AMERICAN INSTITUTE OF TIMBER CONSTRUCTION

AITC Product Report Number P174-001

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Purpose

The purpose of this American Institute of Timber Construction (AITC) Manufacturer Product Report is to detail provisions under the *International Building Code* (IBC) and *International Residential Code* (IRC) for approval of Structural Wood Systems structural glued laminated timber (SWS Glulam) for use in buildings and other structures. The IBC and IRC are the model building codes generally adopted nationwide, regionally, and locally, regulating building design and construction. This Report also contains information for architects, engineers, and builders, for the design and specification of SWS Glulam, as well as installation and construction information.

Code Provisions

Requirements for the manufacturing and use of SWS Glulam in buildings and other structures are provided for in Sections 2303.1.3 and 2306.1 of the IBC and Sections 502.1.3, 602.1.3, and 802.1.2 of the IRC. These code sections address the manufacturing, inspection, testing, and certification of structural glued laminated timber through ANSI A190.1, as well as `layup', design (design value), and specification information in ANSI 117 and ASTM D3737. Structural glued laminated timber is defined in IBC Section 202. These provisions and their applications are summarized in Table 1 below.

Quality Control, Accredited Inspection Agency, and Certification

As referenced by the IBC and IRC, ANSI A190.1 and AITC 200 provide requirements for the quality control and audit of a manufacturer quality control system by an accredited inspection agency. The Pacific Lumber Inspection Bureau (PLIB), under the Trademark AITC, acts as the *approved agency* to conduct inspections and audits of the manufacture of SWS Glulam and thereby certifies compliance to ANSI A190.1, thereby providing certification that the manufacture of SWS Glulam complies with the IBC and IRC. Quality control by PLIB/AITC also ensures conformance to standards addressing appearance (AITC 110), dimensions (AITC 113), adhesives (ANSI 405), end joints (finger joints) (AITC 406),as well as the compliance of the manufacturing process through quality control measures and statistical process control (AITC 200).

Pacific Lumber Inspection Bureau is accredited by the International Accreditation Service (IAS) to perform inspections and audits for conformity to ANSI A190.1 under the International Organization for Standardization (ISO) Standard 17020, Certificate AA-675 (Type A). A copy of this Certificate is available upon request. Specific questions on the PLIB inspection and certification program can be directed to PLIB/AITC at 253.835.3344 or info@plib.org.

Table 1: Code Provisions and References

Code Provisions	IBC Section	IRC Section	Reference Standards
Definition of Structural Glued Laminated Timber	202		
Approved Agency	202	R202	
Manufacturing, Identification, and Certification	2303.1.3	R502.1.3 R602.1.3 R802.1.2	ANSI A190.1 ANSI 117 ASTM D3737
Typical Connection Details	2306.1		AITC 104
Appearance Grades	2306.1		AITC 110
Dimensions	2306.1		AITC 113
Testing and Inspection	2306.1		AITC 200
Design Values	2306.1		ANSI 117
Structural Design	2306.1		ANSI 117, NDS

Notes:
1. Sections and Standards referenced are as in the 2018 and 2021 *International Building Code* (IBC) and 2018 and 2021 *International Residential Code* (IRC).
2. ANSI is the American National Standards Institute, Washington, DC.
3. ASTM is International, West Conshohocken, PA.
4. American Institute of Timber Construction (AITC) is a registered trademark of the Pacific Lumber Inspection Bureau, Federal Way, WA.
5. NDS is the *National Design Specification® for Wood Construction*, American Wood Council, Leesburg, VA.

