada, under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

5.5 1.7E LSL, 1.5E OSL and 1.3E OSL are manufactured by Ainsworth Lumber Co. Ltd. at their facility located in Grande Prairie, Alberta, Canada, under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Rim Board Products (AC124), dated October 2004, (editorially revised January 2008), and with the ICC-ES Acceptance Criteria for Structural Wood-based Products (AC47), dated June 2009.

7.0 IDENTIFICATION

All Durastrand products covered by this report are identified by a stamp which includes the manufacturer's name (see Figure 1) and/or trademark (see Figure 2), the product trade name (1.7E Durastrand LSL, 1.5E Durastrand OSL, 1.3E Durastrand OSL or 0.8E Durastrand OSL), the number of this report (ESR-1053), the thickness, the production shift and date of manufacture, and the name of the inspection agency (APA-EWS).

TABLE 1—DURASTRAND MAXIMUM ALLOWABLE STRESSES[1, 2]

GRADE	MODULUS OF ELASTICITY[7] (10^6 psi)	AXIAL (psi)		JOIST/BEAM EDGE LOADING (psi)			PLANK FACE LOADING (psi)		
		Ft [5, 6]	Fc	Fb [3, 4]	Fv	Fc⊥ [7]	Fb	Fv	Fc⊥ [7]
1.7E	1.7	2,050	2,050	2,150	400	1,200	2,800	150	325
1.5E	1.5	1,775	1,775	1,775	400	1,150	2,550	130	325
1.3E	1.3	1,300	1,300	1,625	350	1,150	2,000	115	285
0.8E	0.8	680	1,100	1,130	355	1,415	—	—	—

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

[1]Allowable stresses are based on a moisture content of less than 16 percent.
[2]For simple span joists or beams uniformly loaded on edge, deflection is calculated as follows:

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

For simple span members uniformly loaded on face, deflection is calculated as follows:

$$\Delta = \frac{270\,wL^4}{Ebd^3} + \frac{86.0\,wL^2}{Ebd}$$

Where:

Δ is deflection, inches
w is uniform load, lbs/ft
L is span, feet
B is beam width, inches
D is beam depth, inches
E is the tabulated Modulus of Elasticity, psi.

[3]Edgewise Fb value for 0.8E OSL is applicable to a 16-inch beam depth or less.
[4]Edgewise Fb values for 1.7E LSL, 1.5E OSL and 1.3E OSL are for 12-inch beam depth; Fb values for depths d (inches), other than 12 inches shall be multiplied by the factor, $(12/d)^{0.25}$. For depths less than 2.5 inches, the factor for 2.5-inch beam depth shall be used.
[5]Ft value for 0.8E OSL is applicable to lengths up to 24 feet.
[6]Ft values for 1.7E LSL, 1.5E OSL, and 1.3E OSL are applicable to 4-foot length or less; Ft values for lengths L (feet) greater than 4 feet shall be multiplied by the factor, $(4/L)^{0.125}$.
[7]Modulus of elasticity and compression perpendicular-to-grain values are not permitted to be increased for load duration.

TABLE 2— MINIMUM ALLOWABLE NAIL SPACING IN DURASTRAND

CONNECTOR SIZE	NAILS INSTALLED IN THE NARROW FACE[1]		NAILS INSTALLED IN THE WIDE FACE	
	ON-CENTER SPACING (inches)	END DISTANCE (inches)	ON-CENTER SPACING (inches)	END DISTANCE (inches)
8d box and common nail	3	2	1	1/2
10d box and common nail	4	2	1	1/2
16d box nail	4	2	1	1/2
16d sinker (12d common) nail	4	2	1	1/2
16d common nail	5	2 1/2	1	7/8

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

[1]Multiple rows of nails are allowed in the narrow face, with a minimum of 1/2-inch spacing between rows and when applied to the edge, rows to be equal distance from centerline.

TABLE 3—EQUIVALENT SPECIFIC GRAVITY FOR DESIGN OF FASTENERS IN DURASTRAND[1]

GRADE	NAILS AND WOOD SCREWS				BOLTS AND LAG SCREWS[2]	
	Withdrawal		Lateral		Lateral	
	Installed in Edge	Installed in Face	Installed in Edge	Installed in Face	Installed in Face	
					Parallel to Grain	Perpendicular to Grain
1.7E	0.44 (red pine)	0.51 (mixed southern pine)	0.49 (Douglas fir-larch North)	0.61 (red maple)	0.51 (mixed southern pine)	0.66 (red oak)
1.5E	0.44 (red pine)	0.50 (Douglas fir-larch)	0.46 (hem-fir North)	0.55 (mixed maple)	0.49 (Douglas fir-larch North)	0.60 (red maple)
1.3E	0.44 (red pine)	0.49 (Douglas fir-larch North)	0.41 (eastern hemlock)	0.51 (mixed southern pine)	0.38 (Engelmann spruce-lodgepole pine)	0.55 (southern pine)
0.8E	0.32 (northern white cedar)	0.43 (hem-fir)	—	0.50 (Douglas fir-larch)	0.32 (northern white cedar)	0.61 (red maple)

[1]Allowable connection design values are as provided by the NDS for lumber having equivalent specific gravities as shown.
[2]When loading at an angle to the grain, the lateral capacity for a bolted connection is calculated using the Hankinson formula in Appendix J of the NDS.

TABLE 4—DURASTRAND ALLOWABLE LOADS FOR RIM BOARD APPLICATIONS[1, 2, 3]

GRADE	MINIMUM THICKNESS (in)	VERTICAL LOAD[4]				LATERAL CAPACITY[5, 6, 7, 8] (pounds per foot)	
		Distributed (pounds per foot)		Concentrated (pounds)		Nails Spaced at 6 Inches o.c.	Nails Spaced at 4 Inches o.c.
		Depth ≤ 16 in.	24 in. ≥ Depth > 16 in.	Depth ≤ 16 in.	24 in. ≥ Depth > 16 in.		
1.3E	1¾	7,000	4,350	5,200	5,200	240	—
0.8E	1¼	5,700	3,500	5,900	5,500	240	330

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 pound per foot = 14.6 N/m.

[1]Durastrand rim board must be installed in accordance with Section 4.3.2.
[2]Values in this table are not permitted to be increased for load duration.
[3]Lag screw connections between Durastrand rim board and deck ledgers have an allowable lateral load of 400 pounds (1.78 kN) per lag screw, provided the conditions under the Exception to Section 4.3.1 are met.
[4]Compression perpendicular-to-grain capacities of the sill plate and floor sheathing must be checked, and must not be exceeded.
[5]Allowable lateral load values are based on the condition that the rim board is supported by a sill plate or top plate consisting of minimum nominal 2x4 lumber having a minimum assigned specific gravity of 0.42.
[6]Durastrand may be substituted for solid-sawn framing in horizontal wood diaphragms as shown in Table 2306.3.1 of the IBC, provided the maximum shear values for the diaphragms are limited to the allowable lateral capacity noted in this table.
[7]Toe-nailed connections are not limited by the 150 lbs/ft lateral load capacity noted for Seismic Design Categories D, E, and F in Section 2305.1.4 of the IBC.
[8]See Table 2 for minimum nail spacing requirements.

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FIGURE 1—AINSWORTH LOGO

DURASTRAND®

FIGURE 2—TRADEMARK FOR DURASTRAND STRUCTURAL COMPOSITE LUMBER