ICC-ES Evaluation Report

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 18 00—Glued-Laminated Construction

REPORT HOLDER:

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EVALUATION SUBJECT:

SSI GLUED-LAMINATED BEAMS, HIGH-STRENGTH COMPOSITE (HSC AND HSC PLUS) LAMINATED BEAMS, MXL GLUED-LAMINATED BEAMS, AND MXL RIM BOARD

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (IBC)
- 2009 *International Residential Code*® (IRC)
- 2006 *International Building Code*® (IBC)
- * ~~2006 *International Residential Code*® (IRC)~~

Property evaluated:

Structural

2.0 USES

Standard Structures, Inc. (SSI), glued-laminated beams, high-strength composite (HSC and HSC Plus) laminated beams, and MXL glued-laminated beams are used as beams, headers, rafters or purlins in applications where the members are stressed in bending due to loads applied perpendicular to the wide faces of the laminations. MXL rim board is used in rim board applications.

3.0 DESCRIPTION

3.1 General:

SSI glued-laminated beams are fabricated to combinations 22F-1.8E/SPF, 20F-1.6E/SPF and 18F-1.6E/SPF; HSC laminated beams are fabricated to combinations 32F-2.1E/DF, 30F-2.1E/DF, 30F-2.0E/DF and 24F-1.8E/SPF; and HSC Plus laminated beams are fabricated to combinations 30F-E1M4 and 30F-E2M4. The beams consist of mechanically and visually graded spruce-pine-fir (SPF), Douglas fir, or Southern pine lumber; and, in the case of the HSC and HSC Plus laminated beams, laminated veneer lumber (LVL). Individual laminations are 2 inches (51mm) or less in net thickness. SSI, HSC, and HSC Plus laminated beams are available in widths of $2^1/_2$ inches (63.5 mm) and larger. The HSC Plus beams are limited to a minimum depth of $9^1/_4$ inches (235 mm). The MXL glued-laminated beams and MXL rim board are fabricated from one grade of mechanically graded SPF lumber. MXL glued-laminated beams used as joists are $1^1/_2$ inches (38 mm) thick. MXL rim board has thicknesses ranging from $1^1/_2$ inches to $1^3/_4$ inches (38 mm to 45 mm), and depths of up to 16 inches (406 mm).

Quality control for lumber grading is monitored by APA—The Engineered Wood Association (APA-EWA) (AA-649) and West Coast Lumber Inspection Bureau. The quality control for the fabrication of the glued-laminated beams is monitored by APA—The Engineered Wood Association, in accordance with the approved quality control manual. SSI, HSC, HSC Plus, and MXL glued-laminated beams meet the requirements of ANSI/AITC A190.1 and the additional requirements of APA-EWS quality control procedures applicable to the layup combinations noted in Table 1.

3.2 Materials:

3.2.1 Adhesives: Face and end-joint bonding adhesives comply with ASTM D 2559 for exterior wet use.

3.2.2 End Joints: End joints comply with ANSI A190.1 and AITC 200 Manufacturing Quality Control Systems Manual for Structural Glued Laminated Timber.

3.2.3 Laminating Stock: The glued-laminated beams described in this report are manufactured using mechanically graded solid-sawn lumber laminations conforming to specified tensile strength and plank MOE values. Additionally, the HSC and HSC Plus beams contain tension laminations consisting of LVL complying with the approved quality control manual. The lumber laminations are approved visually graded or mechanically graded lam stock that also conforms to additional visual requirements, and are identified as proprietary grades. Mechanical grade requirements for the laminating stock are set forth in the approved quality control manual for lumber used in various lamination combinations listed in this report.

3.3 Layup:

Manufacturing grade and layup requirements for the grade combinations are according to the Standard Structures, Inc., Glulam Procedures and the company's quality control manual. Manufacturing details are provided by APA—The Engineered Wood Association, and are included in the procedures and quality control manual. Lamination grades

* Deleted by the City of Los Angeles

and zones are as defined in the Engineered Wood Systems GAP computer program, described in ESR-1940, for the purpose of determining design stresses. Supplemental requirements for the layup combinations are noted in Table 1.

