AMERICAN INSTITUTE OF TIMBER CONSTRUCTION

AITC Product Report Number P155-001

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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 Unalam structural glued laminated timber (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 Unalam Glulam, as well as installation and construction information.

Code Provisions

Requirements for the manufacturing and use of 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 quality control and the audit of the 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 Unalam Glulam and thereby certifies compliance to ANSI A190.1, thereby providing certification that the manufacture of Unalam 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 (Softwood Timbers) AITC 119 (Hardwood Timbers)
Structural Design	2306.1		ANSI 117, AITC 119, NDS

Footnotes:

1. Sections and Standards referenced are as in the 2021 *International Building Code* (IBC) and 2021 *International Residential Code* (IRC).
2. ANSI is the American National Standards Institute, Washington, DC.
3. ASTM International, West Conshohocken, PA.
4. American Institute of Timber Construction (AITC) is a 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

Unalam Glulam Softwood timbers are manufactured from Southern Pine (SP), Douglas Fir (DF), or Alaska Cedar (AC) in any depths to 108 inches (in.) widths to 34 inches, and lengths to 135 feet (ft). Unalam Hardwood Glulam timbers are manufactured from Red Maple or Red Oak. (For larger depths and lengths contact Unalam.) Relevant specifications are the Combination Symbol (see Design Information) and the Appearance Grade (Architectural, Industrial, or Premium). Unalam Glulam is available as straight, cambered, simple curved, complex curved and spiral members. All Unalam Glulam members receive end sealer and shop-applied stain or clear sealer. Available surface textures include planed (standard) or rough sawn textures.

Standard Softwood Unalam Glulam Widths: 3 in., 5 in., 6.5 in., 8.5 in., 10.5 in. Standard Depths: multiples of 1.375 in. (1.334 in. if treated).

Treated Glulam

Where preservative-treated timbers are requested or required, Unalam Glulam timbers are manufactured from SP lumber treated prior to gluing with Chromated Copper Arsenate (CCA) in retentions of 0.4 to 0.6 pcf in accordance with AITC 109 Standard for Preservative Treatment of Structural Glued Laminated Timber.

Design Information

Requirements for the structural design with Unalam 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 Table 2 and Table 3 below. Requirements and design information for Unalam Glulam manufactured from hardwood species are in accordance with AITC 119 and are shown in Table 4 and Table 5. Table 2 and Table 4 provides design values for timbers intended to be used as bending members, such as beams and girders. Table 3 and Table 5 provide design values for timbers intended to be used primarily in compression or tension, such as posts, columns, truss members or collectors. Additional design information, including Load-Span tables, information on Unalam Glulam arches, trusses, and other Unalam Glulam systems, as well as information for the evaluation of holes and notches in Unalam Glulam timbers, is available from AITC and Unalam through their websites and direct request.

GLT Panels

Unalam Glulam can be manufactured for use as floor or roof decking (GLT panels). For these applications, uniform layup members are recommended, using design values from Table 3 (Bending About Y-Y Axis). Panels are shop fabricated specifically for each project. These large panels reduce installation time and waste compared to nominal tongue and groove timber decking.

