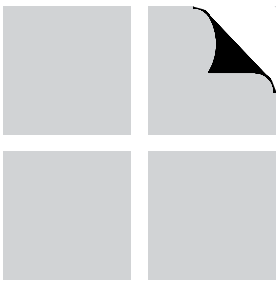
SUPPLEMENT
Structural Glued Laminated Timber



LRFD
LOAD AND RESISTANCE FACTOR DESIGN

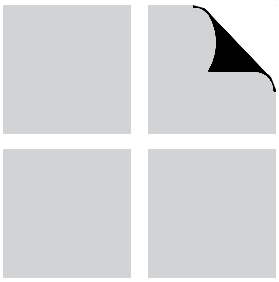
MANUAL FOR ENGINEERED WOOD CONSTRUCTION

A P A

The Engineered Wood Association

ENGINEERED WOOD SYSTEMS
APA EWS

SUPPLEMENT
Structural Glued Laminated Timber



LRFD

LOAD AND RESISTANCE FACTOR DESIGN

MANUAL FOR ENGINEERED WOOD CONSTRUCTION

Preface

This supplement contains adjustment factors, dimensions, factored resistance, reference strengths and other properties required to design structural glued laminated timber in the LRFD format. In this format, the term "resistance" is used to refer to member capacities (i.e., moment resistance, compression resistance, etc.). This is distinct from the term "strength" which refers to limit state material properties — conceptually a "factored allowable stress."

The member resistance values tabulated in this supplement are to be used in conjunction with the design methodologies provided in AF&PA/ASCE 16-95, *Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction.*

The reference strengths were derived according to the principles of ASTM D5457-93, *Standard Specification for Computing the Reference Resistance of Wood-based Materials and Structural Connections for Load and Resistance Factor Design.*

The tabulated reference strength values are to be used within the reference end-use conditions defined therein. When the end-use conditions fall outside the range of the reference conditions, the reference values shall be adjusted by the product of applicable adjustment factors as defined in AF&PA/ASCE 16-95 and also provided in this supplement. For unusual end-use conditions, the designer should consult additional literature for possible further adjustments.

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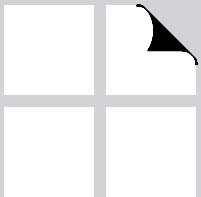
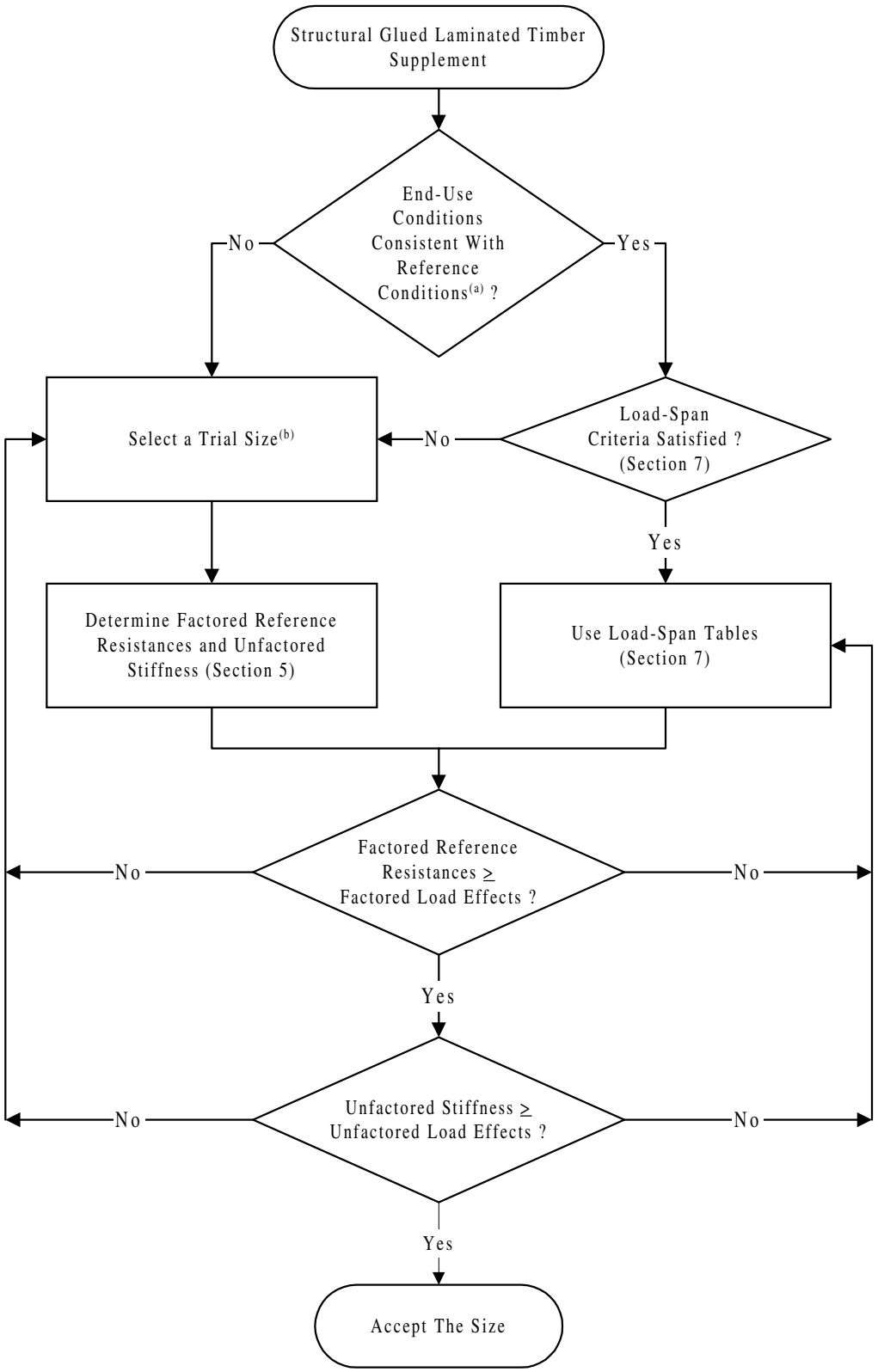
DESIGNER FLOWCHART



1.1 Flowchart

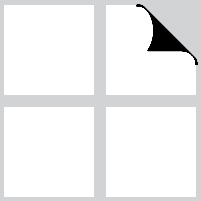


(a) See Section 4.

(b) Tables 3.1 and 3.2 provide reference strengths and MOE for various layup combinations. This information could be used in conjunction with Tables 5.1 through 5.4 to determine the trial size.

2

INTRODUCTION TO STRUCTURAL GLUED LAMINATED TIMBER



2.1 Products Description

Structural glued laminated timber (glulam) is a structural member glued up from suitably selected and prepared pieces of wood either in a straight or curved form with the grain of all pieces essentially parallel to the longitudinal axis of the member. The reference strengths and resistances given in this Supplement are applicable only to glued laminated timber members produced in accordance with American National Standard for Wood Products — Structural Glued Laminated Timber, ANSI/AITC A190.1.

Glued laminated timber members are produced in laminating plants by gluing together dry lumber, normally of 2-in. or 1-in. nominal thickness, under controlled conditions of temperature and pressure. Members with a wide variety of sizes, profiles, and lengths can be produced having superior characteristics of strength, serviceability, and appearance. Glued laminated timber beams are manufactured with the strongest laminations on the bottom and top of the beam, where greatest tension and compression stresses occur.

Glued laminated timber members are manufactured from several softwood species, primarily Douglas Fir-Larch and Southern Pine, but also lesser amounts of Hem-Fir, Spruce-Pine-Fir, Western Woods, Alaska Cedar, and California Redwood are used. In addition, several hardwood species, including Red Oak, Red Maple, and Yellow Poplar, are also used. Standard glued laminated timber sizes are given in Section 9 of this Supplement. Any lengths, up to the maximum length permitted by transportation and handling restrictions, is available.

A glued laminated timber member can be manufactured using a single or multiple grade of lumber, depending on the intended use. In addition, a mixed-species glued laminated timber member is also possible. When the member is intended to be primarily loaded either axially or in bending with the loads acting parallel to the wide faces of the laminations, a single grade combination is recommended. On the other hand, a multiple grade combination provides better cost-effectiveness when the member is primarily loaded in bending due to loads applied perpendicular to the wide faces of the laminations.

On a multiple grade combination, a glued laminated timber member can be produced as either balanced or unbalanced combination, depending on the arrangement of the laminations at the geometrical locations of the member. A balanced combination is symmetrical about the mid-depth, so both faces have the same reference bending strength. An unbalanced combination are asymmetrical and normally, when used as a beam, the face with a lower reference bending strength is stamped as TOP. The balanced combination is intended for use in continuous or cantilevered over supports to provide equal capacity in both positive and negative bending, whereas the unbalanced combination is primarily for use in simple span applications.

Glued laminated timber members are typically produced in three appearance classifications, Premium, Architectural, and Industrial, though Industrial Special is also available. Premium and Architectural beams are higher appearance classifications and are surfaced for a smooth, beautiful finish. Industrial appearance beams are normally used in concealed applications or in construction where appearance is not important. Industrial Special appearance beams are typically used for headers. Design values for the glued laminated timber member are independent of the appearance classifications.

2.2 Common Uses

Glued laminated timber members can be applied as primary or secondary load-carrying components in structures. Table 2.1 lists economical spans for selected timber framing systems using glued laminated timber members in buildings. Other common uses of glued laminated timber members are for transportation structures, highway bridges, marine structures, noise barriers, and dome structures. Table 2.1 may be used for preliminary design purposes to determine the economical span ranges for the selected framing systems. However, all systems require a more extensive analysis for final design.

Table 2.1 Economical Spans for Glued Laminated Timber Framing Systems

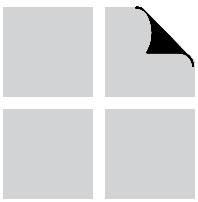
Type of Framing System	Economical Spans (ft)
ROOF	
Simple Span Beams	
Straight or slightly cambered	10 - 100
Tapered, double tapered-pitched, or curved	25 - 100
Cantilevered Beams	up to 90
Continuous Beams	10 - 32
Girders	40 - 80
Three-Hinged Arches	
Gothic	40 - 90
Tudor	20 - 120
A-Frame	20 - 100
Three-centered, Parabolic, or Radial	40 - 250
Two-Hinged Arches	
Radial or Parabolic	50 - 200
Trusses (Heavy)	
Flat or parallel chord	50 - 150
Triangular or pitched	50 - 90
Bowstring (continuous chord)	50 - 200
Carrying	40 - 60
Trusses (Light)	
Flat or parallel chord	20 - 50
Triangular or pitched	20 - 75
Tie arches	50 - 200
Dome structures	200 - 500+
FLOOR	
Simple Span Beams	6 - 40
Continuous Beams	25 - 40

2.3 Availability

Glued laminated timber members are available in both custom and stock sizes. Custom beams are manufactured to the specifications of a specific job, while stock beams are made in common dimensions and cut to length when the beam is ordered. Although glued laminated timber members can be custom fabricated to provide a nearly infinite variety of forms and arrangements, the best economy is generally realized by using standard-size members in a repetitious arrangement. When in doubt, the designer is advised to check with the glued laminated timber suppliers or manufacturers concerning the availability of the glued laminated timber members prior to design. The following associations are available for technical assistance:

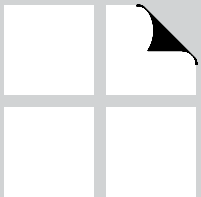
APA - The Engineered Wood Association
Engineered Wood Systems
7011 South 19th Street
Tacoma, WA 98466
Phone: (206) 565-6600
Fax: (206) 565-7265

American Institute of Timber Construction
7012 South Revere Parkway, Suite 140
Englewood, CO 80112
Phone: (303) 792-9559
Fax: (303) 792-0669



3

REFERENCE STRENGTH AND STIFFNESS



3.1 General

The reference strength and mean modulus of elasticity of glued laminated timber are greatly affected by the nonhomogeneous layup of members composed of various grades of lumber as well as the direction of bending. As a result, different reference strength and modulus of elasticity values are assigned for glued laminated timber used primarily in bending, Table 3.1, and primarily in axial loading, Table 3.2. The reference strength values shall be used in conjunction with the dimensions provided in Tables 9.1 (Western Species) and 9.2 (Southern Pine) of Section 9.

3.2 Reference Strength and Modulus of Elasticity

Reference strength values are given in Table 3.1 for bending about the X-X axis. Although permitted, axial loading or bending about the Y-Y axis is not efficient in using the glued laminated timber combinations given in Table 3.1. Therefore, the designer should select glued laminated timber from Table 3.2. Similarly, glued laminated timber combinations in Table 3.2 are inefficiently utilized if the primary use is bending about the X-X axis.

The values for reference strength and stiffness in Tables 3.1 and 3.2 are based on use under reference end use conditions. See Chapter 2 of AF&PA/ASCE 16-95, *Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction,* for details. When used under other conditions, see Section 4 of this Supplement for adjustment factors. The reference flexural strengths are based on members loaded as simple beams. When glued laminated timber is used in continuous or cantilevered beams, the designer should make sure that glued laminated timber combinations which contain tension lamination on both faces (balanced combinations) are used. See Chapter 5 of AF&PA/ASCE 16-95 for further information.

3.3 Reference Strength due to Straight-Tapered End Cuts on the Compression Face

Straight-tapered end cuts on the top at the end of beams are sometimes used to improve drainage, to provide extra head for downspouts and scuppers, to faciliate discharge of water, and to reduce the height of the wall. Table 3.3 provides reference strengths and mean modulus of elasticity values for glued laminated timber with straight-tapered end cuts on the compression face. The reference strength values are provided for bending, F_b, and compression perpendicular to grain, $F_{c\perp}$, and replace the reference strength values provided in Table 3.1 when tapered end cut members are used.

3.4 Reference Radial Tensile Strength

Table 3.4 provides reference radial tensile strength, F_{rt}, for glued laminated timber. Because of uncertainties in determining radial tension strength and the time effect, the reference radial tension strength for all species, except southern pine and hardwoods, is reduced for all loading conditions except for wind and earthquake loads. This reduction is applied in addition to the use of the time effect factor, λ. The resistance factor, ϕ, for radial tension is the same as that for shear, $\phi = 0.75$.

Table 3.1 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Bending[a,b]