Product Information and Specifications

SWS Glulam timbers are manufactured primarily from Southern Pine lumber (laminations) and available in depths up to 88 inches (in.), widths up to 20 in., and lengths up to 115 feet (ft). Relevant specifications for bending members include the Stress Class and Combination Symbol, Balanced or Unbalanced Layup, and the Appearance Grade. Specifications for timbers intended for use primarily in tension and compression are the Combination Symbol and the Appearance Grade. SWS Glulam is manufactured to standard dimensions in accordance with AITC 113 up to the sizes above and in custom shapes and sizes. More information on SWS Glulam and additional products including glulam trusses and timber decking is available on the Structural Wood Systems website, or by direct inquiry to 334-382-6534. AITC Technical Note 24 may be used as a guide in specifying SWS Glulam.

Treated Glulam

Where preservative-treated timbers are requested or required, SWS Glulam timbers are manufactured (treated) in accordance with AITC 109 Standard for *Preservative Treatment of Structural Glued Laminated Timber* utilizing preservatives and retention levels recognized by the American Wood Protection Association (AWPA U1).

Design Information

Requirements for structural design with SWS Glulam can be found in the *National Design Specification® for Wood Construction* (NDS) using design value information in accordance with ANSI 117 as shown in Tables 2 and Table 3 below. Table 2 provides design values for timbers intended to be used as bending members, such as beams and girders. Table 3 provides design values for timbers intended to be used primarily in compression or tension, such as posts, columns, truss members and collectors.

Table 2: Reference Design Values For Structural Wood Systems Structural Glued Laminated Timber[1] - Members Stressed Primarily in Bending

Tabular design values are for normal load duration and dry service conditions.
(Design Values and Footnotes from ANSI 117-2020)

Combination Symbol	Species Outer/ Core	Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)								Bending About Y-Y Axis (Loaded Parallel to the Wide Faces of Laminations)						Axially Loaded		Fasteners	
		Extreme Fiber in Bending		Compression Perpendicular to Grain		Shear Parallel to Grain	Modulus of Elasticity MOE (psi)			Extreme Fiber in Bending	Compression Perpendicular to Grain	Shear Parallel to Grain	Modulus of Elasticity			Tension Parallel to Grain	Compression Parallel to Grain	Specifc Gravity for Fastener Design	
		Bottom of Beam Stressed in Tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Tension Face	Compression Face													Top or Bottom Face	Side Face
		F_{bx^+} (psi)	F_{bx^-} (psi)	$F_{c\perp x}$ (psi)		F_{vx}[2] (psi)	$E_{x\,true}$ ($x10^6$)	$E_{x\,app}$ ($x10^6$)	$E_{x\,min}$ ($x10^6$)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy}[2] [3] (psi)	$E_{y\,true}$ ($x10^6$)	$E_{y\,app}$ ($x10^6$)	$E_{y\,min}$ ($x10^6$)	F_t (psi)	F_c (psi)	G	
24F-1.8E		**2400**	**1850**	**650**		**265**	**1.9**	**1.8**	**0.95**	**1450**	**560**	**230**	**1.7**	**1.6**	**0.85**	**1100**	**1600**	**0.50**	
24F-V3	SP/SP	2400	2000	740	740	300	1.9	1.8	0.95	1700	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
24F-V8	SP/SP	2400	2400	740	740	300	1.9	1.8	0.95	1700	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
26F-1.9E		**2600**	**1950**	**650**		**265**	**2.0**	**1.9**	**1.0**	**1600**	**560**	**230**	**1.7**	**1.6**	**0.85**	**1150**	**1600**	**0.50**	
26F-V1	SP/SP	2600	2000	740	740	300	1.9	1.8	0.95	1700	650	260	1.7	1.6	0.85	1150	1600	0.55	0.55
26F-V2	SP/SP	2600	2100	740	740	300	2.0	1.9	1.0	1950	740	260	1.9	1.8	0.95	1300	1850	0.55	0.55
26F-V3	SP/SP	2600	2100	740	740	300	2.0	1.9	1.0	1950	650	260	1.9	1.8	0.95	1250	1800	0.55	0.55
26F-V4	SP/SP	2600	2600	740	740	300	2.0	1.9	1.0	1700	650	260	1.9	1.8	0.95	1200	1600	0.55	0.55
26F-V5	SP/SP	2600	2600	740	740	300	2.0	1.9	1.0	1950	650	260	1.9	1.8	0.95	1300	1850	0.55	0.55