3.4 MXL Rim Board:

MXL rim board is a continuously supported structural element, located at the same elevation and having the same depth as the joists, in wood-framed floor or roof construction. It is oriented either parallel or perpendicular to the joists, and is used for any combination of the following:

a. To transfer, from above to below, vertical loads at the rim board location.

b. To provide diaphragm attachment (fasteners driven through sheathing, into top edge of rim board).

c. To transfer in-plane lateral loads from the diaphragm to the wall plate below.

d. To provide lateral support to the joist or rafter (resistance against rotation) through attachment to the joist or rafter.

e. To provide closure to the ends of joists or rafters.

f. To provide an attachment base for siding and/or a point of attachment for an exterior deck ledger.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: Reference design values for the SSI, HSC, and HSC Plus glued-laminated beams are given in Table 1, and are for beams having five or more laminations stressed primarily in bending due to loads applied perpendicular to the wide faces of the laminations. Reference design values for the MXL glued-laminated beams are given in Table 3. Design of the structural glued-laminated beams and connections must comply with the applicable code. Reference lateral design values for bolted and nailed connections in SSI, HSC and HSC Plus glued-laminated beams are as specified in the NDS for structural glued laminated timber having a specific gravity as indicated in Table 2 of this report.

4.1.2 MXL Rim Board: Allowable loads for MXL rim board are given in Table 4. Toe-nailed connections between the MXL rim board and the supporting sill plate are not limited by the 150-pound-per-linear-foot (2189 N/m) lateral load capacity noted for Seismic Design Categories D, E, and F in Section 2305.1.4 of the IBC. MXL rim board may be used in horizontal wood diaphragms, provided the design shear loads do not exceed the allowable lateral load transfer capacity noted in Table 4 of this report. MXL rim board may be used as fire blocking, as an alternative to the nominally 2-inch (51 mm) lumber noted in Section 717.2.1 of the IBC and Section R602.8.1 of the IRC.

4.2 Installation:

4.2.1 General: Installation of the SSI, HSC, HSC Plus, and MXL glued-laminated beams must comply with the applicable code, this report, and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation. Unbalanced beams, as indicated in Table 1, must be installed such that the top side, as marked on the beam, is facing up.

4.2.2 MXL Rim Board: For the purposes of the design loads given in Table 4, MXL rim board must have continuous, full-width support along its length. It must be supported by a sill plate or top plate having a minimum assigned specific gravity of 0.42. A minimum of two 8d box nails (or, in the case of $1^3/_4$-inch-thick (45 mm) rim board, two 10d box nails) must be driven through the rim board and into each perpendicular joist, one near the top and one near the bottom. The rim board must be secured to the sill plate with 8d box nails toe-nailed along the base of the rim board at 6 inches (152 mm) on center. Wood structural panel floor sheathing complying with PS-1 or PS-2 must be applied over the rim board and floor joists, such that the edge is flush with the exterior face of the rim board, and must be nailed to the top edge of the rim board with 8d box nails at 6 inches (152 mm) on center.

Lag screw connections between MXL rim board and a deck ledger have an allowable lateral load of 500 pounds (2.23 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 lag screw shank penetrates through the rim board (not including the length of the tapered tip).

b. Deck ledgers must consist of minimum 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 must be attached to the rim board in accordance with the applicable code.

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

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

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

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

5.0 CONDITIONS OF USE

The SSI glued-laminated beams, HSC and HSC Plus laminated beams, MXL glued-laminated beams, and MXL rim board described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Design and installation must comply with this report, the manufacturer's published installation instructions, and the applicable code. In the event of a conflict between this report and the manufacturer's installation instructions, this report governs.

5.2 The allowable design values provided in this report are applicable to glued-laminated beams installed in dry conditions of use, where the maximum in-service moisture content is less than 16 percent. For glued-laminated beams installed in conditions where the in-service moisture content is expected to reach 16 percent or higher, the reference design stresses must be adjusted by the applicable wet service factors given in Tables 1 and 3.

5.3 Use of MXL rim board in wet service conditions is outside the scope of this report.

5.4 Design calculations and details for specific applications must be furnished to the code official to verify compliance with this report and the applicable code. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.5 SSI glued-laminated beams, HSC and HSC Plus laminated beams, MXL glued-laminated beams and MXL rim board are manufactured by Standard Structures, Inc., at their manufacturing facility in Windsor, California, under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

6.0 EVIDENCE SUBMITTED

6.1 Test reports and analysis based on ASTM D 3737.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Structural Wood-based Products (AC47), dated October 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

The SSI glued-laminated beams, HSC and HSC Plus laminated beams, and MXL glued-laminated beams described in this report are identified by a stamp bearing the name of the manufacturer (Standard Structures, Inc.); the wood species; the manufacturing plant number (Mill 1013); the lumber combination symbol; the evaluation report number (ESR-2364); and the name of the inspection agency (APA—The Engineered Wood Association). Unbalanced beams are further marked with a stamp bearing the designation “TOP”, as shown in Figure 1. MXL rim board is also marked with the rim board thickness, in inches.