Table 1: Reference Design Values For Unalam Structural Glued Laminated Softwood 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)	$F_{c\perp y}$ ($x\,10^6$)	F_{vy} 2)3) (psi)	$E_{y\,true}$ ($x10^6$)	$E_{y\,app}$ ($x\,10^6$)	$E_{y\,min}$ ($x10^6$)	F_t (psi)	F_c (psi)	G	
**16F-1.3E*		*1600*	*925*	*315*		*195*	*1.4*	*1.3*	*0.69*	*800*	*315*	*170*	*1.2*	*1.1*	*0.58*	*675*	*925*	*0.41*	
16F-V3	DF/DF	1600	1250	560	560	265	1.6	1.5	0.79	1450	560	230	1.6	1.5	0.79	975	1500	0.50	0.50
16F-V6	DF/DF	1600	1600	560	560	265	1.7	1.6	0.85	1450	560	230	1.6	1.5	0.79	1000	1600	0.50	0.50
16F-V2	SP/SP	1600	1400	740	650	300	1.6	1.5	0.79	1450	650	260	1.5	1.4	0.74	1000	1300	0.55	0.55
16F-V3	SP/SP	1600	1450	740	740	300	1.5	1.4	0.74	1450	650	260	1.5	1.4	0.74	975	1400	0.55	0.55
16F-V5	SP/SP	1600	1600	650	650	300	1.7	1.6	0.85	1600	650	260	1.6	1.5	0.79	1000	1550	0.55	0.55
**20F-1.5E*		*2000*	*1100*	*425*		*195*	*1.6*	*1.5*	*0.79*	*800*	*315*	*170*	*1.3*	*1.2*	*0.63*	*725*	*925*	*0.41*	
20F-V3	DF/DF	2000	1450	650	560	265	1.7	1.6	0.85	1450	560	230	1.6	1.5	0.79	1000	1550	0.50	0.50
20F-V7	DF/DF	2000	2000	650	650	265	1.7	1.6	0.85	1450	560	230	1.7	1.6	0.85	1050	1600	0.50	0.50
20F-V12	AC/AC	2000	1400	560	560	265	1.6	1.5	0.79	1250	470	230	1.5	1.4	0.74	925	1500	0.46	0.46
20F-V13	AC/AC	2000	2000	560	560	265	1.6	1.5	0.79	1250	470	230	1.5	1.4	0.74	950	1550	0.46	0.46
20F-V2	SP/SP	2000	1550	740	650	300	1.6	1.5	0.79	1450	650	260	1.5	1.4	0.74	1000	1400	0.55	0.55
20F-V3	SP/SP	2000	1450	650	650	300	1.6	1.5	0.79	1600	650	260	1.6	1.5	0.79	1000	1400	0.55	0.55
20F-V5	SP/SP	2000	2000	740	740	300	1.7	1.6	0.85	1450	650	260	1.5	1.4	0.74	1050	1500	0.55	0.55
**24F-1.7E*		*2400*	*1450*	*500*		*210*	*1.8*	*1.7*	*0.9*	*1050*	*315*	*185*	*1.4*	*1.3*	*0.69*	*775*	*1000*	*0.42*	
****24F-V5**	**SP/SP**	**2400**	**2400**	**740**	**740**	**300**	**1.8**	**1.7**	**0.9**	**1700**	**650**	**260**	**1.7**	**1.6**	**0.85**	**1150**	**1600**	**0.55**	**0.55**
**24F-1.8E*		*2400*	*1850*	*650*		*265*	*1.9*	*1.8*	*0.95*	*1450*	*560*	*230*	*1.7*	*1.6*	*0.85*	*1100*	*1600*	*0.5*	
24F-V4	DF/DF	2400	1850	650	650	265	1.9	1.8	0.95	1450	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V8	DF/DF	2400	2400	650	650	265	1.9	1.8	0.95	1550	560	230	1.7	1.6	0.85	1100	1650	0.50	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

Table 2 *Continued*: Reference Design Values For Unalam Structural Glued Laminated Softwood 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)	$F_{c\perp y}$ (x 10^6)	F_{vy} [2][3] (psi)	$E_{y\,true}$ (x10^6)	$E_{y\,app}$ (x 10^6)	$E_{y\,min}$ (x10^6)	F_t (psi)	F_c (psi)	G	
**26F-1.9E*		*2600*	*1950*	*650*		*265*	*2.0*	*1.9*	*1.00*	*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).

* *Stress Class*

**** Most common layups**

Table 3: Reference Design Values For Unalam Structural Glued Laminated Softwood Timber[1)]

Members Stressed Primarily in Axial 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 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 $E_{x\,axial}$ ($x10^6$) psi	$E_{x\,app}$, or $E_{y\,app}$, ($x10^6$) psi	$E_{x\,min}$, $E_{y\,min}$, or $E_{x\,axial\,min}$ ($x10^6$) psi	$F_{c\perp}$ (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)	2 or More Laminations F_{by} (psi)	2 or More Laminations F_{by} (psi)	F_{vy} (psi)	2 Laminations to 15 in Deep[4)] F_{bx} (psi)	F_{vx} (psi)
1	DF	L3	1.6	1.5	0.79	560	950	1550	1250	1450	1250	1000	230	1250	265
2	DF	L2	1.7	1.6	0.85	560	1250	1950	1600	1800	1600	1300	230	1700	265
3	DF	L2D	2.0	1.9	1.00	650	1450	2300	1900	2100	1850	1550	230	2000	265
4	DF	L1CL	2.0	1.9	1.00	590	1400	2100	1950	2200	2000	1650	230	2100	265
5	DF	L1	2.1	2.0	1.06	650	1650	2400	2100	2400	2100	1800	230	2200	265
69	AC	L3	1.3	1.2	0.63	470	725	1150	1100	1100	975	775	230	1000	265
70	AC	L2	1.4	1.3	0.69	470	975	1450	1450	1400	1250	1000	230	1350	265
71	AC	L1D	1.7	1.6	0.85	560	1250	1900	1900	1850	1650	1400	230	1750	265
72	AC	L1S	1.7	1.6	0.85	560	1250	1900	1900	1850	1650	1400	230	1900	265
47 1:12	SP	N2M12	1.5	1.4	0.74	650	1200	1900	1150	1750	1550	1300	260	1400	300
47 1:10	SP	N2M10	1.5	1.4	0.74	650	1150	1700	1150	1750	1550	1300	260	1400	300
**47 1:8	SP	N2M	1.5	1.4	0.74	650	1000	1500	1150	1600	1550	1300	260	1400	300
48 1:12	SP	N2D12	1.8	1.7	0.9	740	1400	2200	1350	2000	1800	1500	260	1600	300
48 1:10	SP	N2D10	1.8	1.7	0.9	740	1350	2000	1350	2000	1800	1500	260	1600	300
48 1:8	SP	N2D	1.8	1.7	0.9	740	1150	1750	1350	1850	1800	1500	260	1600	300
49 1:16	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	1300	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 1:14	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 lamination with unbonded edge joints. This reduction shall be cumulative with the adjustment in footnotes 1) and 3).
3. The design values for shear, F_{vx} and F_{vy}, shall be decreased by multipling 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 connetions 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 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 F_{bx} 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.