Combination Symbol[c]	Species-Outer/Core Lams[d]	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Extreme Fiber in Bending: Tension Zone Stressed in Tension[e,s] F_{bx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Extreme Fiber in Bending: Compr. Zone Stressed in Tension[f] F_{bx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Compr. ⊥ to Grain: Tension Face $F_{c\perp x}$ ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Compr. ⊥ to Grain: Compr. Face $F_{c\perp x}$ ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Shear Parallel to Grain (Horiz.) F_{vx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Modulus of Elasticity: Mean E_x ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Modulus of Elasticity: Fifth %-ile E_{05x} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Extreme Fiber in Bending[p] F_{by} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Compr. ⊥ to Grain $F_{c\perp y}$ ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Shear Parallel to Grain (Horizontal): Shear Parallel to Grain (Horiz.) F_{vy} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Shear Parallel to Grain (Horizontal): (multiple lams without edge glue)[r] F_{vy} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Modulus of Elasticity: Mean E_y ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Modulus of Elasticity: Fifth %-ile E_{05y} ksi	Axially Loaded: Tension Parallel to Grain F_t ksi	Axially Loaded: Compr. Parallel to Grain F_c ksi	Axially Loaded: Modulus of Elasticity: Mean E ksi	Axially Loaded: Modulus of Elasticity: Fifth %-ile E_{05} ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Visually Graded Western Species																		
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
16F-V1	DF/WW	4.07	2.03	1.17[g,h]	1.17[g,h]	0.405[p,t]	1300[u]	1100	2.41	0.53	0.375[p,t]	0.185[p,t]	1100[u]	1000[u]	1.82	2.34	1100[u]	1000[u]
16F-V2	HF/HF	4.07	2.03	1.04[i]	0.78[i]	0.445	1400	1200	3.18	0.78	0.390	0.200	1300	1100	2.36	3.12	1300	1100
16F-V3	DF/DF	4.07	2.03	1.17[g,h]	1.17	0.545	1500	1300	3.68	1.17	0.475	0.245	1500	1300	2.57	3.72	1500	1300
The following combination is NOT BALANCED and is intended for straight or slightly cambered members for dry use and industrial appearance[j].																		
16F-V4	DF/WW	4.07	2.03	1.35	1.17[g]	0.260[k,p,t]	1500[u]	1300	2.29	0.53	0.375[p,t]	0.185[p,t]	1300[u]	1100[u]	1.76	1.44	1300[u]	1100[u]
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
16F-V6	DF/DF	4.07	4.07	1.17[g,h]	1.17[g]	0.545	1500	1300	3.68	1.17	0.475	0.245	1400	1200	2.57	3.72	1500	1300
16F-V7	HF/HF	4.07	4.07	0.78[i]	0.78[i]	0.445	1400	1200	3.05	0.78	0.390	0.200	1300	1100	2.30	3.24	1300	1100
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
20F-V1	DF/WW	5.08	2.54	1.35	1.17[g]	0.405[p,t]	1400[u]	1200[u]	2.54	0.53	0.375[p,t]	0.185[p,t]	1200[u]	1100[u]	2.03	2.40	1200[u]	1100[u]
20F-V2	HF/HF	5.08	2.54	1.04[i]	0.78[i]	0.445	1500	1300	3.05	0.78	0.390	0.200	1400	1200	2.57	3.24	1400	1200
20F-V3	DF/DF	5.08	2.54	1.35	1.17[g]	0.545	1600	1400	3.68	1.17	0.475	0.245	1500	1300	2.70	3.72	1500	1300
20F-V10	DF/HF	5.08	2.54	1.35	1.17	0.445	1500	1300	3.30	0.78	0.390	0.200	1400	1200	2.57	3.72	1400	1200
20F-V12	AC/AC	5.08	2.54	1.17	1.17	0.545	1500	1300	3.05	0.98	0.475	0.230	1400	1200	2.43	3.60	1400	1200
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
20F-V7	DF/DF	5.08	5.08	1.35	1.35	0.545	1600	1400	3.68	1.17	0.475	0.245	1600	1400	2.70	3.84	1600	1400
20F-V8	DF/DF	5.08	5.08	1.23[g,h]	1.23[g,h]	0.545	1700	1500	3.68	1.17	0.475	0.245	1600	1400	2.70	3.84	1600	1400
20F-V9	HF/HF	5.08	5.08	1.04[i]	1.04[i]	0.445	1500	1300	3.56	0.78	0.390	0.200	1400	1200	2.63	3.36	1400	1200
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
22F-V1	DF/WW	5.59	2.80	1.35	1.17[g]	0.405[p,t]	1600[u]	1400[u]	2.67	0.53	0.375[p,t]	0.185[p,t]	1300[u]	1100[u]	2.30	2.64	1300[u]	1100[u]
22F-V3	DF/DF	5.59	2.80	1.35	1.17[i]	0.545	1700	1500	3.68	1.17	0.475	0.245	1600	1400	2.84	3.60	1600	1400
22F-V10	DF/DFS	5.59	2.80	1.35	1.17[g]	0.545	1600	1400	4.07	1.04	0.475	0.245	1300	1100	2.70	3.36	1300	1100
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
22F-V8	DF/DF	5.59	5.59	1.23[g,h]	1.23[g,h]	0.545	1700	1500	3.68	1.17	0.475	0.245	1600	1400	2.84	3.96	1600	1400
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
24F-V1	DF/WW	6.10	3.05	1.35	1.35	0.405[p,t]	1700[u]	1500[u]	3.18	0.53	0.390[p,t]	0.200[p,t]	1400[u]	1200[u]	2.57	3.12	1400[u]	1200[u]
24F-V2	HF/HF	6.10	3.05	1.04[i]	1.04[i]	0.445	1500	1300	3.18	0.78	0.390	0.200	1400	1200	2.57	3.12	1400	1200
24F-V4	DF/DF	6.10	3.05	1.35	1.35	0.545	1800	1600	3.81	1.17	0.475	0.245	1600	1400	2.97	3.96	1600	1400
24F-V5	DF/HF	6.10	3.05	1.35	1.35	0.445	1700	1500	3.43	0.78	0.405	0.200	1500	1300	2.97	3.48	1500	1300
24F-V11	DF/DFS	6.10	3.05	1.35[g]	1.17	0.545	1700	1500	4.07	1.04	0.475	0.245	1400	1200	3.11	4.08	1400	1200
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
24F-V8	DF/DF	6.10	6.10	1.35	1.35	0.545	1800	1600	3.68	1.17	0.475	0.245	1600	1400	2.97	3.96	1600	1400
24F-V10	DF/HF	6.10	6.10	1.35	1.35	0.445	1800	1600	3.56	0.78	0.405	0.200	1600	1400	3.11	3.84	1600	1400
Wet Service Factor[b]		0.8	0.8	0.53	0.53	0.875	0.833	0.833	0.8	0.53	0.875	0.875	0.833	0.833	0.8	0.73	0.833	0.833

Table 3.1 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Bending[a,b] (Cont.)

Combination Symbol[c]	Species-Outer/Core Lams[d]	Bending about X-X Axis							Bending about Y-Y Axis						Axially Loaded			
		Loaded Perpendicular to Wide Faces of Laminations							Loaded Parallel to Wide Faces of Laminations									
		Extreme Fiber in Bending		Compr. ⊥ to Grain			Modulus of Elasticity				Shear Parallel to Grain (Horizontal)		Modulus of Elasticity				Modulus of Elasticity	
		Tension Zone Stressed in Tension[e,s]	Compr. Zone Stressed in Tension[f]	Tension Face	Compr. Face	Shear Parallel to Grain (Horiz.)	Mean	Fifth %-ile	Extreme Fiber in Bending[p]	Compr. ⊥ to Grain	Shear Parallel to Grain (Horiz.)	(multiple lams without edge glue)[r]	Mean	Fifth %-ile	Tension Parallel to Grain	Compr. Parallel to Grain	Mean	Fifth %-ile
		F_{bx}	F_{bx}	$F_{c\perp x}$	$F_{c\perp x}$	F_{vx}	E_x	E_{05x}	F_{by}	$F_{c\perp y}$	F_{vy}	F_{vy}	E_y	E_{05y}	F_t	F_c	E	E_{05}
		ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
E-Rated Western Species																		
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
16F-E1	WW/WW	4.07	2.03	0.53[l]	0.53[l]	0.405[p,t]	1300[u]	1100[u]	2.67	0.53	0.360[p,t]	0.185[p,t]	1200[u]	1100[u]	1.96	2.22	1200[u]	1100[u]
16F-E2[n]	HF/HF	4.07	2.03	1.04[m]	1.04[m]	0.445	1400	1200	3.18	0.78	0.390	0.200	1300	1100	2.23	2.88	1300	1100
16F-E3	DF/DF	4.07	2.03	1.35	1.35	0.545	1600	1400	3.68	1.17	0.475	0.245	1500	1300	2.63	3.84	1500	1300
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
16F-E6	DF/DF	4.07	4.07	1.35	1.35	0.545	1600	1400	3.81	1.17	0.475	0.245	1500	1300	2.70	3.84	1500	1300
16F-E7	HF/HF	4.07	4.07	1.04[m]	1.04[m]	0.445	1400	1200	3.18	0.78	0.390	0.200	1300	1100	2.30	2.76	1300	1100
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
20F-E1	WW/WW	5.08	2.54	0.53[l]	0.53[l]	0.405[p,t]	1600[u]	1400[u]	2.80	0.53	0.360[p,t]	0.185[p,t]	1300[u]	1100[u]	2.16	2.52	1300[u]	1100[u]
20F-E2[n]	HF/HF	5.08	2.54	1.04[m]	1.04[m]	0.445	1600	1400	3.56	0.78	0.390	0.200	1400	1200	2.52	3.72	1400	1200
20F-E3	DF/DF	5.08	2.54	1.35	1.35	0.545	1700	1500	3.94	1.17	0.475	0.245	1600	1400	2.84	3.96	1600	1400
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
20F-E6	DF/DF	5.08	5.08	1.35	1.35	0.545	1700	1500	4.07	1.17	0.475	0.245	1600	1400	3.11	3.96	1600	1400
20F-E7[n]	HF/HF	5.08	5.08	1.04[m]	1.04[m]	0.445	1600	1400	3.81	0.78	0.390	0.200	1400	1200	2.84	3.72	1400	1200
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
24F-E1	DF/DF	6.10	3.05	1.35	1.35	0.545	1800	1600	3.94	1.17	0.475	0.245	1600	1400	2.97	3.84	1600	1400
24F-E2[n]	HF/HF	6.10	3.05	1.04[m]	1.04[m]	0.445	1700	1500	3.30	0.78	0.390	0.200	1500	1300	2.30	3.36	1500	1300
24F-E3	DF/HF	6.10	3.05	1.35	1.04[m]	0.445	1800	1600	3.81	0.78	0.390	0.200	1500	1300	2.84	3.72	1500	1300
24F-E4	DF/DF	6.10	3.05	1.35	1.35	0.545	1800	1600	4.19	1.17	0.475	0.245	1700	1500	2.97	4.08	1700	1500
24F-E5	DF/DF	6.10	3.05	1.35	1.35	0.545	1800	1600	4.19	1.17	0.475	0.245	1600	1400	2.97	3.72	1600	1400
24F-E6[n]	HF/WW	6.10	3.05	1.04[m]	1.04[m]	0.405[p,t]	1800[u]	1600[u]	2.80	0.53	0.375[p,t]	0.185[p,t]	1400[u]	1200[u]	2.03	3.00	1400[u]	1200[u]
24F-E14	DF/DF	6.10	3.05	1.35	1.35	0.545	1800	1600	3.68	1.17	0.475	0.245	1600	1400	2.57	3.84	1600	1400
24F-E15	HF/HF	6.10	3.05	1.04	1.04	0.445	1800	1600	3.30	0.78	0.390	0.200	1500	1300	2.57	2.88	1500	1300
The following combinations are BALANCED and are intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
24F-E10	DF/DF	6.10	6.10	1.35	1.35	0.545	1900	1700	4.70	1.17	0.475	0.245	1700	1500	3.51	4.20	1700	1500
24F-E11[n]	HF/HF	6.10	6.10	1.04[m]	1.04[m]	0.445	1800	1600	4.07	0.78	0.390	0.200	1500	1300	3.11	3.72	1500	1300
24F-E13	DF/DF	6.10	6.10	1.35	1.35	0.545	1800	1600	4.96	1.17	0.475	0.245	1700	1500	3.38	4.08	1700	1500
24F-E17	HF/WW	6.10	6.10	1.04[m]	1.04[m]	0.405[p,t]	1800[u]	1600[u]	2.80	0.53	0.375[p,t]	0.185[p,t]	1400[u]	1200[u]	2.03	3.00	1400[u]	1200[u]
24F-E18	DF/DF	6.10	6.10	1.35	1.35	0.545	1800	1600	3.68	1.17	0.475	0.245	1600	1400	2.57	3.84	1600	1400
24F-E20	CSP/CSP	6.10	6.10	1.17	1.17	0.460	1600	1400	2.92	0.73	0.390	0.175	1500	1300	2.30	4.32	1500	1300
Wet Service Factor[b]		0.8	0.8	0.53	0.53	0.875	0.833	0.833	0.8	0.53	0.875	0.875	0.833	0.833	0.8	0.73	0.833	0.833

Table 3.1 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Bending[a,b] (Cont.)

Combination Symbol[c]	Species-Outer/Core Lams[d]	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Extreme Fiber in Bending: Tension Zone Stressed in Tension[e,s] F_{bx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Extreme Fiber in Bending: Compr. Zone Stressed in Tension[f] F_{bx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Compr. ⊥ to Grain: Tension Face $F_{c\perp x}$ ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Compr. ⊥ to Grain: Compr. Face $F_{c\perp x}$ ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Shear Parallel to Grain (Horiz.) F_{vx} ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Modulus of Elasticity: Mean E_x ksi	Bending about X-X Axis: Loaded Perpendicular to Wide Faces of Laminations: Modulus of Elasticity: Fifth %-ile E_{05x} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Extreme Fiber in Bending[p] F_{by} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Compr. ⊥ to Grain $F_{c\perp y}$ ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Shear Parallel to Grain (Horizontal): Shear Parallel to Grain (Horiz.) F_{vy} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Shear Parallel to Grain (Horizontal): (multiple lams without edge glue)[r] F_{vy} ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Modulus of Elasticity: Mean E_y ksi	Bending about Y-Y Axis: Loaded Parallel to Wide Faces of Laminations: Modulus of Elasticity: Fifth %-ile E_{05y} ksi	Axially Loaded: Tension Parallel to Grain F_t ksi	Axially Loaded: Compr. Parallel to Grain F_c ksi	Axially Loaded: Modulus of Elasticity: Mean E ksi	Axially Loaded: Modulus of Elasticity: Fifth %-ile E_{05} ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Visually Graded Southern Pine																		
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
16F-V2	SP/SP	4.07	2.03	1.17[g,h]	1.17[g]	0.575	1400	1200	4.07	1.17	0.505	0.260	1400	1200	2.70	3.72	1400	1200
16F-V3	SP/SP	4.07	2.03	1.35	1.35	0.575	1400	1200	3.68	1.17	0.505	0.260	1300	1100	2.63	3.48	1300	1100
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
16F-V5	SP/SP	4.07	4.07	1.17[g,h]	1.17[g,h]	0.575	1400	1200	4.07	1.17	0.505	0.260	1400	1200	2.70	3.72	1400	1200
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
20F-V2	SP/SP	5.08	2.54	1.35	1.17[g]	0.575	1600	1400	3.68	1.17	0.505	0.260	1400	1200	2.84	3.72	1400	1200
20F-V3	SP/SP	5.08	2.54	1.17[g,h]	1.17[g]	0.575	1400	1200	4.07	1.17	0.505	0.260	1400	1200	2.70	3.60	1400	1200
The following combination is NOT BALANCED and is intended for straight or slightly cambered members for dry use and industrial appearance[j].																		
20F-V4	SP/SP	5.08	2.54	1.35	1.17[g]	0.260[o]	1500	1300	2.80	0.98	0.430	0.215	1300	1100	1.96	2.28	1300	1100
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
20F-V5	SP/SP	5.08	5.08	1.35	1.35	0.575	1600	1400	3.68	1.17	0.505	0.260	1400	1200	2.84	3.72	1400	1200
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
22F-V1	SP/SP	5.59	2.80	1.35	1.35	0.575	1600	1400	4.07	1.17	0.505	0.260	1500	1300	2.84	3.96	1500	1300
22F-V2	SP/SP	5.59	2.80	1.17[g,h]	1.17[g]	0.575	1400	1200	4.07	1.17	0.505	0.260	1400	1200	2.70	3.60	1400	1200
22F-V3	SP/SP	5.59	2.80	1.35	1.17[g]	0.575	1600	1400	3.81	1.17	0.505	0.260	1400	1200	2.84	3.60	1400	1200
The following combination is NOT BALANCED and is intended for straight or slightly cambered members for dry use and industrial appearance.																		
22F-V4	SP/SP	5.59	2.80	1.35	1.17[g]	0.260[o]	1600	1400	3.18	0.98	0.445	0.230	1400	1200	2.23	2.40	1400	1200
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
22F-V5	SP/SP	5.59	5.59	1.35	1.35	0.575	1600	1400	4.07	1.17	0.505	0.260	1500	1300	2.84	3.84	1500	1300
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
24F-V1	SP/SP	6.10	3.05	1.35	1.17[g]	0.575	1700	1500	3.81	1.17	0.505	0.260	1500	1300	2.97	3.24	1500	1300
24F-V3	SP/SP	6.10	3.05	1.35	1.35	0.575	1800	1600	4.07	1.17	0.505	0.260	1600	1400	3.11	4.08	1600	1400
The following combination is NOT BALANCED and is intended for straight or slightly cambered members for dry use and industrial appearance[j].																		
24F-V4	SP/SP	6.10	3.05	1.35	1.17[g]	0.260[o]	1700	1500	3.18	0.98	0.445	0.230	1400	1200	2.30	2.52	1400	1200
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
24F-V5	SP/SP	6.10	6.10	1.35	1.35	0.575	1700	1500	4.07	1.17	0.505	0.260	1500	1300	3.11	4.08	1500	1300
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
26F-V1	SP/SP	6.61	3.30	1.35	1.35	0.575	1800	1600	4.83	1.17	0.505	0.260	1600	1400	3.11	3.84	1600	1400
26F-V2	SP/SP	6.61	3.30	1.35	1.35	0.575	1900	1700	5.59	1.35	0.505	0.260	1800	1600	3.24	3.96	1800	1600
26F-V3	SP/SP	6.61	3.30	1.35	1.35	0.575	1900	1700	5.34	1.17	0.505	0.260	1800	1600	3.11	3.84	1800	1600
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
26F-V4	SP/SP	6.61	6.61	1.35	1.35	0.575	1900	1700	5.34	1.17	0.505	0.260	1800	1600	3.11	3.84	1800	1600
Wet Service Factor[b]		0.8	0.8	0.53	0.53	0.875	0.833	0.833	0.8	0.53	0.875	0.875	0.833	0.833	0.8	0.73	0.833	0.833

Table 3.1 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Bending[a,b] (Cont.)