TABLE 1—REFERENCE DESIGN VALUES FOR SSI, HSC, AND HSC PLUS GLUED LAMINATED BEAMS [1, 2, 3, 4]

COMBINATION SYMBOL [5]	SPECIES OUTER / CORE [6]	UNBALANCED / BALANCED [7]	BENDING ABOUT X-X AXIS LOADED PERPENDICULAR TO WIDE FACE OF LAMINATIONS						BENDING ABOUT Y-Y AXIS LOADED PARALLEL TO WIDE FACE OF LAMINATIONS				AXIAL LOADING		
			Extreme Fiber in Bending [8]		Compression Perpendicular to Grain		Shear Parallel to Grain [9,10]		Modulus of Elasticity [11]	Extreme Fiber in Bending [12,13]	Compression Perpendicular to Grain	Shear Parallel to Grain [9,10,14]		Modulus of Elasticity [11]	Tension Parallel to Grain	Compression Parallel to Grain	Modulus of Elasticity
			Tension Zone Stressed in Tension	Compression Zone Stressed in Tension	Tension Face	Compression Face											
			F_{bX}^{+} (psi)	F_{bX}^{-} (psi)	$F_{C\text{-}perp\ X}$ (psi)		F_{VX} (psi)		E_X (10^6 psi)	F_{bY} (psi)	$F_{C\text{-}perp\ Y}$ (psi)	F_{VY} (psi)		E_Y (10^6 psi)	F_t (psi)	$F_{c//}$ (psi)	E_{axial} (10^6 psi)
30F-E1M4	LVL/SP	UB	3,000	2,400	650	805	300		2.1	1,750	650	265		1.7	1,350	1,750	1.7
30F-E2M4	LVL/SP	B	3,000	3,000	650	650	300		2.1	1,750	650	265		1.7	1,350	1,750	1.7
32F-2.1E/DF	DF/Special	UB	3,200	2000	510	650	265	190	2.1	1,950	560	215	175	1.9	1200	1850	1.9
30F-2.1E/DF	DF/Special	UB	3,000	2000	510	650	265	190	2.1	1,800	560	215	175	1.8	1050	1850	1.8
30F-2.0E/DF	DF/Special	UB	3,000	2000	510	650	265	190	2.0	1,800	560	215	175	1.8	1050	1850	1.8
24F-E/SPF1	SPF/Special	UB	2,400	1,850	560	560	195	160	1.8	2,200	470	170	140	1.6	1,350	1,950	1.6
22F-E/SPF1	SPF/SPF	UB	2,200	1,850	560	560	195	160	1.8	2,200	470	170	140	1.6	1,350	1,950	1.6
20F-E/SPF1	SPF/SPF	UB	2,000	1,500	560	560	195	160	1.6	2,000	470	170	140	1.6	1,250	1,850	1.6
18F-E/SPF1	SPF/SPF	UB	1,800	1,300	560	470	195	160	1.6	1,800	470	170	140	1.5	1,250	1,700	1.5
32F-2.1E/DF	DF/Special	B	3,200	3,200	510	510	265	190	2.1	3,200	560	215	175	1.9	1200	1850	1.9
30F-2.1E/DF	DF/Special	B	3,000	3,000	510	510	265	190	2.1	3,000	560	215	175	1.8	1050	1850	1.8
30F-2.0E/DF	DF/Special	B	3,000	3,000	510	510	265	190	2.0	3,000	560	215	175	1.8	1050	1850	1.8
24F-E/SPF1	SPF/Special	B	2,400	2,400	560	560	195	160	1.8	2,200	470	170	140	1.6	1,350	1,950	1.6
22F-E/SPF1	SPF/SPF	B	2,200	2,200	560	560	195	160	1.8	2,200	470	170	140	1.6	1,350	1,950	1.6
20F-E/SPF1	SPF/SPF	B	2,000	2,000	560	560	195	160	1.6	2,000	470	170	140	1.6	1,250	1,850	1.6
18F-E/SPF1	SPF/SPF	B	1,800	1,800	560	560	195	160	1.6	1,800	470	170	140	1.5	1,250	1,700	1.5
Wet service factors [2]			0.8	0.8	0.53	0.53	0.875		0.833	0.8	0.53	0.875		0.833	0.8	0.73	0.833

For **SI:** 1 psi = 6.895 kPa.