** **Most common layups**

Table 4: Reference Design Values for Unalam Structural Glued Laminated Hardwood Timber

Members Stressed Primarily in Bending (Tabular design values are for normal load duration and dry service conditions [1) 2) 3) 4)].)
(Design Values and Footnotes from AITC 119-1996 and NDS)

Combination Symbol	Species Group [4)]	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		
		Extreme Fiber in Bending [5)]		Compression Perpendicular to Grain		Shear Parallel to Grain	Modulus of Elasticity [7)]	Extreme Fiber in Bending [8)]	Compression Perpendicular to Grain	Shear Parallel to Grain	Shear Parallel to Grain for Members with Multiple Piece Laminations which are not Edge Bonded [9)]	Modulus of Elasticity [7)]	Tension Parallel to Grain	Compression Parallel to Grain	Modulus of Elasticity
		Tension Zone Stressed in Tension [6)]	Compression Zone Stressed in Tension	Tension Face	Compression Face										
		F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} (psi)	E_x (x 10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} (psi)	F_{vy} (psi)	E_y (x 10^6 psi)	F_t (psi)	F_c (psi)	E (x 10^6 psi)
14F-V2	B	1400	700	590	590	180	1.3	1450	590	160	65	1.1	750	1200	1.1
14F-V4	B	1400	1400	590	590	180	1.3	1450	590	160	65	1.1	775	1200	1.1
16F-V1	B	1600	800	590	590	180	1.4	1400	590	160	65	1.2	800	1200	1.2
16F-V3	B	1600	1600	590	590	180	1.4	1400	590	160	65	1.2	850	1200	1.2
Wet use factors		0.80	0.80	0.53	0.53	0.875	0.833	0.80	0.53	0.875	0.875	0.833	0.80	0.73	0.833

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. For combinations and design values applicable to members loaded primarily axially or parallel to the wide faces of the laminations, see **Table 5**. For members of 2 or 3 laminations, see **Table 5**.
2. The tabulated design values are for dry service conditions. To obtain wet service design values, multiply the tabulated values by the factors shown at the bottom of the table.
3. The tabulated design values are for normal duration of loading. For other durations of loading, see NDS 2.3.2.
4. Species Group is in accordance with AITC 119.
5. The tabulated design values for bending about the X-X axis in this table shall be multiplied by the volume factor, C_V, in accordance with NDS 5.3.6, with x = 10 for hardwoods.
6. When special tension laminations are not used, the design values in bending about the X-X axis, F_{bx}, shall be multiplied by 0.75 for bending members over 15 in. deep, and 0.85 for beams less than or equal to 15 in. in depth.
7. Modulus of elasticity values are average values and include an adjustment for shear deflection such that calculation of shear deflection for most designs is unnecessary. For stability calculations a reduced modulus of elasticity shall be used determined by approved means.
8. The values of F_{by} were calculated based on members 12 in. in depth (bending about Y-Y axis). When the depth is less than 12 in., the values of F_{by} can be increased by multiplying by the flat use factor C_{fu} for glued laminated timber in accordance with Section 5.3.7 of the NDS.
9. These values for shear parallel to grain, F_{vy}, apply to members manufactured using multiple piece laminations with unbonded edge joints. For members manufactured using single piece laminations or using multiple piece laminations with bonded edge joints the shear parallel to grain values in the previous column apply. For members with 5, 7 or 9 laminations, the values in this column shall be reduced by 20%.