Combination Symbol[c]	Species-Outer/Core Lams[d]	Bending about X-X Axis							Bending about Y-Y Axis						Axially Loaded			
		Loaded Perpendicular to Wide Faces of Laminations							Loaded Parallel to Wide Faces of Laminations									
		Extreme Fiber in Bending		Compr. ⊥ to Grain		Shear Parallel to Grain (Horiz.)	Modulus of Elasticity		Extreme Fiber in Bending[p]	Compr. ⊥ to Grain	Shear Parallel to Grain (Horizontal)		Modulus of Elasticity		Tension Parallel to Grain	Compr. Parallel to Grain	Modulus of Elasticity	
		Tension Zone Stressed in Tension[e,s]	Compr. Zone Stressed in Tension[f]	Tension Face	Compr. Face		Mean	Fifth %-ile			Shear Parallel to Grain (Horiz.)	(multiple lams without edge glue)[r]	Mean	Fifth %-ile			Mean	Fifth %-ile
		F_{bx}	F_{bx}	$F_{c\perp x}$	$F_{c\perp x}$	F_{vx}	E_x	E_{05x}	F_{by}	$F_{c\perp y}$	F_{vy}	F_{vy}	E_y	E_{05y}	F_t	F_c	E	E_{05}
		ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
E-Rated Southern Pine																		
The following combinations is NOT BALANCED and is intended primarily for simple-span applications.																		
16F-E1	SP/SP	4.07	2.03	1.35	1.35	0.575	1600	1400	3.94	1.17	0.505	0.260	1500	1300	2.84	3.84	1500	1300
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
16F-E3	SP/SP	4.07	4.07	1.35	1.35	0.575	1600	1400	4.32	1.17	0.505	0.260	1500	1300	2.97	3.96	1500	1300
The following combinations is NOT BALANCED and is intended primarily for simple-span applications.																		
20F-E1	SP/SP	5.08	2.54	1.35	1.35	0.575	1700	1500	4.07	1.17	0.505	0.260	1500	1300	2.84	3.84	1500	1300
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
20F-E3	SP/SP	5.08	5.08	1.35	1.35	0.575	1700	1500	4.57	1.17	0.505	0.260	1500	1300	3.11	4.08	1500	1300
The following combinations is NOT BALANCED and is intended primarily for simple-span applications.																		
22F-E1	SP/SP	5.59	2.80	1.35	1.35	0.575	1700	1500	4.07	1.17	0.505	0.260	1500	1300	2.84	3.96	1500	1300
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
22F-E3	SP/SP	5.59	5.59	1.35	1.35	0.575	1700	1500	4.45	1.17	0.505	0.260	1500	1300	3.11	3.96	1500	1300
The following combinations are NOT BALANCED and are intended primarily for simple-span applications.																		
24F-E1	SP/SP	6.10	3.05	1.35	1.35	0.575	1800	1600	4.07	1.17	0.505	0.260	1600	1400	2.97	4.20	1600	1400
24F-E2	SP/SP	6.10	3.05	1.35	1.35	0.575	1900	1700	4.32	1.17	0.505	0.260	1600	1400	3.11	4.08	1600	1400
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
24F-E4	SP/SP	6.10	6.10	1.35	1.35	0.575	1800	1600	5.08	1.17	0.505	0.260	1600	1400	3.38	4.20	1600	1400
The following combinations is NOT BALANCED and is intended primarily for simple-span applications.																		
28F-E1	SP/SP	7.12	3.56	1.35	1.35	0.575	2000	1800	4.07	1.17	0.505	0.260	1700	1500	3.51	4.44	1700	1500
The following combination is BALANCED and is intended for members continuous or cantilevered over supports and provide equal capacity in both positive and negative bending.																		
28F-E2	SP/SP	7.12	7.12	1.35	1.35	0.575	2000	1800	4.07	1.17	0.505	0.260	1700	1500	3.51	4.44	1700	1500
The following combination is NOT BALANCED, is only for nominal widths, 6 in. or less, and is intended primarily for simple-span applications.																		
30F-E1	SP/SP	7.62	3.81	1.35	1.35	0.575	2000	1800	4.45	1.17	0.505	0.260	1700	1500	3.38	4.20	1700	1500
The following combination is BALANCED, is only for nominal widths, 6 in. or less, and is intended primarily for simple-span applications.																		
30F-E2	SP/SP	7.62	7.62	1.35	1.35	0.575	2000	1800	4.45	1.17	0.505	0.260	1700	1500	3.38	4.20	1700	1500
Wet Service Factor[b]		0.8	0.8	0.53	0.53	0.875	0.833	0.833	0.8	0.53	0.875	0.875	0.833	0.833	0.8	0.73	0.833	0.833

Table 3.1 Footnotes

(This table is converted from AITC 117-93, courtesy of the American Institute of Timber Construction.)

[a] 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. Design values are tabulated, however, 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 3.2. For members of 2 or 3 laminations, see Table 3.2.

[b] 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 end of the table.

[c] The combination symbols relate to a specific combination of grades and species in AITC 117-Manufacturing that will provide the design values shown for the combination. The first two numbers in the combination symbol correspond to the design value in bending shown in Column 3. The letter in the combination symbol (either a "V" or an "E") indicates whether the combination is made from visually graded (V) or E-rated (E) lumber in the outer zones.

[d] The symbols used for species are DF = Douglas Fir-Larch, DFS = Douglas Fir South, HF = Hem-Fir, WW = Softwood Species, ES = Eastern Spruce, AC = Alaska Cedar, CSP = Canadian Spruce-Pine, and SP = Southern Pine. (N3 refers to No. 3 structural joists and planks or structural light framing grade.) Softwood Species (WW) and Eastern Spruce are included in the general category of Western species although Eastern Spruce and some Softwood Species are produced in other areas.

[e] The tabulated design values in bending are based on members 5-1/8 in. wide by 12 in. deep by 21 ft long uniformly loaded and used for a simple span. For larger members, these values must be multiplied by a volume factor, C_v.

[f] Design values in this column are for extreme fiber stress in bending when the member is loaded such that the compression zone laminations are subjected to tensile stresses. The values in this column may be increased 0.51 ksi where end joint spacing restrictions are applied to the compression zone when stressed in tension.

[g] Where specified, this value may be increased to 1.35 ksi by providing in the bearing area at least one dense 2 in. nominal thickness lamination of Douglas Fir-Larch for Western species combinations, or Southern Pine for Southern Pine combinations. These dense laminations must be backed by a medium grain lamination of the same species.

[h] For bending members greater than 15 in. in depth, the design value for compression stress perpendicular to grain is 1.35 ksi on the tension face.

[i] Where specified, this value may be increased by providing at least two 2 in. nominal thickness Douglas Fir-Larch laminations in the bearing area. The compression perpendicular to grain design values for Douglas Fir-Larch are 1.17 ksi for medium grain and 1.35 ksi for dense.

[j] These combinations are for dry conditions of use only because they may contain wane. They are recommended for industrial appearance grade and for straight or slightly cambered members only. If wane is omitted these restrictions do not apply.

[k] Where specified, this value may be increased to 0.405 ksi for Softwood Species (WW) and to 0.445 ksi for Hem-Fir by prohibiting wane on both sides of the member; or to 0.330 psi for Softwood Species (WW) and to 0.375 ksi for Hem-Fir by prohibiting wane on one side of the member.

[l] The compression perpendicular to grain design value of 0.53 ksi is based on the lowest strength species of the Softwood Species (WW) group. If at lease one two 2 in. nominal thickness lamination of E-rated Hem-Fir with the same E value, or E-rated Douglas Fir-Larch 200 ksi higher in modulus of elasticity (E) than that specified is used in the bearing area on the face of the member subjected to the compression perpendicular to grain stress. $F_{c\perp}$ may be increased to 0.78 ksi. If at lease two 2 in. nominal thickness laminations of E-rated Hem-Fir with the same E value, or E-rated Douglas Fir-Larch 200 ksi higher in modulus of elasticity than that specified are used in the bearing area on the face of the member subjected to the compression perpendicular to grain stress, $F_{c\perp}$ may be increase to 1.04 ksi.

[m] Where specified, this value may be increased to 1.35 ksi by providing in the bearing area at lease one 2 in. nominal thickness lamination of Douglas Fir-Larch for Western species combinations, or one 2 in. nominal thickness lamination of Southern Pine for Southern Pine combinations having a modulus of elasticity (E) value 200 ksi higher than the E value specified.

[n] E-rated Douglas Fir-Larch 200 ksi higher in modulus of elasticity may be substituted for the specified E-rated Hem-Fir.

[o] Where specified, this value may be increased to 0.405 ksi either by prohibiting coarse grain material or by prohibiting wane on both sides of the member; to 0.475 ksi by prohibiting both coarse grain material and wane on one side of the member or to 0.575 ksi by prohibiting both coarse grain material and wane on both sides of the member.

[p] Footnote (e) to Table 3.2 also applies.

[q] Where Douglas Fir South is used in place of all of the Softwood Species (WW) laminations required in western species combinations 16F-V1, 16F-V4, 20F-V1, 22F-V1, 24F-V1, 16F-E1, 20F-E1, and 24F-E6 the design value for shear parallel to grain (horizontal) is the same as for combinations using all Douglas Fir-Larch. (F_{vx} = 0.545 ksi and F_{vy} = 0.475 ksi.)

[r] These values for shear parallel to grain (horizontal), 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 F_{vy} values in column 12 apply. For members with 5, 7 or 9 laminations, the values in column 13 shall be reduced by 20%. Unbonded edge joints occurring in adjacent laminations shall be at least 1-1/2 inches apart.

[s] The design valued in bending about the X-X axis (F_{bx}) in this column for bending members hall be multiplied by 0.75 when the member greater than 15 in. in depth is manufactured without the required special tension lamination(s) and 0.85 for members up to 15 in. in depth.

[t] The following species may be used for Softwood Species (WW) provided the design values in shear parallel to grain (horizontal) in Column 7 (F_{vx}) and in Column 12 (F_{vy}) are reduced by 0.03 ksi and the design values in shear parallel to grain (horizontal) in Column 13 (F_{vy}) are reduced by 0.015 ksi: Coast Sitka Spruce, Coast Species, Eastern White Pine (North) and Western White Pine.

[u] The following may be used for Softwood Species (WW) provided the design values in modulus of elasticity (E_x and E_y) in Columns 8, 14, and 18 are reduced by 100 ksi and the 5th percentile values (E_{05x} and E_{05y}) be accordingly reduced based on the provisions given in ASCE 16-95: Western Cedars, Western Cedars (North), White Woods (Western Woods) and California Redwood - open grain.

Table 3.2 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Axial Loading[a,b]

Combination Symbol	Species[c]	Grade[d]	Modulus of Elasticity		Compr. ⊥ to Grain	Axially Loaded			Bending about Y-Y Axis							Bending about X-X Axis		
						Tension Parallel to Grain	Compr. Parallel to Grain		Loaded Parallel to Wide Faces of Laminations							Loaded Perpendicular to Wide Faces of Laminations		
									Extreme Fiber in Bending[e]			Shear Parallel to Grain (Horizontal)				Extreme Fiber in Bending[g]		Shear Para. to Grain[f]
			Mean	Fifth %-ile		2 or More Lams	4 or More Lams	2 or 3 Lams	4 or More Lams	3 Lams	2 Lams	4 or More Lams (multiple piece lams)[l]	4 or More Lams	3 Lams	2 Lams	2 Lams to 15 in. Deep[h]	4 or More Lams[i,o]	2 or More Lams
			E	E_{05}	$F_{c\perp}$	F_t	F_c	F_c	F_{by}	F_{by}	F_{by}	F_{vy}	F_{vy}	F_{vy}	F_{vy}	F_{bx}	F_{bx}	F_{vx}
			ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Visually Graded Western Species																		
1	DF	L3	1500	1300	1.17[j]	2.43	3.72	2.88	3.68	3.18	2.54	0.245	0.475	0.460	0.420	3.18	3.81	0.545
2	DF	L2	1700	1500	1.17[j]	3.38	4.56	3.84	4.57	4.07	3.30	0.245	0.475	0.460	0.420	4.32	5.08	0.545
3	DF	L2D	1800	1600	1.35	3.92	5.52	4.44	5.34	4.70	3.94	0.245	0.475	0.460	0.420	5.08	5.84	0.545
4	DF	L1CL	1900	1700	1.23[j]	3.78	5.04	4.56	5.59	5.08	4.19	0.245	0.475	0.460	0.420	4.83	5.59	0.545
5	DF	L1	2000	1800	1.35	4.32	5.76	5.04	6.10	5.34	4.57	0.245	0.475	0.460	0.420	5.59	6.10	0.545
14	HF	L3	1300	1100	0.78[j]	2.16	2.64	2.34	3.05	2.67	2.16	0.200	0.390	0.375	0.330	2.80	3.30	0.445
15	HF	L2	1400	1200	0.78[j]	2.84	3.24	3.12	3.81	3.43	2.80	0.200	0.390	0.375	0.330	3.68	4.32	0.445
16	HF	L1	1600	1400	0.78[j]	3.24	3.60	3.48	4.45	3.94	3.30	0.200	0.390	0.375	0.330	4.07	4.83	0.445
17	HF	L1D	1700	1500	1.04	3.78	4.20	4.08	5.08	4.70	3.94	0.200	0.390	0.375	0.330	4.83	5.59	0.445
22	WW	L3	1000	900	0.53[m]	1.42	2.04	1.62	2.03[n]	1.78	1.40	0.175	0.345	0.330	0.300	1.84	2.16	0.405
69	AC	L3	1300	1100	0.98	1.89	2.76	2.76	2.54	2.22	1.78	0.230	0.475	0.460	0.405	2.54	2.92	0.545
70	AC	L2	1400	1200	0.98	2.70	3.48	3.72	3.18	2.80	2.35	0.230	0.475	0.460	0.405	3.43	3.94	0.545
71	AC	L1D	1700	1500	1.17	3.38	4.56	4.92	4.19	3.81	3.18	0.230	0.475	0.460	0.405	4.32	5.08	0.545
72	AC	L1S	1700	1500	1.17	3.38	4.56	4.92	4.19	3.81	3.18	0.230	0.475	0.460	0.405	4.32	5.08	0.545
E-Rated Western Species																		
27	DF	1.9E-2	1800	1600	1.35	2.43	4.20	2.88	3.68	3.18	2.54	0.245	0.475	0.460	0.420	3.18	3.81	0.545
28	DF	2.1E-2	2000	1800	1.35	2.97	4.80	3.36	3.68	3.18	2.54	0.245	0.475	0.460	0.420	3.81	4.45	0.545
29	DF	2.3E-2	2200	1900	1.35	3.38	5.52	3.72	4.19	3.56	2.92	0.245	0.475	0.460	0.420	4.32	5.08	0.545
30	DF	1.9E-6	1800	1600	1.35	4.19	5.04	4.08	6.10	6.10	5.34	0.245	0.475	0.460	0.420	4.57	5.34	0.545
31	DF	2.1E-6	2000	1800	1.35	4.86	5.76	4.56	6.10	6.10	6.10	0.245	0.475	0.460	0.420	5.34	6.10	0.545
32	DF	2.3E-6	2200	1900	1.35	4.86	5.76	5.04	6.10	6.10	6.10	0.245	0.475	0.460	0.420	5.84	6.10	0.545
62	DF	2.2E-2	2100	1800	1.35	3.11	5.28	3.60	3.94	3.43	2.80	0.245	0.475	0.460	0.420	4.07	4.83	0.545
63	DF	2.2E-6	2100	1800	1.35	4.86	5.76	4.80	6.10	6.10	6.10	0.245	0.475	0.460	0.420	5.59	6.10	0.545
33	HF	1.6E-2	1500	1300	1.04	2.16	2.52	2.28	3.05	2.67	2.16	0.200	0.390	0.375	0.330	2.80	3.30	0.445
34	HF	1.9E-2	1800	1500	1.04	2.43	3.12	2.88	3.68	3.18	2.54	0.200	0.390	0.375	0.330	3.18	3.81	0.445
35	HF	2.1E-2	2000	1800	1.04	2.97	3.72	3.36	3.68	3.18	2.54	0.200	0.390	0.375	0.330	3.81	4.45	0.445
36	HF	1.6E-4	1500	1300	1.04	3.24	3.48	3.12	5.34	4.83	4.32	0.200	0.390	0.375	0.330	3.56	4.19	0.445
37	HF	1.9E-6	1800	1600	1.04	4.19	4.68	4.08	6.10	6.10	5.34	0.200	0.390	0.375	0.330	4.57	5.34	0.445
38	HF	2.1E-6	2000	1800	1.04	4.86	5.76	4.56	6.10	6.10	6.10	0.200	0.390	0.375	0.330	5.34	6.10	0.445
39	WW	1.6E-2	1500	1300	0.53	2.16	2.88	2.28	3.05	2.67	2.16	0.175	0.345	0.330	0.300	2.80	3.30	0.405
40	WW	1.9E-2	1800	1600	0.53	2.43	3.60	2.88	3.68	3.18	2.54	0.175	0.345	0.330	0.300	3.18	3.81	0.405
41	WW	2.1E-2	2000	1800	0.53	2.97	4.20	3.36	3.68	3.18	2.54	0.175	0.345	0.330	0.300	3.81	4.45	0.405
42	WW	1.6E-4	1500	1300	0.53	3.24	3.72	3.12	5.34	4.83	4.32	0.175	0.345	0.330	0.300	3.56	4.19	0.405
43	WW	1.9E-6	1800	1600	0.53	4.19	4.68	4.08	6.10	6.10	5.34	0.175	0.345	0.330	0.300	4.57	5.34	0.405
44	WW	2.1E-6	2000	1800	0.53	4.86	5.28	4.56	6.10	6.10	6.10	0.175	0.345	0.330	0.300	5.34	6.10	0.405
Wet Service Factor[b]			0.833	0.833	0.53	0.8	0.73	0.73	0.8	0.8	0.8	0.875	0.875	0.875	0.875	0.8	0.8	0.875

Table 3.2 Reference Strength and Modulus of Elasticity for Glued Laminated Timber Used Primarily in Axial Loading[a,b] (Cont.)