Footnotes:

1) The combinations in this table are applicable to members consisting of 4 or more laminations and are intended primarily for members stressed in bending due to loads applied perpendicular to the wide faces of the laminations. However, design values are tabulated for loading both perpendicular and parallel to the wide faces of the laminations. For combinations and design values applicable to members loaded primarily axially or parallel to the wide faces of the laminations, see Table 3. For members of 2 or 3 laminations, see ANSI 117.

2) The design values for shear, F_{vx} and F_{vy}, shall be decreased by multiplying by a factor of 0.72 for non-prismatic members, notched members, and for all members subject to impact or cyclic loading. The reduced design value shall be used for the design of members at connections that transfer shear by mechanical fasteners. The reduced design value shall also be used for determination of design values for radial tension and torsion.

3) Design values are for timbers made from a single piece of lumber across the width or multiple-pieces that have been edge bonded. For timber manufactured from multiple piece laminations (across width) that are not edge-bonded, value shall be multiplied by 0.4 for members with 5, 7, or 9 laminations or by 0.5 for all other members. This reduction shall be cumulative with the adjustment in footnote 2).

Table 3: Reference Design Values For Structural Wood Systems Structural Glued Laminated Timber[1)]

Members Stressed Primarily in Tension or Compression (Tabular design values are for normal load duration and dry service conditions.)
(Design Values and Footnotes from ANSI 117-2020)

Combination Symbol	Species	Grade	All Loading							Bending About Y-Y Axis (Loaded Parallel to the Wide Faces of Laminations				Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)	
			Modulus of Elasticity			Compression Perpendicular to Grain	Tension Parallel to Grain	Compression Parallel to Grain		Bending			Shear Parallel to Grain[1) 2) 3)]	Bending	Shear Parallel to Grain[3)]
			$E_{x\,true}$ $E_{y\,true}$ or E_{axial} (10^6 psi)	$E_{x\,app}$ or $E_{y\,app}$ (10^6 psi)	$E_{x\,min}$ $E_{y\,min}$ or $E_{axial\,min}$ (10^6 psi)	$F_{c\perp x}$ (psi)	2 or more Laminations F_t (psi)	4 or more Laminations F_c (psi)	2 or 3 Laminations F_c (psi)	4 or more Laminations F_{by} (psi)	3 Laminations F_{by} (psi)	2 Laminations F_{by} (psi)	F_{vy} (psi)	2 Laminations to 15 in.Deep[4)] F_x (psi)	F_{vx} (psi)
49	SP	N1M16	1.8	1.7	0.9	650	1350	2100	1450	1950	1750	1500	260	1800	300
49 1:14	SP	N1M14	1.8	1.7	0.9	650	1350	2000	1450	1950	1750	1500	260	1800	300
49 1:12	SP	N1M12	1.8	1.7	0.9	650	1350	1900	1450	1950	1750	1500	260	1800	300
49 1:10	SP	N1M	1.8	1.7	0.9	650	1150	1700	1450	1850	1750	1500	260	1800	300
50	SP	N1D14	2.0	1.9	1.0	740	1550	2300	1700	2300	2100	1750	260	2100	300
50 1:12	SP	N1D12	2.0	1.9	1.0	740	1500	2200	1700	2300	2100	1750	260	2100	300
50 1:10	SP	N1D	2.0	1.9	1.0	740	1350	2000	1700	2100	2100	1750	260	2100	300

Footnotes:

1) For members with 2 or 3 laminations, the shear design value for transverse loads parallel to the wide faces of the laminations, F_{vy}, shall be reduced by multiplying by a factor of 0.84 or 0.95, respectively.