Table 5: Reference Design Values for Unalam Structural Glued Laminated Hardwood Timber

Members Stressed Primarily in Axial Tension or Compression (Tabular design values are for normal load duration and dry service conditions [1) 2) 3)].)
(Design Values and Footnotes from AITC 119-96 and NDS)

Combination Symbol	Species Group [4)]	Grade	All Loading		Axial Loading			Bending About Y-Y Axis (Loaded Perpendicular to Wide Faces of Laminations)							Bending About X-X Axis (Loaded Parallel to the Wide Faces of Laminations)		
			Modulus of Elasticity E[5)]	Compression Perpendicular to Grain	Tension Parallel to Grain	Compression Parallel to Grain		Extreme Fiber in Bending [6)]			Shear Parallel to Grain [7)]				Bending [8)]		Shear Parallel to Grain [7)]
					2 or More Laminations	4 or More Laminations	2 or 3 Laminations	4 or More Laminations	3 Laminations	2 Laminations	4 or More Lams (for members with multiple piece lams[9)]	4 or More Lams[10)]	3 Lams[10)]	2 Lams[10)]	2 Lams to 15 in. deep[11)]	4 or More Laminations[12)]	2 or More Laminations
			E (x 10^6 psi)	$F_{c\perp x}$ (psi)	F_t (psi)	F_c (psi)	F_c (psi)	F_{by} (psi)	F_{by} (psi)	F_{by} (psi)	F_{vy} (psi)	F_{vy} (psi)	F_{vy} (psi)	F_{vy} (psi)	F_{bx} (psi)	F_{bx} (psi)	F_{vx} (psi)
H5	B	N3	1.2	590	350	800	800	1050	900	750	65	160	150	135	750	1000	180
H6	B	N2	1.3	590	750	1150	1150	1450	1300	1050	65	160	150	135	1000	1200	180
H7	B	N1	1.5	590	850	1300	1300	1650	1500	1300	65	160	150	135	1350	1600	180
H8	B	SS	1.5	590	950	1450	1450	1700	1550	1350	65	160	150	135	1400	1700	180
Wet use factors			0.833	0.53	0.80	0.73	0.73	0.80	0.80	0.80	0.875	0.875	0.875	0.875	0.80	0.80	0.875

Footnotes:

1. The combinations in this table are intended primarily for members loaded either axially or in bending with the loads acting parallel to the wide faces of the laminations. Design values for bending due to loading applied perpendicular to the wide faces of the laminations are also included; however, the combinations in Table 4 are usually better suited for this condition of loading.
2. The tabulated design values are for dry conditions of use. To obtain wet-use design values, multiply the tabulated values by the factors shown at the bottom of the table.
3. The tabulated design values are for normal duration of loading. For other durations of loading, see NDS 2.3.2.
4. Species Group is in accordance with AITC 119.
5. Modulus of elasticity values are average values and include an adjustment for shear deflection such that calculation of shear deflection for most designs is unnecessary. For stability calculations a reduced modulus of elasticity shall be used determined by approved means.
6. The values of F_{by} are based on members 12 in. in depth (bending about Y-Y axis). When the depth is less than 12 in., the values of F_{by} can be increased by multiplying by the flat use factor C_{fu} for glued laminated timber in accordance with NDS Section 5.3.7.
7. The design values in shear parallel to grain contained in this table are based on members without wane.
8. The tabulated design values for bending about the X-X axis in this table shall be multiplied by the volume factor, C_V, in accordance with NDS 5.3.6, with x = 10 for hardwoods.
9. These values for shear parallel to grain, F_{vy}, apply to members manufactured using multiple piece laminations with unbonded edge joints. For members with 5, 7 or 9 laminations the values in this column shall be reduced by 20%.
10. These values for shear parallel to grain, F_{vy}, apply to members using single piece laminations or using multiple piece laminations with bonded edge joints.
11. The design values are for members of from 2 laminations to 15 in. in depth without tension laminations.
12. The design values are for members of 4 or more laminations in depth and require special tension laminations. When special tension laminations are not used, the design values in bending about the X-X axis, F_{bx}, shall be multiplied by 0.75 for bending members over 15 in. deep. For bending members 15 in. and less in depth, use the design values in the preceding column.

Fire Resistance and Fire Resistance Rated and Heavy Timber Construction

As provided in Section 722.1 of the IBC, the fire resistance of Unalam Glulam may be calculated in accordance with Chapter 16 of the National Design Specification® for Wood Construction. Unalam 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). Unalam also manufactures 1-Hour and 2-Hour Glulam timbers. 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 Unalam Glulam timbers may be found in AITC 111. Holes and notches in Unalam Glulam timbers may be evaluated in accordance with AITC Technical Note 19 and the NDS.

Mark

The AITC Mark on Unalam structural glued laminated timbers, example facsimile in Figure 1 below, 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.

Unalam staff stands ready to provide project-specific assistance in the design, detailing, cost-estimating, and recommendation with regard to construction/ erection of their glued laminated timbers. Unalam may be contacted at 607-369-9341, info@unalam.com, or through their website, www.unalam.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 Unalam Plant P-155