						Axially Loaded			Bending about Y-Y Axis							Bending about X-X Axis		
									Loaded Parallel to Wide Faces of Laminations							Loaded Perpendicular to Wide Faces of Laminations		
			Modulus of Elasticity						Extreme Fiber in Bending[e]			Shear Parallel to Grain (Horizontal)				Extreme Fiber in Bending[g]		Shear Para. to Grain[f]
Combination Symbol	Species[c]	Grade[d]	Mean	Fifth %-ile	Compr. ⊥ to Grain	Tension Parallel to Grain	Compr. Parallel to Grain					4 or More Lams (multiple piece lams)[l]				2 Lams to 15 in. Deep[h]	4 or More Lams[i,o]	2 or More Lams
			2 or More Lams	4 or More Lams	2 or 3 Lams	4 or More Lams	3 Lams	2 Lams	4 or More Lams	3 Lams	2 Lams		4 or More Lams	3 Lams	2 Lams			
			E	E_{05}	$F_{c\perp}$	F_t	F_c	F_c	F_{by}	F_{by}	F_{by}	F_{vy}	F_{vy}	F_{vy}	F_{vy}	F_{bx}	F_{bx}	F_{vx}
			ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi	ksi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Visually Graded Southern Pine																		
47	SP	N2M[k]	1400	1200	1.17[j]	3.24	4.56	2.76	4.45	3.94	3.30	0.260	0.505	0.475	0.430	3.56	4.07	0.575
48	SP	N2D[k]	1700	1500	1.35	3.78	5.28	3.24	5.08	4.57	3.81	0.260	0.505	0.475	0.430	4.07	4.83	0.575
49	SP	N1M[k]	1700	1500	1.17[j]	3.65	5.04	3.48	4.96	4.45	3.81	0.260	0.505	0.475	0.430	4.57	5.34	0.575
50	SP	N1D[k]	1900	1700	1.35	4.19	5.52	4.08	5.84	5.34	4.45	0.260	0.505	0.475	0.430	5.34	6.10	0.575
E-Rated Southern Pine																		
53	SP	1.9E-2	1800	1600	1.35	2.43	4.56	2.88	3.68	3.18	2.54	0.260	0.505	0.475	0.430	3.18	3.81	0.575
54	SP	2.1E-2	2000	1800	1.35	2.97	5.52	3.36	3.68	3.18	2.54	0.260	0.505	0.475	0.430	3.81	4.45	0.575
55	SP	2.3E-2	2200	1900	1.35	3.38	5.76	3.72	4.19	3.56	2.92	0.260	0.505	0.475	0.430	4.32	5.08	0.575
56	SP	1.9E-6	1800	1600	1.35	4.19	4.44	4.08	6.10	6.10	5.34	0.260	0.505	0.475	0.430	4.57	5.34	0.575
57	SP	2.1E-6	2000	1800	1.35	4.86	5.76	4.56	6.10	6.10	6.10	0.260	0.505	0.475	0.430	5.34	6.10	0.575
58	SP	2.3E-6	2200	1900	1.35	4.86	5.76	5.04	6.10	6.10	6.10	0.260	0.505	0.475	0.430	5.84	6.10	0.575
Wet Service Factor[b]			0.833	0.833	0.53	0.8	0.73	0.73	0.8	0.8	0.8	0.875	0.875	0.875	0.875	0.8	0.8	0.875

Table 3.2 Footnotes

(This table is converted from AITC 117-93, courtesy of the American Institute of Timber Construction.)

[a] 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 3.1 are usually better suited for this condition of loading. The design values for bending about the X-X axis (F_{bx}) shown in Column 17 are for members from 2 laminations to 15 in. deep without tension laminations. Design values approximately 15% higher for members with 4 or more laminations are shown in Column 18. These higher design values, however, require special tension laminations which may not be readily available.

[b] The tabulated design values are for dry conditions of use. To obtain wet-use design values, multiple the tabulated values by the factors shown at the end of the table.

[c] The symbols used for species are DF = Douglas Fir-Larch, DFS = Douglas Fir South, HF = Hem-Fir, WW = Softwood Species, ES = Eastern Spruce, AC = Alaska Cedar, and SP = Southern Pine.

[d] Grade designations are as follows:

Visually Graded Western species
- L1 is L1 laminating grade (dense for Douglas Fir-Larch and Douglas Fir South).
- L1D is L1 dense laminating grade for Hem-Fir and Alaska Cedar.
- L1CL is L1 close grain laminating grade.
- L1S is a special grade of Alaska Cedar
- L2D is L2 laminating grade (dense).
- L2 is L2 laminating grade (medium grain).
- L3 is L3 laminating grade (medium grain for Douglas Fir-Larch, Douglas Fir South and Hem-Fir

Visually Graded Southern Pine
- SSD is dense select structural, structural joists and planks, or structural light framing grade (dense).
- SSM is select structural, structural joists and planks, or structural light framing grade (medium grain).
- N1D is No. 1 dense select structural, structural joists and planks, or structural light framing grade or No. 1 boards graded as dense.
- N1M is No. 1 structural, structural joists and planks, or structural light framing grade or No. 1 boards all with a medium grain rate of growth.
- N2D is No. 2 dense structural joists and planks, or structural light framing grade or No. 2 boards graded as dense.
- N2M is No. 2 structural joists and planks, or structural light framing grade or No. 2 boards all with a medium grain rate of growth.
- N3M is No. 3 structural joists and planks, or structural light framing grade or No. 3 boards all with a medium grain rate of growth.
- N3C is No. 3 structural joists and planks, or structural light framing grade or No. 3 boards all with a coarse grain rate of growth.

E-Rated Grades — All Species (Except Eastern Spruce)
- 2.3E-6 has 1/6 edge characteristic with 2.3E.
- 2.2E-6 has 1/6 edge characteristic with 2.2E.
- 2.1E-6 has 1/6 edge characteristic with 2.1E.
- 1.9E-6 has 1/6 edge characteristic with 1.9E.
- 1.6E-4 has 1/4 edge characteristic with 1.6E.
- 2.3E-2, 2.2E-2, 2.1E-2, 1.9E-2, 1.6E-2 are E rated grades with edge characteristics occupying up to 1/2 of cross section.

Softwood species and eastern Spruce are included in the general category of Western Species although Eastern Spruce and some Softwood Species are produced in other areas.

[e] 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 following flat use factor, C_{fu}, for glued laminated timber:

Depth, in.		Multiplying Factor
Western Species	Southern Pine	
10-3/4	10-1/2	1.01
8-3/4	8-1/2	1.04
6-3/4	6-3/4	1.07
5-1/8	5 or 5-1/8	1.10
3-1/8	3 or 3-1/8	1.16

[f] The design values in shear parallel to grain (horizontal) contained in this table are based on members without wane.

[g] The tabulated design values in bending about the X-X axis in this table are applicable to members 12 in. deep, 5-1/8 in. wide, 21 ft long, uniformly loaded and used for a simple span. For members greater than 12 in. in depth, the requirements of 4.4.2 apply.

[h] The design values are for members of from 2 laminations to 15 in. in depth without tension laminations.

[i] The design values are for members of 4 or more laminations in depth and require special tension laminations. When these values are used in design and the member is specified by combination symbol, the designer should also specify the required design value in bending.

[j] When tension laminations are used to obtain the design value for F_{bx} shown in Column 17, the compression perpendicular to grin value, F_{c}^, for the tension face may be increased to 1.35 ksi for Douglas Fir-Larch, Douglas Fir South and Southern Pine, and to 1.04 ksi for Hem-Fir because the tension laminations are required to be dense.

[k] Combinations 47, 48, 49 and 50 have more restrictive slope of grain requirements than the basic slope of grain of the grades of lumber used in order to obtain higher tension parallel to grain values and design values in bending when loaded perpendicular to the wide faces of the laminations. The slopes of grain used to calculate the design values in Table 3.2 were: Combination 47, 1:14; Combination 48, 1:14; Combination 49, 1:16; and Combination 50, 1:14. When design stresses are lower than the design values shown, or when a less restrictive slope of grain provides the same design value, a less restrictive slope of grain may be used. The following table gives the design values of these combinations for various slopes of grain: Values of F_{bx} in Column 5 are for members of 2 laminations to 15 in. depth without tension laminations and values in Column 6 are for members of 4 or more laminations with tension laminations.

Slope of Grain	Com. Symbol	F_t ksi	F_c ksi	F_c ksi	F_{bx} ksi	F_{bx} ksi	F_{by} ksi	F_{by} ksi	F_{by} ksi
		2 or more lams	2 or 3 lams	4 or more lams	2 lams to 15 in.	4 or more lams	2 lams	3 lams	4 or more lams
1		2	3	4	5	6	7	8	9
1:12	47	3.24	2.76	4.56	3.56	4.07	3.30	3.94	4.45
	48	3.78	3.24	5.28	4.07	4.83	3.81	4.57	5.08
	49	3.51	3.48	4.56	4.45	5.34	3.81	4.45	4.96
	50	4.19	4.08	5.28	5.34	6.10	4.45	5.34	5.84
1:10	47	3.11	2.76	4.08	3.56	4.07	3.30	3.94	4.45
	48	3.65	3.24	4.80	4.07	4.83	3.81	4.57	5.08
	49	3.11	3.48	4.08	3.94	4.70	3.81	4.45	4.70
	50	3.65	4.08	4.80	4.57	5.34	4.45	5.34	5.34
1:8	47	2.97	2.76	3.60	3.43	4.07	3.30	3.94	4.07
	48	3.11	3.24	4.20	4.07	4.70	3.81	4.57	4.70
	49	--	--	--	--	--	--	--	--
	50	--	--	--	--	--	--	--	--

[l] These values for shear parallel to grain (horizontal), 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 F_{vy} values in columns 14, 15 and 16 apply. For members with 5, 7 or 9 laminations, the values in column 13 shall be reduced by 20%. Unbonded edge joints occurring in adjacent laminations shall be at least 1-1/2 inches apart.

(Continued on next page)

Table 3.2 Footnotes (Cont.)

(This table is converted from AITC 117-93, courtesy of the American Institute of Timber Construction.)

[m] The following may be used for Softwood Species (WW) provided the modulus of elasticity (E) is reduced by 100 ksi and the 5th percentile values (E_{05}) be accordingly reduced based on the provisions given in ASCE 16-95: Western Cedars, Western Cedars (North), White Woods (Western Woods) and California Redwood - open grain.

[n] The following may be used for Softwood Species (WW) provided the design values in shear parallel to grain (horizontal) in Column 13 (F_{vy}) are reduced by 0.015 ksi and the design values in shear parallel to grain (horizontal) in Columns 14, 15 and 16 (F_{vy}) and in Column 19 (F_{vx}) are reduced by 0.03 ksi: Coast Sitka Spruce, Coast Species, Western White Pine and Eastern White Pine.

[o] 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 Column 17.

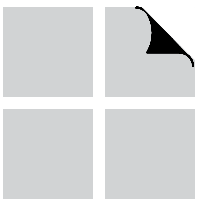
Table 3.3 Reference Strength and Modulus of Elasticity for Glued Laminated Timber with Tapered Cuts on Compression Face

Comb. Symbol	Ref. Strength, ksi F_{bx} [(a)]	Ref. Strength, ksi $F_{c\perp x}$	E_x [(a)], ksi Mean	E_x [(a)], ksi 5th %-ile
Visually Graded Western Species				
16F-V1	3.43	0.53	1300	1100
16F-V2	4.07	0.78	1300	1100
16F-V3	4.07	1.17	1500	1300
16F-V4	2.16	0.53	1300	1100
16F-V6	4.07	1.17	1500	1300
16F-V7	4.07	0.78	1300	1100
20F-V1	3.56	0.53	1300	1100
20F-V2	4.83	0.78	1500	1300
20F-V3	5.08	1.17	1600	1400
20F-V7	5.08	1.17	1600	1400
20F-V8	5.08	1.17	1600	1400
20F-V9	4.83	0.78	1500	1300
20F-V10	4.96	0.78	1500	1300
20F-V12	4.70	0.98	1500	1300
22F-V1	3.56	0.53	1300	1100
22F-V3	5.59	1.17	1700	1500
22F-V8	5.59	1.17	1700	1500
22F-V10	4.83	1.04	1500	1300
24F-V1	3.68	0.53	1300	1100
24F-V2	4.83	0.78	1500	1300
24F-V4	5.59	1.17	1700	1500
24F-V5	5.34	0.78	1600	1400
24F-V8	5.59	1.17	1700	1500
24F-V10	5.08	0.78	1600	1400
24F-V11	5.34	1.04	1500	1300
E-Rated Western Species				
16F-E1	3.56	0.53	1300	1100
16F-E2	3.81	0.78	1300	1100
16F-E3	2.16	1.17	1600	1400
16F-E6	3.81	1.17	1600	1400
16F-E7	3.81	0.78	1300	1100
20F-E1	3.56	0.53	1300	1100
20F-E2	4.83	0.78	1500	1300
20F-E3	5.08	1.17	1600	1400
20F-E6	5.08	1.17	1600	1400
20F-E7	4.70	0.78	1500	1300
24F-E1	5.84	1.17	1800	1600
24F-E2	5.08	0.78	1600	1400
24F-E3	5.08	0.78	1600	1400
24F-E4	5.84	1.17	1700	1500
24F-E5	5.84	1.17	1800	1600
24F-E6	3.68	0.53	1300	1100
24F-E10	5.84	1.17	1800	1600
24F-E11	5.08	0.78	1600	1400
24F-E13	5.84	1.17	1700	1500
24F-E14	5.84	1.17	1800	1600
24F-E15	4.57	0.78	1500	1300
24F-E17	3.56	0.53	1300	1100
24F-E18	5.34	1.17	1700	1500
24F-E20	4.57	0.73	1500	1300
Visually Graded Southern Pine				
16F-V2	3.81	1.17	1400	1200
16F-V3	3.94	1.17	1400	1200
16F-V5	3.81	1.17	1400	1200
20F-V2	4.07	1.17	1500	1300
20F-V3	5.08	1.17	1400	1200
20F-V4	2.92	0.98	1400	1200
20F-V5	3.94	1.17	1500	1300
22F-V1	5.34	1.17	1500	1300
22F-V2	5.34	1.17	1400	1200
22F-V3	4.07	1.17	1500	1300
22F-V4	3.05	0.98	1500	1300
22F-V5	5.34	1.17	1500	1300
24F-V1	4.19	1.17	1600	1400
24F-V3	5.84	1.17	1600	1400
24F-V4	3.05	0.98	1500	1300
24F-V5	5.84	1.17	1600	1400
26F-V1	5.84	1.17	1600	1400
26F-V2	6.10	1.35	1800	1600
26F-V3	6.10	1.17	1800	1600
26F-V4	6.10	1.17	1800	1600
E-Rated Southern Pine				
16F-E1	4.07	1.17	1600	1400
16F-E3	4.07	1.17	1600	1400
20F-E1	5.08	1.17	1600	1400
20F-E3	5.08	1.17	1600	1400
22F-E1	5.59	1.17	1700	1500
22F-E3	5.34	1.17	1600	1400
24F-E1	5.59	1.17	1700	1500
24F-E2	6.10	1.17	1700	1500
24F-E4	5.59	1.17	1700	1500
28F-E1	6.61	1.17	1800	1600
28F-E2	6.61	1.17	1800	1600
30F-E1	6.61	1.17	1800	1600
30F-E2	6.61	1.17	1800	1600

[(a)] Values are applicable to members that have up to one-half the depth on the compression side removed by taper cutting. Values are for dry conditions of use and 12 in. or less in depth.

Table 3.4 Reference Radial Tensile Strength, F_{rt}

Species	Wind and Earthquake, ksi	Other Loadings, ksi
Alaska Cedar	0.181	0.043
California Redwood	0.121	0.121
Canadian Spruce Pine	0.153	0.043
Douglas Fir-Larch	0.158	0.043
Douglas Fir-South	0.158	0.043
Eastern Spruce	0.138	0.043
Hem-Fir	0.150	0.043
Softwood Species	0.135	0.043
Southern Pine	0.193	0.193



DESIGN ADJUSTMENT FACTORS

4

4.1 General

The adjustment factors provided in this section are for non-reference end use conditions and material modification effects. These factors shall be used to modify the reference strength, F, or the factored reference resistance, ϕR, as well as the reference elastic modulus, E, or the reference stiffnesses, EI (or $E_{05}I$), and EA when one or more of the specific end use or material modification conditions fall outside the limits of the reference conditions defined in Chapter 2.5 of AF&PA/ASCE 16-95.

4.2 Wet Service Factor, C_M

The reference strength, F, and factored reference resistance, ϕR, values provided in this Supplement are applicable to dry use conditions of glued laminated timber (maximum equilibrium moisture content of 16%) and its connections. When glued laminated timber members are exposed to wet service conditions, the adjustment factors provided in Table 4.1 shall be applied.

Table 4.1 Wet Service Factor for Glued Laminated Timber, C_M

M	V	T	P	$P_\perp$	P_g	EI, $E_{05}I$, EA
0.80	0.875	0.80	0.73	0.53	0.57	0.833

4.3 Temperature Factor, C_t

End use conditions other than those defined in Section 2.5(b) of AF&PA/ASCE 16-95 require the use of the temperature factor, C_t. This factor is applied for a sustained elevated temperature ranging from 100 to 150°F. When the equilibrium moisture content of a glued laminated timber member exceeds the reference condition limitation during sustained elevated temperature exposure, both the temperature and wet service (moisture) factors shall be applied. When the equilibrium moisture content of a glued laminated timber falls within the limits of the reference conditions during sustained exposure to elevated temperatures, only the temperature factor shall be applied. The temperature factor is given in Table 4.2.

Table 4.2 Temperature Factor for Glued Laminated Timber Exposed To Sustained Elevated Temperature, C_t

Resistance	End Use Condition	Permanent Temperature °F	
		100<°F≤125	125<°F≤150
EI, $E_{05}I$, EA, T	Dry or Wet	0.9	0.9
Other Properties and Connections	Dry	0.8	0.7
	Wet	0.7	0.5

4.4 Preservative Treatment Factor, C_{pt}

Whenever practical, the moisture content of permanent structural wood members should be kept below 20%. If this is not feasible then preservative treatment shall be required unless the heartwood of a naturally decay resistant species such as Redwood and Cedar is used.