[1]The combinations in this table are applicable to SSI, HSC, and HSC Plus structural glued laminated timbers that are intended primarily for members stressed in bending due to loads applied perpendicular to the wide faces of the laminations. Design values are given, however, for loading both perpendicular and parallel to the wide faces of the laminations.

[2]The tabulated design values are for dry conditions of use, where the maximum in-service moisture content is less than 16 percent. For conditions where the in-service moisture content is expected to reach 16 percent or higher, the reference design stresses must be adjusted by the applicable wet service factors, C_M, given above.

[3]The tabulated design values are for normal duration of loading. For other durations of loading, the reference design stresses must be adjusted by the applicable load duration factor, CD, in accordance with NDS Section 5.3.2.

[4]When the glued laminated beams will experience sustained exposure to elevated temperatures of 100°F (38°C) or greater, the reference design stresses must be adjusted by the applicable temperature factor, C_t, in accordance with NDS Section 2.3.3.

[5]SSI, HSC and HSC Plus glued laminated beams consist of a minimum of five laminations. Additionally, the 30F-E1M4 and 30F-E2M4 combinations are limited to a depth of $9^1/_4$ inches.

[6]The symbols used to indicate wood species are as follows: LVL = laminated veneer lumber; SP = Southern pine; DF = Douglas fir; SPF = Spruce-pine-fir.

[7]Balanced layups (B) are intended for multiple span or simple span applications. Unbalanced layups (UB) are intended for simple span applications only.

[8]The reference bending design values, F_{bX}, are based on members $5^1/_8$ inches (130 mm) in width by 12 inches (305 mm) in depth by 21 feet (6,400 mm) in length. For members with a larger volume, F_{bX} must be adjusted by the volume factor, C_v, in accordance with NDS Section 5.3.6.

[9]For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS Section 3.4.3.3), the reference shear design values, F_{vX} and F_{vY}, must be multiplied by a factor of 0.72.

[10]The tabulated design values for shear, F_{vX} and F_{vY}, do not include adjustments for checking.

[11]The reference modulus of elasticity values, E_X and E_Y, already include a 5% shear deflection (also known as "apparent E"). For beam stability and column stability calculations, E_{min} can be calculated by multiplying E_X and E_Y by 0.528.

[12]The values of F_{bY} were calculated based on members 12 inches in depth (about the Y-Y bending axis). For depths other than 12 inches, F_{bY} may be adjusted by the flat use factor, $C_{fu} = (12/d)^{0.11}$, where *d* is the beam depth (dimensions parallel to the wide face of the laminations).

[13]The values of FbY are for extreme fiber stress in bending when the member is loaded such that the compression zone laminations are subject to tensile stresses.

[14]The values of F_{vY} are for timbers with laminations made from a single piece of lumber across the width, or multiple pieces that have been edge bonded. For glued laminated beams manufactured from multiple piece laminations that are not edge bonded, F_{vY} must be multiplied by 0.4 for members with 5, 7,or 9 laminations, or by 0.5 for all other members. This reduction is cumulative with all other applicable adjustment factors.

TABLE 2—SPECIFIC GRAVITY AND DOWEL BEARING STRENGTH FOR CONNECTIONS IN SSI, HSC, AND HSC PLUS[1]

GRADE MOE PSI x 10^6	SPECIFIC GRAVITY	DOWEL BEARING STRENGTH (psi)
SPF/WL4 1.6E	0.44	3,650
SPF/WL3 1.8E	0.47	4,150
SPF/WL2 2.0E	0.50	4,650
SPF/WL1 2.0E	0.50	4,650
LVL Tension Laminations - Nails Lateral Only	0.50	4,650
DF/All Grades	0.50	4,650
Southern Pine / All Grades	0.50	4,650

For **SI:** 1 psi = 6.895 kPa.

[1]Reference lateral design values for bolted and nailed connections in SSI, HSC and HSC Plus glued-laminated beams are as specified in the NDS for structural glued laminated timber having a specific gravity as indicated in the table above.

TABLE 3—REFERENCE DESIGN VALUES FOR MXL GLUED LAMINATED BEAMS[1,2,3,4,5]

COMBINATION SYMBOL	SPECIES OUTER / CORE[6]	BENDING ABOUT X-X AXIS (Loaded Perpendicular to Wide Face of Laminations)						SPECIFIC GRAVITY FOR FASTENER DESIGN[9]	
		Extreme Fiber in Bending		Compression Perpendicular to Grain		Shear Parallel to Grain[7]	Modulus of Elasticity[8]	Top or Bottom Face	Side Face
		Tension Zone Stressed in Tension	Compression Zone Stressed in Tension	Tension Face	Compression Face				
		F_{bX}^+ (psi)	F_{bX}^- (psi)	$F_{C\text{-}perpX}$ (psi)		F_{vX} (psi)	E_X (10^6 psi)		
SSI MXL	SPF/SPF	2,100	2,100	615	615	215	1.9	0.50	0.50
Wet service Factor, C_M		0.8		0.53		0.875	0.833	See NDS Sect. 10.3.3	

For **SI:** 1 psi = 6.895 kPa.