2) The shear design value for transverse loads applied parallel to the wide faces of the laminations, F_{vy}, shall be multiplied by 0.4 for members with 5, 7, or 9 laminations manufactured from multiple pieces laminations (across width) that are not edge bonded. The shear design value, F_{vy}, shall be multiplied by 0.5 for all other members manufactured from multiple piece laminations with unbonded edge joints. This reduction shall be cumulative with the adjustment in footnotes a) and c).

3) The design values for shear, F_{vx} and F_{vy}, shall be decreased by multiplying by a factor of 0.72 for non-prismatic members, notched members, and for all members subject to impact or cyclic loading. The reduced design value shall be used for the design of members at connections that transfer shear by mechanical fasteners. The reduced design value shall also be used for determination of design values for radial tension and torsion.

4) The tabulated F_{bx} values are for members without special tension lams up to 15 inches in depth. If the member depth is greater than 15 inches without special tensions lams, the tabulated Fbx values must be multiplied by a factor of 0.88. If special tension lams are used, the tabulated F_{bx} values are permitted to be increased by a factor of 1.18 regardless of the member depth, provided that the increased F_{bx} value does not exceed 2,400 psi.

Fire Resistance and Fire Resistance Rated and Heavy Timber Construction

As provided in Section 722.1 of the IBC, the fire resistance of SWS Glulam may be calculated in accordance with Chapter 16 of the *National Design Specification® for Wood Construction*. SWS Glulam may also be used in Heavy Timber construction in accordance with Section 2304.11 of the IBC and Section IBC Section 2304.9 (timber decking). Structural Wood Systems also manufactures 1-Hour and 2-Hour Glulam timbers. More information on the use of SWS Glulam timbers and decking in Fire-Resistance-Rated construction is a available by direct inquiry to Structural Wood Systems at 334-382-6534. AITC Technical Note 7 and the American Wood Council Technical Report 10 provide additional information on fire resistance of wood members, connections, and assemblies in general and applicable to glulam.

Installation and Construction

Proper handling, installation, connection detailing, and protection are important for the performance and longevity of structural glued laminated timbers. AITC 104 contains Typical Construction Details for glued laminated timbers. Requirements and recommendations for transit, storage, and erection of SWS Glulam timbers may be found in AITC 111 and Structural Wood Systems Product information guides. Holes and notches in SWS Glulam timbers may be evaluated in accordance with AITC Technical Note 19 and the NDS. Additional installation and construction requirements are provided by Structural Wood Systems.

Mark

The AITC Mark on SWS Glulam, Figure 1, indicates that the timbers have been produced under the AITC auditing program of the Pacific Lumber Inspection Bureau (PLIB) to conform to ANSI A190.1 in accordance with the International Building Code (IBC) and International Residential Code (IRC), and are suitable for approval for construction in buildings and other structures regulated by the IBC and IRC, as well as other regional and local codes based on the IBC and IRC.

Structural Wood Systems staff stands ready to provide project-specific assistance in the design, detailing, cost-estimating, and recommendations with regard to construction/erection of their glued laminated timbers. Structural Wood Systems may be contacted at 334-382-6534 or through their website, www.structuralwood.com. AITC Technical Notes and Standards and additional information on structural glued laminated timber may be found at www.aitc-glulam.org or www.plib.org, or by contacting PLIB directly at 253.835.3344.

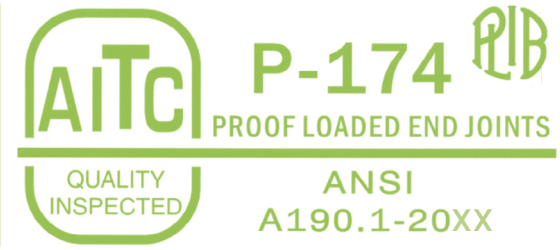

Figure 1 AITC Quality Mark Facsimile for Structural Wood System Plant P-174