Most preservative chemicals used today do not significantly alter the strength properties of structural wood products. However, the method of pre-conditioning and post-conditioning, as well as the treatment method itself, may significantly weaken the wood. For some preservative treatment methods with strict manufacturing control, as listed in Table 4.3, the effect on strength degradation can be eliminated (C_{pt} = 1.0).

Table 4.3 Preservative Treatment Effect on Glued Laminated Timber

No adjustment to R is required when glued laminated timber is preservative-treated using the following American Wood Preservers' Association Standards (C_{pt} = 1.0)	
Designation	Title
C1-88	All Timber Products - Preservative Treatment by Pressure Processes
C14-89	Wood For Highway Construction - Preservative Treatment by Pressure Processes
C15-88	Wood for Commercial - Residential Construction - Preservative Treatment by Pressure Processes
C28-93	Standard for Preservative Treatment of Structural Glued Laminated Members and Laminations Before Gluing of Southern Pine, Pacific Coast Douglas-fir, Hem Fir, and Western Hemlock by Pressure Processes

4.5 Fire Retardant Treatment Factor, C_{rt}

The adjustment factor for fire retardant treatments shall be applied to the reference resistance of wood products treated with pressure impregnated fire-retardants. However, the glued laminated timber industry has no recommendation on the use of fire-retardant treatments with glued laminated timber and therefore, AF&PA/ASCE 16-95 does not provide specific adjustment factors for fire-retardants used in conjunction with glued laminated timber.

4.6 Beam Stability Factor, C_L

The reference bending strength of glued laminated timber shall be adjusted by the beam stability factor, C_L. Refer to Section 5.2 of AF&PA/ASCE 16-95 for the determination of an appropriate beam stability factor, which is not accumulative with the volume factor, C_v, given in Section 4.7 of this Supplement.

4.7 Column Stability Factor, C_P

The reference value for compression parallel to grain of glued laminated timber is affected by the dimensions and modulus of elasticity. Refer to Section 4.3 of AF&PA/ASCE 16-95 for the determination of an appropriate column stability factor

4.8 Volume Factor, C_V

The reference bending strength of glued laminated timber is affected by geometry and size. Generally, larger sizes have a correspondingly lower reference bending strength than smaller members. To account for this behavior, a volume factor, C_V, which is the product of loading condition coefficient, K_L, width, C_{gb}, depth, C_{gd}, and length, C_{gl}, factors shall be applied. C_V shall not exceed 1.0 and is computed as follows:

$$C_V = K_L C_{gb} C_{gd} C_{gl} \leq 1.0 \quad [4.1]$$

where:

K_L = loading condition coefficient shown in Table 4.4,

$$C_{gb} = \left(\frac{b_1}{b_2}\right)^p;\ C_{gd} = \left(\frac{d_1}{d_2}\right)^q;\ C_{gl} = \left(\frac{\ell_1}{\ell_2}\right)^r$$

b_1 = 5-1/8 inches,

b_2 = width of bending member being checked in inches. For multiple piece width layups, b_2 = width of widest piece in the layup. Thus, b_2 £ 10.75 in.,

d_1 = 12 inches,

d_2 = depth of bending member being checked in inches,

ℓ_1 = 21 feet,

ℓ_2 = length of bending member being checked between points of zero moment in feet, and

p, q, r = as defined in Table 4.5.

Table 4.4 Loading Condition Coefficients, K_L

Simple Span Beam	K_L
Concentrated load at midspan	1.09
Uniformly distributed load	1.00
Two equal concentrated loads at 1/3 points of span	0.96
Continuous or Cantilever Beam	**K_L**
All loading conditions	1.00

Table 4.5 provides the exponent values and reference dimensions for use with reference bending strength or reference bending resistance. Separate exponent values are given for Western species and for Southern Pine. No volume adjustment is required for properties other than reference bending strength or reference bending resistance. Tables 4.7 and 4.8 gives C_V values for Western species and Southern Pine glued laminated timbers, respectively, assuming the loading condition coefficient is equal to 1.0.

Table 4.5 Exponents for Volume Factor Equation

Exponent Symbol	Exponent	
	Western Species	Southern Pine
p	0.10	0.05
q	0.10	0.05
r	0.10	0.05

4.9 Curvature Factor, C_c

The curvature factor, C_c, is used to adjust the reference bending strengths and resistances of curved glued laminated timber members only. It takes into account the difference in extreme outer fiber stress between a curved member and a straight prismatic member, as well as any residual stresses that may remain in a lamination that has been bent to the stated curvature. However, the curvature factor, C_c, shall not be applied to reference bending strengths or resistances in the straight portion of a member, regardless of curvature in other portions. Also, this factor is not applicable to cambered glued laminated timber members or in the design of pitched and tapered curved glued laminated timber members. The curvature factor, C_c, shall be calculated in accordance with the following equation:

$$C_c = 1 - 2000\left(\frac{t}{R}\right)^2 \qquad [4.2]$$

where:

t = thickness of lamination in inches,

R = radius of curvature of inside face of lamination in inches,

$t/R \leq 1/100$ for hardwoods and Southern Pine, and

$t/R \leq 1/125$ for other species.

4.10 Flat Use Factor, C_{fu}

The reference bending strength or resistance of glued laminated timber shall be adjusted by the flat use factor, C_{fu}, when loaded in bending parallel to wide faces of the laminations (the y-y axis). The reference bending strengths in the parallel to wide faces of the laminations, F_{by}, as given in Tables 3.1 and 3.2 of this Supplement, are based on members with laminations 12 in. wide. For members with laminations less than 12 in. wide, the tabulated F_{by} values shall be adjusted by a flat use factor, C_{fu}, as listed in Table 4.6. When the width of the laminations is greater than 12 in., as may occur in members with multiple-piece laminations, C_{fu} shall be obtained by use of the equation given in footnote (a) of Table 4.6.

Table 4.6 Flat Use Factor[(a)], C_{fu}

Member Dimensions Parallel to Wide Faces of Laminations	C_{fu}
10-3/4 or 10-1/2	1.01
8-3/4 or 8-1/2	1.04
6-3/4	1.07
5-1/8 or 5	1.10
3-1/8 or 3	1.16
2-1/2	1.19

[(a)] Values for C_{fu} are rounded values from the equation $(12/d)^{1/9}$ where d is the dimension of the wide faces of the laminations.

Table 4.7 Volume Factor[a] for Bending about X-X Axis *Western Species* Glued Laminated Timber

Depth	C_V when Span (ft) is										
d (in.)	8	12	16	20	24	28	32	36	40	44	48
2-1/2 in. Width											
6	1.000	1.000	--	--	--	--	--	--	--	--	--
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-1/2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.996	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	1.000	0.998	0.986	0.976	--	--
18	1.000	1.000	1.000	1.000	1.000	1.000	0.989	0.978	0.967	0.958	--
19-1/2	1.000	1.000	1.000	1.000	1.000	0.994	0.981	0.970	0.960	0.951	0.942
21	1.000	1.000	1.000	1.000	1.000	0.987	0.974	0.963	0.953	0.944	0.935
3 in. Width											
6	1.000	1.000	--	--	--	--	--	--	--	--	--
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-1/2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--
15	1.000	1.000	1.000	1.000	1.000	1.000	0.989	0.978	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	0.993	0.980	0.968	0.958	--	--
18	1.000	1.000	1.000	1.000	1.000	0.984	0.971	0.960	0.950	0.941	--
19-1/2	1.000	1.000	1.000	1.000	0.992	0.977	0.964	0.952	0.942	0.933	0.925
21	1.000	1.000	1.000	1.000	0.984	0.969	0.956	0.945	0.935	0.926	0.918
22-1/2	1.000	1.000	1.000	0.996	0.978	0.963	0.950	0.939	0.929	0.920	0.912
24	1.000	1.000	1.000	0.989	0.971	0.956	0.944	0.933	0.923	0.914	0.906
3-1/8 in. Width											
6	1.000	1.000	--	--	--	--	--	--	--	--	--
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-1/2	1.000	1.000	1.000	1.000	1.000	1.000	0.996	--	--	--	--
15	1.000	1.000	1.000	1.000	1.000	0.998	0.985	0.974	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	0.989	0.976	0.964	0.954	--	--
18	1.000	1.000	1.000	1.000	0.996	0.980	0.967	0.956	0.946	0.937	--
19-1/2	1.000	1.000	1.000	1.000	0.988	0.973	0.960	0.948	0.938	0.930	0.922
21	1.000	1.000	1.000	0.998	0.980	0.965	0.953	0.941	0.932	0.923	0.915
22-1/2	1.000	1.000	1.000	0.992	0.974	0.959	0.946	0.935	0.925	0.916	0.908
24	1.000	1.000	1.000	0.985	0.967	0.953	0.940	0.929	0.919	0.910	0.903

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.7 Volume Factor[a] for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	8	12	16	20	24	28	32	36	40	44	48
5 in. Width											
6	1.000	1.000	--	--	--	--	--	--	--	--	--
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12	1.000	1.000	1.000	1.000	0.989	0.974	--	--	--	--	--
13-1/2	1.000	1.000	1.000	0.996	0.978	0.963	0.950	--	--	--	--
15	1.000	1.000	1.000	0.985	0.967	0.953	0.940	0.929	--	--	--
16-1/2	1.000	1.000	0.998	0.976	0.958	0.944	0.931	0.920	0.910	--	--
18	1.000	1.000	0.989	0.967	0.950	0.935	0.923	0.912	0.903	0.894	--
19-1/2	1.000	1.000	0.981	0.960	0.942	0.928	0.916	0.905	0.895	0.887	0.879
21	1.000	1.000	0.974	0.953	0.935	0.921	0.909	0.898	0.889	0.880	0.873
22-1/2	1.000	0.996	0.967	0.946	0.929	0.915	0.903	0.892	0.883	0.874	0.867
24	1.000	0.989	0.961	0.940	0.923	0.909	0.897	0.886	0.877	0.869	0.861
25-1/2	1.000	0.983	0.955	0.934	0.917	0.903	0.891	0.881	0.872	0.863	0.856
27	1.000	0.978	0.950	0.929	0.912	0.898	0.886	0.876	0.867	0.858	0.851
28-1/2	1.000	0.972	0.945	0.924	0.907	0.893	0.881	0.871	0.862	0.854	0.846
30	1.000	0.967	0.940	0.919	0.903	0.889	0.877	0.867	0.858	0.849	0.842
31-1/2	1.000	0.963	0.935	0.915	0.898	0.884	0.873	0.862	0.853	0.845	0.838
33	0.998	0.958	0.931	0.910	0.894	0.880	0.869	0.858	0.849	0.841	0.834
34-1/2	0.993	0.954	0.927	0.906	0.890	0.876	0.865	0.855	0.846	0.838	0.830
36	0.989	0.950	0.923	0.903	0.886	0.873	0.861	0.851	0.842	0.834	0.827
5-1/8 in. Width											
6	1.000	1.000	--	--	--	--	--	--	--	--	--
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12	1.000	1.000	1.000	1.000	0.987	0.972	--	--	--	--	--
13-1/2	1.000	1.000	1.000	0.993	0.975	0.960	0.948	--	--	--	--
15	1.000	1.000	1.000	0.983	0.965	0.950	0.938	0.927	--	--	--
16-1/2	1.000	1.000	0.995	0.973	0.956	0.941	0.929	0.918	0.908	--	--
18	1.000	1.000	0.987	0.965	0.948	0.933	0.921	0.910	0.900	0.892	--
19-1/2	1.000	1.000	0.979	0.957	0.940	0.926	0.913	0.903	0.893	0.885	0.877
21	1.000	1.000	0.972	0.950	0.933	0.919	0.907	0.896	0.887	0.878	0.871
22-1/2	1.000	0.993	0.965	0.944	0.927	0.912	0.900	0.890	0.880	0.872	0.865
24	1.000	0.987	0.959	0.938	0.921	0.907	0.895	0.884	0.875	0.867	0.859
25-1/2	1.000	0.981	0.953	0.932	0.915	0.901	0.889	0.879	0.870	0.861	0.854
27	1.000	0.975	0.948	0.927	0.910	0.896	0.884	0.874	0.865	0.856	0.849
28-1/2	1.000	0.970	0.942	0.922	0.905	0.891	0.879	0.869	0.860	0.852	0.844
30	1.000	0.965	0.938	0.917	0.900	0.887	0.875	0.865	0.856	0.847	0.840
31-1/2	1.000	0.960	0.933	0.912	0.896	0.882	0.871	0.860	0.851	0.843	0.836
33	0.995	0.956	0.929	0.908	0.892	0.878	0.867	0.856	0.847	0.839	0.832
34-1/2	0.991	0.952	0.925	0.904	0.888	0.874	0.863	0.853	0.844	0.836	0.828
36	0.987	0.948	0.921	0.900	0.884	0.871	0.859	0.849	0.840	0.832	0.825

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.7 Volume Factor[a] for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	10	14	18	22	26	30	34	38	42	46	50
6-3/4 in. Width											
7-1/2	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9	1.000	1.000	1.000	0.997	--	--	--	--	--	--	--
10-1/2	1.000	1.000	1.000	0.981	0.965	--	--	--	--	--	--
12	1.000	1.000	0.988	0.968	0.952	0.939	--	--	--	--	--
13-1/2	1.000	1.000	0.976	0.957	0.941	0.928	--	--	--	--	--
15	1.000	0.991	0.966	0.947	0.931	0.918	0.907	--	--	--	--
16-1/2	1.000	0.981	0.957	0.938	0.922	0.909	0.898	0.888	--	--	--
18	1.000	0.973	0.949	0.930	0.914	0.901	0.890	0.880	0.872	--	--
19-1/2	0.998	0.965	0.941	0.922	0.907	0.894	0.883	0.873	0.865	0.857	--
21	0.991	0.958	0.934	0.916	0.900	0.888	0.877	0.867	0.858	0.851	0.843
22-1/2	0.984	0.951	0.928	0.909	0.894	0.882	0.871	0.861	0.852	0.845	0.838
24	0.978	0.945	0.922	0.903	0.889	0.876	0.865	0.855	0.847	0.839	0.832
25-1/2	0.972	0.940	0.916	0.898	0.883	0.871	0.860	0.850	0.842	0.834	0.827
27	0.966	0.934	0.911	0.893	0.878	0.866	0.855	0.845	0.837	0.829	0.823
28-1/2	0.961	0.929	0.906	0.888	0.873	0.861	0.850	0.841	0.832	0.825	0.818
30	0.956	0.924	0.901	0.884	0.869	0.857	0.846	0.837	0.828	0.821	0.814
31-1/2	0.951	0.920	0.897	0.879	0.865	0.852	0.842	0.832	0.824	0.817	0.810
33	0.947	0.916	0.893	0.875	0.861	0.848	0.838	0.829	0.820	0.813	0.806
34-1/2	0.943	0.912	0.889	0.871	0.857	0.845	0.834	0.825	0.817	0.809	0.803
36	0.939	0.908	0.885	0.868	0.853	0.841	0.831	0.821	0.813	0.806	0.799
37-1/2	0.935	0.904	0.882	0.864	0.850	0.838	0.827	0.818	0.810	0.803	0.796
39	0.931	0.900	0.878	0.861	0.846	0.834	0.824	0.815	0.807	0.799	0.793
40-1/2	0.928	0.897	0.875	0.857	0.843	0.831	0.821	0.812	0.804	0.796	0.790
42	0.924	0.894	0.872	0.854	0.840	0.828	0.818	0.809	0.801	0.794	0.787
43-1/2	0.921	0.891	0.869	0.851	0.837	0.825	0.815	0.806	0.798	0.791	0.784
45	0.918	0.888	0.866	0.848	0.834	0.823	0.812	0.803	0.795	0.788	0.782
46-1/2	0.915	0.885	0.863	0.846	0.832	0.820	0.810	0.801	0.793	0.786	0.779
48	0.912	0.882	0.860	0.843	0.829	0.817	0.807	0.798	0.790	0.783	0.777
49-1/2	0.909	0.879	0.857	0.840	0.826	0.815	0.805	0.796	0.788	0.781	0.774
51	0.907	0.877	0.855	0.838	0.824	0.812	0.802	0.793	0.785	0.778	0.772
52-1/2	0.904	0.874	0.852	0.835	0.822	0.810	0.800	0.791	0.783	0.776	0.770
54	0.901	0.872	0.850	0.833	0.819	0.808	0.798	0.789	0.781	0.774	0.767
55-1/2	0.899	0.869	0.848	0.831	0.817	0.805	0.795	0.787	0.779	0.772	0.765
57	0.897	0.867	0.845	0.829	0.815	0.803	0.793	0.785	0.777	0.770	0.763
58-1/2	0.894	0.865	0.843	0.826	0.813	0.801	0.791	0.783	0.775	0.768	0.761
60	0.892	0.862	0.841	0.824	0.811	0.799	0.789	0.781	0.773	0.766	0.759