[1]The combinations in this table are applicable to MXL structural glued laminated timbers that are intended primarily for members stressed in bending due to loads applied perpendicular to the wide faces of the laminations.
[2]The tabulated design values are for dry conditions of use, where the maximum in-service moisture content is less than 16 percent. For conditions where the in-service moisture content is expected to reach 16 percent or higher, the reference design stresses must be adjusted by the applicable wet service factors, C_M, given above.
[3]The tabulated design values are for normal duration of loading. For other durations of loading, the reference design stresses must be adjusted by the applicable load duration factor, C_D, in accordance with NDS Section 5.3.2.
[4]When the glued laminated beams will experience sustained exposure to elevated temperatures of 100°F (38 C) or greater, the reference design stresses must be adjusted by the applicable temperature factor, C_t, in accordance with NDS Section 2.3.3.
[5]MXL glued laminated beams consist of a minimum of five laminations, and have depths ranging from $7^1/_4$ inches to 16 inches and a width of $1^1/_2$ inches.
[6]The symbols used to indicate wood species are as follows: SPF = Spruce-pine-fir.
[7]For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS Section 3.4.3.3), the reference shear design value, F_{vX}, must be multiplied by a factor of 0.72.
[8]The reference modulus of elasticity value, E_X, already includes a 5% shear deflection (also known as "apparent E"). For beam stability and column stability calculations, E_{min} can be calculated by multiplying E_X by 0.528.
[9]Reference lateral design values for bolted and nailed connections in MXL glued-laminated beams are as specified in the NDS for structural glued laminated timber having a specific gravity as indicated in the table above.

TABLE 4—ALLOWABLE LOADS FOR MXL RIM BOARD[1]

THICKNESS (inches)	LATERAL LOAD TRANSFER CAPACITY[2,3]	UNIFORM VERTICAL LOAD CAPACITY[4] (lb/ft)	CONCENTRATED VERTICAL LOAD CAPACITY[4,5] (lb/ft)	SPECIFIC GRAVITY FOR FASTENER DESIGN[6] (lb)	
				Bolted and Nailed Connections	Lag Screw Connections[7]
$1^1/_2$	220	2,500	2,800	0.50	(See footnote 7)
$1^3/_4$	220	2,500	2,800	0.50	(See footnote 7)

[1]The design loads given in this table are for MXL rim board installed in accordance with Section 4.2.2.
[2]Allowable lateral load transfer capacity may not be increased for duration of load.
[3]The allowable lateral load transfer capacity is based on the condition that the rim board is supported by a sill plate or top plate consisting of minimum nominal 2-by-4 lumber having a minimum assigned specific gravity of 0.42, as determined by NDS Table 11.3.2A.
[4]Allowable uniform and concentrated vertical load capacities may be adjusted for the applicable duration of load in accordance with NDS Section 2.3.2.
[5]Compression perpendicular-to-grain capacities of the sill plate and floor sheathing must be checked.
[6]Reference lateral design values for bolted and nailed connections in MXL glued-laminated beams are as specified in the NDS for structural glued laminated timber having a specific gravity as indicated in the table above.
[7]Lag screw connections between MXL rim board and deck ledgers have an allowable lateral load of 500 pounds per lag screw, provided the conditions in Section 4.2.2 are met.

Standard Structures Inc

APA EWS

HSC 30F-2.1E DF

ICC-ES ESR-2364

MILL 1013 **ANSI A190.1-2007**

Standard Structures Inc.

APA EWS

HSC 32F-2.1E DF

ICC-ES ESR-2364

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HSC PLUS 30F-2.1E SYP

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24F-1.8E / SPF

ICC-ES ESR-2364

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MXL 21F-1.9E / SPF

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MXL RIM / SPF

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TOP

FIGURE 1—LABELS FOR SSI GLUED LAMINATED BEAMS, HSC AND HSC PLUS GLUED LAMINATED BEAMS, MXL GLUED LAMINATED BEAMS, AND MXL RIM BOARD