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.7 Volume Factor[(a)] for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	10	14	18	22	26	30	34	38	42	46	50
8-3/4 in. Width											
9	1.000	1.000	0.991	0.971	--	--	--	--	--	--	--
10-1/2	1.000	1.000	0.976	0.956	0.940	--	--	--	--	--	--
12	1.000	0.987	0.963	0.944	0.928	0.915	--	--	--	--	--
13-1/2	1.000	0.976	0.951	0.932	0.917	0.904	--	--	--	--	--
15	0.998	0.965	0.941	0.923	0.907	0.895	0.883	--	--	--	--
16-1/2	0.989	0.956	0.932	0.914	0.899	0.886	0.875	0.865	--	--	--
18	0.980	0.948	0.924	0.906	0.891	0.878	0.867	0.858	0.849	--	--
19-1/2	0.973	0.940	0.917	0.899	0.884	0.871	0.861	0.851	0.843	0.835	--
21	0.965	0.933	0.910	0.892	0.877	0.865	0.854	0.845	0.836	0.829	0.822
22-1/2	0.959	0.927	0.904	0.886	0.871	0.859	0.848	0.839	0.831	0.823	0.816
24	0.953	0.921	0.898	0.880	0.866	0.853	0.843	0.834	0.825	0.818	0.811
25-1/2	0.947	0.915	0.893	0.875	0.861	0.848	0.838	0.828	0.820	0.813	0.806
27	0.941	0.910	0.888	0.870	0.856	0.843	0.833	0.824	0.816	0.808	0.801
28-1/2	0.936	0.905	0.883	0.865	0.851	0.839	0.828	0.819	0.811	0.804	0.797
30	0.932	0.901	0.878	0.861	0.847	0.835	0.824	0.815	0.807	0.800	0.793
31-1/2	0.927	0.896	0.874	0.857	0.843	0.831	0.820	0.811	0.803	0.796	0.789
33	0.923	0.892	0.870	0.853	0.839	0.827	0.816	0.807	0.799	0.792	0.786
34-1/2	0.919	0.888	0.866	0.849	0.835	0.823	0.813	0.804	0.796	0.789	0.782
36	0.915	0.884	0.862	0.845	0.831	0.820	0.809	0.800	0.792	0.785	0.779
37-1/2	0.911	0.881	0.859	0.842	0.828	0.816	0.806	0.797	0.789	0.782	0.776
39	0.907	0.877	0.856	0.839	0.825	0.813	0.803	0.794	0.786	0.779	0.773
40-1/2	0.904	0.874	0.852	0.835	0.822	0.810	0.800	0.791	0.783	0.776	0.770
42	0.901	0.871	0.849	0.832	0.819	0.807	0.797	0.788	0.780	0.773	0.767
43-1/2	0.898	0.868	0.846	0.830	0.816	0.804	0.794	0.785	0.778	0.771	0.764
45	0.895	0.865	0.843	0.827	0.813	0.801	0.791	0.783	0.775	0.768	0.762
46-1/2	0.892	0.862	0.841	0.824	0.810	0.799	0.789	0.780	0.772	0.765	0.759
48	0.889	0.859	0.838	0.821	0.808	0.796	0.786	0.778	0.770	0.763	0.757
49-1/2	0.886	0.857	0.835	0.819	0.805	0.794	0.784	0.775	0.768	0.761	0.754
51	0.883	0.854	0.833	0.816	0.803	0.791	0.782	0.773	0.765	0.758	0.752
52-1/2	0.881	0.852	0.831	0.814	0.801	0.789	0.779	0.771	0.763	0.756	0.750
54	0.878	0.849	0.828	0.812	0.798	0.787	0.777	0.769	0.761	0.754	0.748
55-1/2	0.876	0.847	0.826	0.810	0.796	0.785	0.775	0.766	0.759	0.752	0.746
57	0.874	0.845	0.824	0.807	0.794	0.783	0.773	0.764	0.757	0.750	0.744
58-1/2	0.871	0.843	0.822	0.805	0.792	0.781	0.771	0.762	0.755	0.748	0.742
60	0.869	0.840	0.820	0.803	0.790	0.779	0.769	0.761	0.753	0.746	0.740

[(a)]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.7 Volume Factor[a] for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	12	16	20	24	28	32	36	40	44	48	52
10-3/4 in. Width											
12	0.982	0.954	0.933	0.916	0.902	--	--	--	--	--	--
13-1/2	0.971	0.943	0.922	0.906	0.892	0.880	--	--	--	--	--
15	0.960	0.933	0.913	0.896	0.882	0.871	0.860	--	--	--	--
16-1/2	0.951	0.924	0.904	0.888	0.874	0.862	0.852	0.843	--	--	--
18	0.943	0.916	0.896	0.880	0.866	0.855	0.845	0.836	0.828	--	--
19-1/2	0.936	0.909	0.889	0.873	0.860	0.848	0.838	0.829	0.822	0.814	--
21	0.929	0.902	0.882	0.866	0.853	0.842	0.832	0.823	0.815	0.808	0.802
22-1/2	0.922	0.896	0.876	0.860	0.847	0.836	0.826	0.818	0.810	0.803	0.796
24	0.916	0.890	0.871	0.855	0.842	0.831	0.821	0.812	0.805	0.798	0.791
25-1/2	0.911	0.885	0.865	0.850	0.837	0.826	0.816	0.807	0.800	0.793	0.787
27	0.906	0.880	0.860	0.845	0.832	0.821	0.811	0.803	0.795	0.788	0.782
28-1/2	0.901	0.875	0.856	0.840	0.828	0.817	0.807	0.799	0.791	0.784	0.778
30	0.896	0.871	0.851	0.836	0.823	0.812	0.803	0.794	0.787	0.780	0.774
31-1/2	0.892	0.866	0.847	0.832	0.819	0.808	0.799	0.791	0.783	0.776	0.770
33	0.888	0.862	0.843	0.828	0.815	0.805	0.795	0.787	0.779	0.773	0.767
34-1/2	0.884	0.859	0.840	0.824	0.812	0.801	0.792	0.783	0.776	0.769	0.763
36	0.880	0.855	0.836	0.821	0.808	0.798	0.788	0.780	0.773	0.766	0.760
37-1/2	0.876	0.851	0.833	0.818	0.805	0.794	0.785	0.777	0.770	0.763	0.757
39	0.873	0.848	0.829	0.814	0.802	0.791	0.782	0.774	0.767	0.760	0.754
40-1/2	0.870	0.845	0.826	0.811	0.799	0.788	0.779	0.771	0.764	0.757	0.751
42	0.866	0.842	0.823	0.808	0.796	0.785	0.776	0.768	0.761	0.754	0.748
43-1/2	0.863	0.839	0.820	0.806	0.793	0.783	0.774	0.765	0.758	0.752	0.746
45	0.860	0.836	0.818	0.803	0.791	0.780	0.771	0.763	0.756	0.749	0.743
46-1/2	0.858	0.833	0.815	0.800	0.788	0.778	0.768	0.760	0.753	0.747	0.741
48	0.855	0.831	0.812	0.798	0.785	0.775	0.766	0.758	0.751	0.744	0.738
49-1/2	0.852	0.828	0.810	0.795	0.783	0.773	0.764	0.756	0.748	0.742	0.736
51	0.850	0.826	0.807	0.793	0.781	0.770	0.761	0.753	0.746	0.740	0.734
52-1/2	0.847	0.823	0.805	0.791	0.778	0.768	0.759	0.751	0.744	0.738	0.732
54	0.845	0.821	0.803	0.788	0.776	0.766	0.757	0.749	0.742	0.736	0.730
55-1/2	0.843	0.819	0.801	0.786	0.774	0.764	0.755	0.747	0.740	0.734	0.728
57	0.840	0.817	0.799	0.784	0.772	0.762	0.753	0.745	0.738	0.732	0.726
58-1/2	0.838	0.814	0.796	0.782	0.770	0.760	0.751	0.743	0.736	0.730	0.724
60	0.836	0.812	0.794	0.780	0.768	0.758	0.749	0.741	0.734	0.728	0.722

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.7 Volume Factor[a] for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	12	16	20	24	28	32	36	40	44	48	52
12-1/4 in. Width											
13-1/2	0.958	0.931	0.910	0.894	0.880	0.868	--	--	--	--	--
15	0.948	0.921	0.901	0.884	0.871	0.859	0.849	--	--	--	--
16-1/2	0.939	0.912	0.892	0.876	0.863	0.851	0.841	0.832	--	--	--
18	0.931	0.904	0.884	0.868	0.855	0.844	0.834	0.825	0.817	--	--
19-1/2	0.923	0.897	0.877	0.862	0.848	0.837	0.827	0.819	0.811	0.804	--
21	0.917	0.891	0.871	0.855	0.842	0.831	0.821	0.813	0.805	0.798	0.792
22-1/2	0.910	0.884	0.865	0.849	0.836	0.825	0.816	0.807	0.799	0.792	0.786
24	0.904	0.879	0.859	0.844	0.831	0.820	0.810	0.802	0.794	0.787	0.781
25-1/2	0.899	0.873	0.854	0.839	0.826	0.815	0.805	0.797	0.789	0.783	0.776
27	0.894	0.868	0.849	0.834	0.821	0.810	0.801	0.792	0.785	0.778	0.772
28-1/2	0.889	0.864	0.845	0.829	0.817	0.806	0.796	0.788	0.781	0.774	0.768
30	0.884	0.859	0.840	0.825	0.813	0.802	0.792	0.784	0.777	0.770	0.764
31-1/2	0.880	0.855	0.836	0.821	0.809	0.798	0.789	0.780	0.773	0.766	0.760
33	0.876	0.851	0.832	0.817	0.805	0.794	0.785	0.777	0.769	0.763	0.757
34-1/2	0.872	0.847	0.829	0.814	0.801	0.791	0.781	0.773	0.766	0.759	0.753
36	0.868	0.844	0.825	0.810	0.798	0.787	0.778	0.770	0.763	0.756	0.750
37-1/2	0.865	0.840	0.822	0.807	0.795	0.784	0.775	0.767	0.760	0.753	0.747
39	0.862	0.837	0.819	0.804	0.792	0.781	0.772	0.764	0.757	0.750	0.744
40-1/2	0.858	0.834	0.816	0.801	0.789	0.778	0.769	0.761	0.754	0.747	0.741
42	0.855	0.831	0.813	0.798	0.786	0.775	0.766	0.758	0.751	0.744	0.739
43-1/2	0.852	0.828	0.810	0.795	0.783	0.773	0.764	0.756	0.748	0.742	0.736
45	0.849	0.825	0.807	0.792	0.780	0.770	0.761	0.753	0.746	0.739	0.733
46-1/2	0.847	0.823	0.804	0.790	0.778	0.767	0.758	0.750	0.743	0.737	0.731
48	0.844	0.820	0.802	0.787	0.775	0.765	0.756	0.748	0.741	0.735	0.729
49-1/2	0.841	0.817	0.799	0.785	0.773	0.763	0.754	0.746	0.739	0.732	0.726
51	0.839	0.815	0.797	0.783	0.771	0.760	0.751	0.744	0.737	0.730	0.724
52-1/2	0.836	0.813	0.795	0.780	0.768	0.758	0.749	0.741	0.734	0.728	0.722
54	0.834	0.810	0.792	0.778	0.766	0.756	0.747	0.739	0.732	0.726	0.720
55-1/2	0.832	0.808	0.790	0.776	0.764	0.754	0.745	0.737	0.730	0.724	0.718
57	0.829	0.806	0.788	0.774	0.762	0.752	0.743	0.735	0.728	0.722	0.716
58-1/2	0.827	0.804	0.786	0.772	0.760	0.750	0.741	0.733	0.726	0.720	0.714
60	0.825	0.802	0.784	0.770	0.758	0.748	0.739	0.732	0.725	0.718	0.713

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.8 Volume Factor[a] for Bending about X-X Axis *Southern Pine* Glued Laminated Timber

Depth	C_V when Span (ft) is										
d (in.)	8	12	16	20	24	28	32	36	40	44	48
2-1/2 in. Width											
5-1/2	1.000	1.000	--	--	--	--	--	--	--	--	--
6-7/8	1.000	1.000	1.000	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
11	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12-3/8	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-3/4	1.000	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--
15-1/8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.997	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.993	0.988	--	--
17-7/8	1.000	1.000	1.000	1.000	1.000	1.000	0.995	0.989	0.984	0.979	--
19-1/4	1.000	1.000	1.000	1.000	1.000	0.998	0.991	0.985	0.980	0.976	0.971
20-5/8	1.000	1.000	1.000	1.000	1.000	0.994	0.988	0.982	0.977	0.972	0.968
22	1.000	1.000	1.000	1.000	0.999	0.991	0.985	0.979	0.974	0.969	0.965
23-3/8	1.000	1.000	1.000	1.000	0.996	0.988	0.982	0.976	0.971	0.966	0.962
3 in. Width											
5-1/2	1.000	1.000	--	--	--	--	--	--	--	--	--
6-7/8	1.000	1.000	1.000	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
11	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12-3/8	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-3/4	1.000	1.000	1.000	1.000	1.000	1.000	0.999	--	--	--	--
15-1/8	1.000	1.000	1.000	1.000	1.000	1.000	0.994	0.988	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	0.996	0.990	0.984	0.979	--	--
17-7/8	1.000	1.000	1.000	1.000	1.000	0.992	0.986	0.980	0.975	0.970	--
19-1/4	1.000	1.000	1.000	1.000	0.996	0.989	0.982	0.976	0.971	0.967	0.963
20-5/8	1.000	1.000	1.000	1.000	0.993	0.985	0.979	0.973	0.968	0.963	0.959
22	1.000	1.000	1.000	0.999	0.990	0.982	0.976	0.970	0.965	0.960	0.956
23-3/8	1.000	1.000	1.000	0.996	0.987	0.979	0.973	0.967	0.962	0.957	0.953
3-1/8 in. Width											
5-1/2	1.000	1.000	--	--	--	--	--	--	--	--	--
6-7/8	1.000	1.000	1.000	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
11	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
12-3/8	1.000	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--
13-3/4	1.000	1.000	1.000	1.000	1.000	1.000	0.997	--	--	--	--
15-1/8	1.000	1.000	1.000	1.000	1.000	0.999	0.992	0.986	--	--	--
16-1/2	1.000	1.000	1.000	1.000	1.000	0.994	0.988	0.982	0.977	--	--
17-7/8	1.000	1.000	1.000	1.000	0.998	0.990	0.984	0.978	0.973	0.968	--
19-1/4	1.000	1.000	1.000	1.000	0.994	0.987	0.980	0.974	0.969	0.965	0.961
20-5/8	1.000	1.000	1.000	1.000	0.991	0.983	0.977	0.971	0.966	0.961	0.957
22	1.000	1.000	1.000	0.997	0.988	0.980	0.974	0.968	0.963	0.958	0.954
23-3/8	1.000	1.000	1.000	0.994	0.985	0.977	0.971	0.965	0.960	0.955	0.951

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.8 Volume Factor[a] for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	8	12	16	20	24	28	32	36	40	44	48
5 in. Width											
6-7/8	1.000	1.000	1.000	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
11	1.000	1.000	1.000	1.000	0.999	--	--	--	--	--	--
12-3/8	1.000	1.000	1.000	1.000	0.993	0.985	--	--	--	--	--
13-3/4	1.000	1.000	1.000	0.997	0.988	0.980	0.974	--	--	--	--
15-1/8	1.000	1.000	1.000	0.992	0.983	0.976	0.969	0.963	--	--	--
16-1/2	1.000	1.000	0.999	0.988	0.979	0.971	0.965	0.959	0.954	--	--
17-7/8	1.000	1.000	0.995	0.984	0.975	0.967	0.961	0.955	0.950	0.946	--
19-1/4	1.000	1.000	0.991	0.980	0.971	0.964	0.957	0.952	0.947	0.942	0.938
20-5/8	1.000	1.000	0.988	0.977	0.968	0.961	0.954	0.949	0.944	0.939	0.935
22	1.000	0.999	0.985	0.974	0.965	0.957	0.951	0.946	0.941	0.936	0.932
23-3/8	1.000	0.996	0.982	0.971	0.962	0.955	0.948	0.943	0.938	0.933	0.929
24-3/4	1.000	0.993	0.979	0.968	0.959	0.952	0.946	0.940	0.935	0.931	0.927
26-1/8	1.000	0.990	0.976	0.965	0.957	0.949	0.943	0.937	0.933	0.928	0.924
27-1/2	1.000	0.988	0.974	0.963	0.954	0.947	0.941	0.935	0.930	0.926	0.922
28-7/8	1.000	0.985	0.971	0.961	0.952	0.945	0.938	0.933	0.928	0.923	0.919
30-1/4	1.000	0.983	0.969	0.958	0.950	0.942	0.936	0.931	0.926	0.921	0.917
31-5/8	1.000	0.981	0.967	0.956	0.948	0.940	0.934	0.929	0.924	0.919	0.915
33	0.999	0.979	0.965	0.954	0.946	0.938	0.932	0.927	0.922	0.917	0.913
34-3/8	0.997	0.977	0.963	0.952	0.944	0.936	0.930	0.925	0.920	0.915	0.911
35-3/4	0.995	0.975	0.961	0.950	0.942	0.935	0.928	0.923	0.918	0.914	0.910
5-1/8 in. Width											
6-7/8	1.000	1.000	1.000	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	1.000	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	1.000	1.000	--	--	--	--	--	--
11	1.000	1.000	1.000	1.000	0.998	--	--	--	--	--	--
12-3/8	1.000	1.000	1.000	1.000	0.992	0.984	--	--	--	--	--
13-3/4	1.000	1.000	1.000	0.996	0.987	0.979	0.973	--	--	--	--
15-1/8	1.000	1.000	1.000	0.991	0.982	0.974	0.968	0.962	--	--	--
16-1/2	1.000	1.000	0.998	0.987	0.978	0.970	0.964	0.958	0.953	--	--
17-7/8	1.000	1.000	0.994	0.983	0.974	0.966	0.960	0.954	0.949	0.945	--
19-1/4	1.000	1.000	0.990	0.979	0.970	0.963	0.956	0.951	0.946	0.941	0.937
20-5/8	1.000	1.000	0.987	0.976	0.967	0.959	0.953	0.947	0.942	0.938	0.934
22	1.000	0.998	0.983	0.973	0.964	0.956	0.950	0.944	0.939	0.935	0.931
23-3/8	1.000	0.995	0.980	0.970	0.961	0.953	0.947	0.941	0.937	0.932	0.928
24-3/4	1.000	0.992	0.978	0.967	0.958	0.951	0.944	0.939	0.934	0.929	0.925
26-1/8	1.000	0.989	0.975	0.964	0.955	0.948	0.942	0.936	0.931	0.927	0.923
27-1/2	1.000	0.987	0.973	0.962	0.953	0.946	0.939	0.934	0.929	0.925	0.921
28-7/8	1.000	0.984	0.970	0.959	0.951	0.943	0.937	0.932	0.927	0.922	0.918
30-1/4	1.000	0.982	0.968	0.957	0.948	0.941	0.935	0.929	0.925	0.920	0.916
31-5/8	1.000	0.980	0.966	0.955	0.946	0.939	0.933	0.927	0.922	0.918	0.914
33	0.998	0.978	0.964	0.953	0.944	0.937	0.931	0.925	0.921	0.916	0.912
34-3/8	0.996	0.976	0.962	0.951	0.942	0.935	0.929	0.924	0.919	0.914	0.910
35-3/4	0.994	0.974	0.960	0.949	0.941	0.933	0.927	0.922	0.917	0.913	0.909

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.8 Volume Factor[a] for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	10	14	18	22	26	30	34	38	42	46	50
6-3/4 in. Width											
6-7/8	1.000	1.000	--	--	--	--	--	--	--	--	--
8-1/4	1.000	1.000	1.000	--	--	--	--	--	--	--	--
9-5/8	1.000	1.000	1.000	0.995	--	--	--	--	--	--	--
11	1.000	1.000	0.998	0.988	0.980	--	--	--	--	--	--
12-3/8	1.000	1.000	0.992	0.983	0.974	0.967	--	--	--	--	--
13-3/4	1.000	1.000	0.987	0.977	0.969	0.962	0.956	--	--	--	--
15-1/8	1.000	0.995	0.983	0.973	0.965	0.958	0.952	--	--	--	--
16-1/2	1.000	0.991	0.978	0.968	0.960	0.954	0.948	0.942	--	--	--
17-7/8	1.000	0.987	0.974	0.965	0.957	0.950	0.944	0.939	0.934	--	--
19-1/4	1.000	0.983	0.971	0.961	0.953	0.946	0.940	0.935	0.930	0.926	--
20-5/8	0.996	0.980	0.967	0.958	0.950	0.943	0.937	0.932	0.927	0.923	0.919
22	0.993	0.976	0.964	0.955	0.947	0.940	0.934	0.929	0.924	0.920	0.916
23-3/8	0.990	0.974	0.961	0.952	0.944	0.937	0.931	0.926	0.921	0.917	0.913
24-3/4	0.987	0.971	0.959	0.949	0.941	0.934	0.929	0.923	0.919	0.915	0.911
26-1/8	0.985	0.968	0.956	0.946	0.939	0.932	0.926	0.921	0.916	0.912	0.908
27-1/2	0.982	0.966	0.954	0.944	0.936	0.930	0.924	0.919	0.914	0.910	0.906
28-7/8	0.980	0.963	0.951	0.942	0.934	0.927	0.921	0.916	0.912	0.908	0.904
30-1/4	0.977	0.961	0.949	0.940	0.932	0.925	0.919	0.914	0.910	0.906	0.902
31-5/8	0.975	0.959	0.947	0.937	0.930	0.923	0.917	0.912	0.908	0.904	0.900
33	0.973	0.957	0.945	0.935	0.928	0.921	0.915	0.910	0.906	0.902	0.898
34-3/8	0.971	0.955	0.943	0.934	0.926	0.919	0.913	0.908	0.904	0.900	0.896
35-3/4	0.969	0.953	0.941	0.932	0.924	0.917	0.912	0.907	0.902	0.898	0.894
37-1/8	0.967	0.951	0.939	0.930	0.922	0.916	0.910	0.905	0.900	0.896	0.893
38-1/2	0.966	0.950	0.938	0.928	0.921	0.914	0.908	0.903	0.899	0.895	0.891
39-7/8	0.964	0.948	0.936	0.927	0.919	0.912	0.907	0.902	0.897	0.893	0.889
41-1/4	0.962	0.946	0.934	0.925	0.917	0.911	0.905	0.900	0.896	0.892	0.888
42-5/8	0.961	0.945	0.933	0.924	0.916	0.909	0.904	0.899	0.894	0.890	0.886
44	0.959	0.943	0.931	0.922	0.914	0.908	0.902	0.897	0.893	0.889	0.885
45-3/8	0.958	0.942	0.930	0.921	0.913	0.907	0.901	0.896	0.891	0.887	0.884
46-3/4	0.956	0.940	0.929	0.919	0.912	0.905	0.900	0.895	0.890	0.886	0.882
48-1/8	0.955	0.939	0.927	0.918	0.910	0.904	0.898	0.893	0.889	0.885	0.881
49-1/2	0.954	0.938	0.926	0.917	0.909	0.903	0.897	0.892	0.888	0.884	0.880
50-7/8	0.952	0.936	0.925	0.915	0.908	0.901	0.896	0.891	0.886	0.882	0.879
52-1/4	0.951	0.935	0.923	0.914	0.907	0.900	0.895	0.890	0.885	0.881	0.877
53-5/8	0.950	0.934	0.922	0.913	0.905	0.899	0.893	0.888	0.884	0.880	0.876
55	0.949	0.933	0.921	0.912	0.904	0.898	0.892	0.887	0.883	0.879	0.875
56-3/8	0.947	0.932	0.920	0.911	0.903	0.897	0.891	0.886	0.882	0.878	0.874
57-3/4	0.946	0.930	0.919	0.910	0.902	0.896	0.890	0.885	0.881	0.877	0.873
59-1/8	0.945	0.929	0.918	0.909	0.901	0.895	0.889	0.884	0.880	0.876	0.872
60-1/2	0.944	0.928	0.917	0.908	0.900	0.894	0.888	0.883	0.879	0.875	0.871

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 4.8 Volume Factor[a] for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	10	14	18	22	26	30	34	38	42	46	50
8-1/2 in. Width											
9-5/8	1.000	1.000	0.993	0.984	--	--	--	--	--	--	--
11	1.000	0.999	0.987	0.977	0.969	--	--	--	--	--	--
12-3/8	1.000	0.993	0.981	0.971	0.963	0.956	--	--	--	--	--
13-3/4	1.000	0.988	0.976	0.966	0.958	0.951	0.945	--	--	--	--
15-1/8	1.000	0.984	0.971	0.962	0.954	0.947	0.941	--	--	--	--
16-1/2	0.996	0.979	0.967	0.957	0.949	0.943	0.937	0.932	--	--	--
17-7/8	0.992	0.975	0.963	0.954	0.946	0.939	0.933	0.928	0.923	--	--
19-1/4	0.988	0.972	0.960	0.950	0.942	0.935	0.930	0.924	0.920	0.916	--
20-5/8	0.985	0.968	0.956	0.947	0.939	0.932	0.926	0.921	0.917	0.912	0.909
22	0.982	0.965	0.953	0.944	0.936	0.929	0.923	0.918	0.914	0.910	0.906
23-3/8	0.979	0.962	0.950	0.941	0.933	0.926	0.921	0.915	0.911	0.907	0.903
24-3/4	0.976	0.960	0.948	0.938	0.930	0.924	0.918	0.913	0.908	0.904	0.900
26-1/8	0.973	0.957	0.945	0.936	0.928	0.921	0.915	0.910	0.906	0.902	0.898
27-1/2	0.971	0.955	0.943	0.933	0.925	0.919	0.913	0.908	0.904	0.899	0.896
28-7/8	0.968	0.952	0.940	0.931	0.923	0.917	0.911	0.906	0.901	0.897	0.894
30-1/4	0.966	0.950	0.938	0.929	0.921	0.915	0.909	0.904	0.899	0.895	0.891
31-5/8	0.964	0.948	0.936	0.927	0.919	0.912	0.907	0.902	0.897	0.893	0.889
33	0.962	0.946	0.934	0.925	0.917	0.911	0.905	0.900	0.895	0.891	0.888
34-3/8	0.960	0.944	0.932	0.923	0.915	0.909	0.903	0.898	0.894	0.889	0.886
35-3/4	0.958	0.942	0.930	0.921	0.913	0.907	0.901	0.896	0.892	0.888	0.884
37-1/8	0.956	0.940	0.929	0.919	0.912	0.905	0.900	0.895	0.890	0.886	0.882
38-1/2	0.955	0.939	0.927	0.918	0.910	0.904	0.898	0.893	0.888	0.884	0.881
39-7/8	0.953	0.937	0.925	0.916	0.908	0.902	0.896	0.891	0.887	0.883	0.879
41-1/4	0.951	0.935	0.924	0.915	0.907	0.900	0.895	0.890	0.885	0.881	0.878
42-5/8	0.950	0.934	0.922	0.913	0.905	0.899	0.893	0.888	0.884	0.880	0.876
44	0.948	0.932	0.921	0.912	0.904	0.898	0.892	0.887	0.883	0.879	0.875
45-3/8	0.947	0.931	0.919	0.910	0.903	0.896	0.891	0.886	0.881	0.877	0.874
46-3/4	0.945	0.930	0.918	0.909	0.901	0.895	0.889	0.884	0.880	0.876	0.872
48-1/8	0.944	0.928	0.917	0.907	0.900	0.894	0.888	0.883	0.879	0.875	0.871
49-1/2	0.943	0.927	0.915	0.906	0.899	0.892	0.887	0.882	0.877	0.873	0.870
50-7/8	0.941	0.926	0.914	0.905	0.897	0.891	0.885	0.881	0.876	0.872	0.869
52-1/4	0.940	0.924	0.913	0.904	0.896	0.890	0.884	0.879	0.875	0.871	0.867
53-5/8	0.939	0.923	0.912	0.903	0.895	0.889	0.883	0.878	0.874	0.870	0.866
55	0.938	0.922	0.911	0.901	0.894	0.888	0.882	0.877	0.873	0.869	0.865
56-3/8	0.937	0.921	0.909	0.900	0.893	0.886	0.881	0.876	0.872	0.868	0.864
57-3/4	0.935	0.920	0.908	0.899	0.892	0.885	0.880	0.875	0.871	0.867	0.863
59-1/8	0.934	0.919	0.907	0.898	0.891	0.884	0.879	0.874	0.870	0.866	0.862
60-1/2	0.933	0.918	0.906	0.897	0.890	0.883	0.878	0.873	0.869	0.865	0.861

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

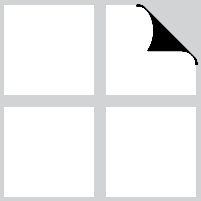
Table 4.8 Volume Factor[a] for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	C_V when Span (ft) is										
d (in.)	12	16	20	24	28	32	36	40	44	48	52
10-1/2 in. Width											
11	0.996	0.982	0.971	0.963	--	--	--	--	--	--	--
12-3/8	0.991	0.976	0.966	0.957	0.950	--	--	--	--	--	--
13-3/4	0.985	0.971	0.961	0.952	0.945	0.938	--	--	--	--	--
15-1/8	0.981	0.967	0.956	0.947	0.940	0.934	0.928	--	--	--	--
16-1/2	0.976	0.963	0.952	0.943	0.936	0.930	0.924	0.919	--	--	--
17-7/8	0.973	0.959	0.948	0.939	0.932	0.926	0.921	0.916	0.911	--	--
19-1/4	0.969	0.955	0.945	0.936	0.929	0.923	0.917	0.912	0.908	0.904	--
20-5/8	0.966	0.952	0.941	0.933	0.926	0.919	0.914	0.909	0.905	0.901	--
22	0.963	0.949	0.938	0.930	0.923	0.916	0.911	0.906	0.902	0.898	0.894
23-3/8	0.960	0.946	0.935	0.927	0.920	0.914	0.908	0.904	0.899	0.895	0.892
24-3/4	0.957	0.943	0.933	0.924	0.917	0.911	0.906	0.901	0.897	0.893	0.889
26-1/8	0.954	0.941	0.930	0.922	0.915	0.909	0.903	0.899	0.894	0.890	0.887
27-1/2	0.952	0.938	0.928	0.919	0.912	0.906	0.901	0.896	0.892	0.888	0.885
28-7/8	0.950	0.936	0.926	0.917	0.910	0.904	0.899	0.894	0.890	0.886	0.882
30-1/4	0.947	0.934	0.923	0.915	0.908	0.902	0.897	0.892	0.888	0.884	0.880
31-5/8	0.945	0.932	0.921	0.913	0.906	0.900	0.895	0.890	0.886	0.882	0.878
33	0.943	0.930	0.919	0.911	0.904	0.898	0.893	0.888	0.884	0.880	0.877
34-3/8	0.941	0.928	0.918	0.909	0.902	0.896	0.891	0.886	0.882	0.878	0.875
35-3/4	0.939	0.926	0.916	0.907	0.900	0.894	0.889	0.885	0.880	0.877	0.873
37-1/8	0.938	0.924	0.914	0.906	0.899	0.893	0.888	0.883	0.879	0.875	0.871
38-1/2	0.936	0.923	0.912	0.904	0.897	0.891	0.886	0.881	0.877	0.873	0.870
39-7/8	0.934	0.921	0.911	0.903	0.896	0.890	0.884	0.880	0.876	0.872	0.868
41-1/4	0.933	0.919	0.909	0.901	0.894	0.888	0.883	0.878	0.874	0.870	0.867
42-5/8	0.931	0.918	0.908	0.900	0.893	0.887	0.881	0.877	0.873	0.869	0.865
44	0.930	0.916	0.906	0.898	0.891	0.885	0.880	0.875	0.871	0.867	0.864
45-3/8	0.928	0.915	0.905	0.897	0.890	0.884	0.879	0.874	0.870	0.866	0.863
46-3/4	0.927	0.914	0.904	0.895	0.888	0.883	0.877	0.873	0.869	0.865	0.861
48-1/8	0.926	0.912	0.902	0.894	0.887	0.881	0.876	0.872	0.867	0.864	0.860
49-1/2	0.924	0.911	0.901	0.893	0.886	0.880	0.875	0.870	0.866	0.862	0.859
50-7/8	0.923	0.910	0.900	0.892	0.885	0.879	0.874	0.869	0.865	0.861	0.858
52-1/4	0.922	0.909	0.899	0.890	0.884	0.878	0.873	0.868	0.864	0.860	0.857
53-5/8	0.921	0.907	0.897	0.889	0.882	0.877	0.871	0.867	0.863	0.859	0.856
55	0.919	0.906	0.896	0.888	0.881	0.875	0.870	0.866	0.862	0.858	0.854
56-3/8	0.918	0.905	0.895	0.887	0.880	0.874	0.869	0.865	0.861	0.857	0.853
57-3/4	0.917	0.904	0.894	0.886	0.879	0.873	0.868	0.864	0.859	0.856	0.852
59-1/8	0.916	0.903	0.893	0.885	0.878	0.872	0.867	0.863	0.858	0.855	0.851
60-1/2	0.915	0.902	0.892	0.884	0.877	0.871	0.866	0.862	0.858	0.854	0.850

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

CAPACITY SELECTION TABLES

5



5.1 General

Factored reference resistance and stiffness values are provided in this section. The resistance factor, ϕ, is based on the value specified in AF&PA/ASCE 16-95 for all reference resistances listed in this section. The time effect factor, λ, of 0.80 is used. For λ other than 0.80, the tabulated resistances should be divided by 0.80 and then multiplied by the appropriate λ.

5.2 Factored Reference Bending Resistance, $\lambda\phi_b M$, and Shear Resistance, $\lambda\phi_v V$

Factored reference bending resistance, $\lambda\phi_b M$, and factored reference shear resistance, $\lambda\phi_v V$, are given for various reference strength levels in Table 5.1 for Western species glued laminated timber and Table 5.2 for Southern Pine glued laminated timber. These factored reference resistances shall be further multiplied by applicable design adjustment factors given in Section 6 of this Supplement. Note that the tabulated values for factored reference bending resistance, $\lambda\phi_b M$, have **NOT** been adjusted for volume factor (see Section 4.8 of this Supplement) as the length of the glued laminated timber member is not specified in the tables.

The factored reference bending resistances in Tables 5.1 and 5.2 are based on fully laterally supported members. When members are not laterally supported, see Chapter 5 of AF&PA/ASCE 16-95, for design details.

5.3 Reference Bending Stiffness, EI and $E_{05}I$

Tables 5.3 (Western species) and 5.4 (Southern Pine) provide the reference bending stiffness for various glued laminated timber sizes at different E levels. The tabulated values are applicable to either mean-based reference bending stiffness, EI, or fifth-percentile-based buckling stiffness, $E_{05}I$. The mean-based values shall be used for deflection computations. The fifth-percentile-based values shall be used for strength computations such as column buckling.

5.4 Factored Reference Tension Parallel to Grain Resistance, $\lambda\phi_t T$

Factored reference tension parallel to grain resistance, $\lambda\phi_t T$, can be calculated by multiplying the reference tensile strength parallel to grain (given in Tables 3.1 and 3.2) by the cross-sectional area (given in Tables 9.1 and 9.2), an appropriate time effect factor, and resistance factor (ϕ_t = 0.80). This factored reference resistance shall be further multiplied by applicable design adjustment factors given in Section 4 of this Supplement.

5.5 Factored Reference Compression Parallel to Grain Resistance, $\lambda\phi_c P$

Factored reference resistance for compression parallel-to-grain, $\lambda\phi_c P$, (crushing) can be calculated by multiplying the reference compression strength parallel to grain (given in Tables 3.1 and 3.2) by the cross-sectional area (given in Tables 9.1 and 9.2), an appropriate time effect factor, and resistance factor (ϕ_c = 0.90). This factored reference resistance shall be further multiplied by applicable design adjustment factors, especially the column stability factor when appropriate, given in Section 4 of this Supplement.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
2-1/2 in. Width								
6	62.22	57.02	51.82	41.51	3.270	2.760	2.670	2.430
7-1/2	97.22	89.09	80.96	64.87	4.088	3.450	3.338	3.038
9	140.0	128.3	116.6	93.41	4.905	4.140	4.005	3.645
10-1/2	190.5	174.6	158.7	127.1	5.723	4.830	4.673	4.253
12	248.9	228.1	207.3	166.1	6.540	5.520	5.340	4.860
13-1/2	315.0	288.7	262.3	210.2	7.358	6.210	6.008	5.468
15	388.9	356.4	323.9	259.5	8.175	6.900	6.675	6.075
16-1/2	470.5	431.2	391.9	313.9	8.993	7.590	7.343	6.683
18	560.0	513.2	466.3	373.6	9.810	8.280	8.010	7.290
19-1/2	657.2	602.3	547.3	438.5	10.63	8.970	8.678	7.898
21	762.2	698.5	634.7	508.5	11.45	9.660	9.345	8.505
3 in. Width								
6	74.66	68.42	62.18	49.82	3.924	3.312	3.204	2.916
7-1/2	116.7	106.9	97.16	77.84	4.905	4.140	4.005	3.645
9	168.0	153.9	139.9	112.1	5.886	4.968	4.806	4.374
10-1/2	228.7	209.5	190.4	152.6	6.867	5.796	5.607	5.103
12	298.7	273.7	248.7	199.3	7.848	6.624	6.408	5.832
13-1/2	378.0	346.4	314.8	252.2	8.829	7.452	7.209	6.561
15	466.7	427.6	388.6	311.4	9.810	8.280	8.010	7.290
16-1/2	564.6	517.4	470.2	376.7	10.79	9.108	8.811	8.019
18	672.0	615.8	559.6	448.4	11.77	9.936	9.612	8.748
19-1/2	788.6	722.7	656.8	526.2	12.75	10.76	10.41	9.477
21	914.6	838.2	761.7	610.3	13.73	11.59	11.21	10.21
22-1/2	1050	962.2	874.4	700.5	14.72	12.42	12.02	10.94
24	1195	1095	994.9	797.1	15.70	13.25	12.82	11.66
3-1/8 in. Width								
6	77.78	71.27	64.77	51.89	4.088	3.450	3.338	3.038
7-1/2	121.5	111.4	101.2	81.08	5.109	4.313	4.172	3.797
9	175.0	160.4	145.7	116.8	6.131	5.175	5.006	4.556
10-1/2	238.2	218.3	198.4	158.9	7.153	6.038	5.841	5.316
12	311.1	285.1	259.1	207.6	8.175	6.900	6.675	6.075
13-1/2	393.7	360.8	327.9	262.7	9.197	7.763	7.509	6.834
15	486.1	445.5	404.8	324.3	10.22	8.625	8.344	7.594
16-1/2	588.2	539.0	489.8	392.4	11.24	9.488	9.178	8.353
18	700.0	641.5	582.9	467.0	12.26	10.35	10.01	9.113
19-1/2	821.5	752.8	684.1	548.1	13.28	11.21	10.85	9.872
21	952.7	873.1	793.4	635.7	14.31	12.08	11.68	10.63
22-1/2	1094	1002	910.8	729.7	15.33	12.94	12.52	11.39
24	1244	1140	1036	830.3	16.35	13.80	13.35	12.15

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
5 in. Width								
6	124.4	114.0	103.6	83.03	6.540	5.520	5.340	4.860
7-1/2	194.4	178.2	161.9	129.7	8.175	6.900	6.675	6.075
9	280.0	256.6	233.2	186.8	9.810	8.280	8.010	7.290
10-1/2	381.1	349.2	317.4	254.3	11.45	9.660	9.345	8.505
12	497.8	456.1	414.5	332.1	13.08	11.04	10.68	9.720
13-1/2	630.0	577.3	524.6	420.3	14.72	12.42	12.02	10.94
15	777.8	712.7	647.7	518.9	16.35	13.80	13.35	12.15
16-1/2	941.1	862.4	783.7	627.9	17.99	15.18	14.69	13.37
18	1120	1026	932.7	747.3	19.62	16.56	16.02	14.58
19-1/2	1314	1205	1095	877.0	21.26	17.94	17.36	15.80
21	1524	1397	1269	1017	22.89	19.32	18.69	17.01
22-1/2	1750	1604	1457	1168	24.53	20.70	20.03	18.23
24	1991	1825	1658	1328	26.16	22.08	21.36	19.44
25-1/2	2248	2060	1872	1500	27.80	23.46	22.70	20.66
27	2520	2309	2099	1681	29.43	24.84	24.03	21.87
28-1/2	2808	2573	2338	1873	31.07	26.22	25.37	23.09
30	3111	2851	2591	2076	32.70	27.60	26.70	24.30
31-1/2	3430	3143	2856	2288	34.34	28.98	28.04	25.52
33	3764	3450	3135	2512	35.97	30.36	29.37	26.73
34-1/2	4114	3770	3426	2745	37.61	31.74	30.71	27.95
36	4480	4105	3731	2989	39.24	33.12	32.04	29.16
5-1/8 in. Width								
6	127.6	116.9	106.2	85.10	6.704	5.658	5.474	4.982
7-1/2	199.3	182.6	166.0	133.0	8.379	7.073	6.842	6.227
9	287.0	263.0	239.0	191.5	10.06	8.487	8.210	7.472
10-1/2	390.6	358.0	325.3	260.6	11.73	9.902	9.579	8.718
12	510.2	467.5	424.9	340.4	13.41	11.32	10.95	9.963
13-1/2	645.7	591.7	537.8	430.8	15.08	12.73	12.32	11.21
15	797.2	730.5	663.9	531.9	16.76	14.15	13.68	12.45
16-1/2	964.6	884.0	803.3	643.6	18.43	15.56	15.05	13.70
18	1148	1052	956.0	765.9	20.11	16.97	16.42	14.94
19-1/2	1347	1235	1122	898.9	21.79	18.39	17.79	16.19
21	1562	1432	1301	1043	23.46	19.80	19.16	17.44
22-1/2	1794	1644	1494	1197	25.14	21.22	20.53	18.68
24	2041	1870	1700	1362	26.81	22.63	21.89	19.93
25-1/2	2304	2111	1919	1537	28.49	24.05	23.26	21.17
27	2583	2367	2151	1723	30.17	25.46	24.63	22.42
28-1/2	2878	2637	2397	1920	31.84	26.88	26.00	23.66
30	3189	2922	2656	2128	33.52	28.29	27.37	24.91
31-1/2	3516	3222	2928	2346	35.19	29.70	28.74	26.15
33	3858	3536	3213	2574	36.87	31.12	30.10	27.40
34-1/2	4217	3865	3512	2814	38.55	32.53	31.47	28.64
36	4592	4208	3824	3064	40.22	33.95	32.84	29.89

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
6-3/4 in. Width								
7-1/2	262.5	240.5	218.6	175.1	11.04	9.315	9.011	8.201
9	378.0	346.4	314.8	252.2	13.24	11.18	10.81	9.842
10-1/2	514.5	471.5	428.5	343.3	15.45	13.04	12.62	11.48
12	672.0	615.8	559.6	448.4	17.66	14.90	14.42	13.12
13-1/2	850.5	779.4	708.3	567.4	19.87	16.77	16.22	14.76
15	1050	962.2	874.4	700.5	22.07	18.63	18.02	16.40
16-1/2	1270	1164	1058	847.7	24.28	20.49	19.82	18.04
18	1512	1386	1259	1009	26.49	22.36	21.63	19.68
19-1/2	1774	1626	1478	1184	28.69	24.22	23.43	21.32
21	2058	1886	1714	1373	30.90	26.08	25.23	22.96
22-1/2	2362	2165	1967	1576	33.11	27.95	27.03	24.60
24	2688	2463	2238	1793	35.32	29.81	28.84	26.24
25-1/2	3034	2781	2527	2025	37.52	31.67	30.64	27.88
27	3402	3117	2833	2270	39.73	33.53	32.44	29.52
28-1/2	3790	3473	3157	2529	41.94	35.40	34.24	31.16
30	4200	3849	3498	2802	44.15	37.26	36.05	32.81
31-1/2	4630	4243	3856	3089	46.35	39.12	37.85	34.45
33	5082	4657	4232	3391	48.56	40.99	39.65	36.09
34-1/2	5554	5090	4626	3706	50.77	42.85	41.45	37.73
36	6048	5542	5037	4035	52.97	44.71	43.25	39.37
37-1/2	6562	6014	5465	4378	55.18	46.58	45.06	41.01
39	7098	6504	5911	4736	57.39	48.44	46.86	42.65
40-1/2	7654	7014	6374	5107	59.60	50.30	48.66	44.29
42	8232	7543	6855	5492	61.80	52.16	50.46	45.93
43-1/2	8830	8092	7354	5892	64.01	54.03	52.27	47.57
45	9450	8660	7870	6305	66.22	55.89	54.07	49.21
46-1/2	10090	9247	8403	6732	68.42	57.75	55.87	50.85
48	10750	9853	8954	7174	70.63	59.62	57.67	52.49
49-1/2	11430	10480	9522	7629	72.84	61.48	59.47	54.13
51	12140	11120	10110	8098	75.05	63.34	61.28	55.77
52-1/2	12860	11790	10710	8582	77.25	65.21	63.08	57.41
54	13610	12470	11330	9079	79.46	67.07	64.88	59.05
55-1/2	14370	13170	11970	9591	81.67	68.93	66.68	60.69
57	15160	13890	12630	10120	83.88	70.79	68.49	62.33
58-1/2	15970	14630	13300	10660	86.08	72.66	70.29	63.97
60	16800	15390	13990	11210	88.29	74.52	72.09	65.61

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
8-3/4 in. Width								
9	490.0	449.0	408.1	326.9	17.17	14.49	14.02	12.76
10-1/2	666.9	611.2	555.4	445.0	20.03	16.91	16.35	14.88
12	871.1	798.3	725.4	581.2	22.89	19.32	18.69	17.01
13-1/2	1102	1010	918.1	735.6	25.75	21.74	21.03	19.14
15	1361	1247	1133	908.1	28.61	24.15	23.36	21.26
16-1/2	1647	1509	1372	1099	31.47	26.57	25.70	23.39
18	1960	1796	1632	1308	34.34	28.98	28.04	25.52
19-1/2	2300	2108	1916	1535	37.20	31.40	30.37	27.64
21	2668	2445	2222	1780	40.06	33.81	32.71	29.77
22-1/2	3062	2806	2550	2043	42.92	36.23	35.04	31.89
24	3484	3193	2902	2325	45.78	38.64	37.38	34.02
25-1/2	3933	3605	3276	2624	48.64	41.06	39.72	36.15
27	4410	4041	3672	2942	51.50	43.47	42.05	38.27
28-1/2	4913	4503	4092	3278	54.36	45.89	44.39	40.40
30	5444	4989	4534	3632	57.23	48.30	46.73	42.53
31-1/2	6002	5500	4999	4005	60.09	50.72	49.06	44.65
33	6588	6037	5486	4395	62.95	53.13	51.40	46.78
34-1/2	7200	6598	5996	4804	65.81	55.55	53.73	48.90
36	7840	7184	6529	5231	68.67	57.96	56.07	51.03
37-1/2	8507	7795	7084	5676	71.53	60.38	58.41	53.16
39	9201	8432	7662	6139	74.39	62.79	60.74	55.28
40-1/2	9922	9093	8263	6620	77.25	65.21	63.08	57.41
42	10670	9779	8886	7120	80.12	67.62	65.42	59.54
43-1/2	11450	10490	9533	7637	82.98	70.04	67.75	61.66
45	12250	11230	10200	8173	85.84	72.45	70.09	63.79
46-1/2	13080	11990	10890	8727	88.70	74.87	72.42	65.91
48	13940	12770	11610	9299	91.56	77.28	74.76	68.04
49-1/2	14820	13580	12340	9889	94.42	79.70	77.10	70.17
51	15730	14420	13100	10500	97.28	82.11	79.43	72.29
52-1/2	16670	15280	13890	11120	100.1	84.53	81.77	74.42
54	17640	16160	14690	11770	103.0	86.94	84.11	76.55
55-1/2	18630	17080	15520	12430	105.9	89.36	86.44	78.67
57	19650	18010	16370	13110	108.7	91.77	88.78	80.80
58-1/2	20700	18970	17240	13810	111.6	94.19	91.11	82.92
60	21780	19960	18140	14530	114.5	96.60	93.45	85.05

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
10-3/4 in. Width								
12	1070	980.7	891.2	714.0	28.12	23.74	22.96	20.90
13-1/2	1354	1241	1128	903.7	31.64	26.70	25.83	23.51
15	1672	1532	1393	1116	35.15	29.67	28.70	26.12
16-1/2	2023	1854	1685	1350	38.67	32.64	31.57	28.73
18	2408	2207	2005	1607	42.18	35.60	34.44	31.35
19-1/2	2826	2590	2353	1886	45.70	38.57	37.31	33.96
21	3277	3003	2729	2187	49.21	41.54	40.18	36.57
22-1/2	3762	3448	3133	2510	52.73	44.51	43.05	39.18
24	4281	3923	3565	2856	56.24	47.47	45.92	41.80
25-1/2	4833	4429	4024	3224	59.76	50.44	48.79	44.41
27	5418	4965	4512	3615	63.27	53.41	51.66	47.02
28-1/2	6037	5532	5027	4028	66.79	56.37	54.53	49.63
30	6689	6129	5570	4463	70.31	59.34	57.41	52.25
31-1/2	7374	6758	6141	4920	73.82	62.31	60.28	54.86
33	8093	7417	6740	5400	77.34	65.27	63.15	57.47
34-1/2	8846	8106	7367	5902	80.85	68.24	66.02	60.08
36	9632	8826	8021	6426	84.37	71.21	68.89	62.69
37-1/2	10450	9577	8703	6973	87.88	74.18	71.76	65.31
39	11300	10360	9414	7542	91.40	77.14	74.63	67.92
40-1/2	12190	11170	10150	8133	94.91	80.11	77.50	70.53
42	13110	12010	10920	8747	98.43	83.08	80.37	73.14
43-1/2	14060	12890	11710	9383	101.9	86.04	83.24	75.76
45	15050	13790	12530	10040	105.5	89.01	86.11	78.37
46-1/2	16070	14730	13380	10720	109.0	91.98	88.98	80.98
48	17120	15690	14260	11420	112.5	94.94	91.85	83.59
49-1/2	18210	16690	15160	12150	116.0	97.91	94.72	86.20
51	19330	17710	16100	12900	119.5	100.9	97.59	88.82
52-1/2	20480	18770	17060	13670	123.0	103.8	100.5	91.43
54	21670	19860	18050	14460	126.5	106.8	103.3	94.04
55-1/2	22890	20980	19060	15270	130.1	109.8	106.2	96.65
57	24150	22130	20110	16110	133.6	112.7	109.1	99.27
58-1/2	25430	23310	21180	16970	137.1	115.7	111.9	101.9
60	26750	24520	22280	17850	140.6	118.7	114.8	104.5

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.1 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is				$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is			
d (in.)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.545	0.460	0.445	0.405
12-1/4 in. Width								
13-1/2	1543	1414	1285	1030	36.05	30.43	29.44	26.79
15	1905	1746	1587	1271	40.06	33.81	32.71	29.77
16-1/2	2306	2113	1920	1538	44.06	37.19	35.98	32.74
18	2744	2514	2285	1831	48.07	40.57	39.25	35.72
19-1/2	3220	2951	2682	2149	52.07	43.95	42.52	38.70
21	3735	3423	3110	2492	56.08	47.33	45.79	41.67
22-1/2	4287	3929	3570	2861	60.09	50.72	49.06	44.65
24	4878	4470	4062	3255	64.09	54.10	52.33	47.63
25-1/2	5507	5046	4586	3674	68.10	57.48	55.60	50.60
27	6174	5658	5141	4119	72.10	60.86	58.87	53.58
28-1/2	6879	6304	5729	4590	76.11	64.24	62.14	56.56
30	7622	6985	6347	5085	80.12	67.62	65.42	59.54
31-1/2	8403	7701	6998	5607	84.12	71.00	68.69	62.51
33	9223	8451	7680	6153	88.13	74.38	71.96	65.49
34-1/2	10080	9237	8395	6726	92.13	77.76	75.23	68.47
36	10980	10060	9140	7323	96.14	81.14	78.50	71.44
37-1/2	11910	10910	9918	7946	100.1	84.53	81.77	74.42
39	12880	11800	10730	8594	104.1	87.91	85.04	77.40
40-1/2	13890	12730	11570	9268	108.2	91.29	88.31	80.37
42	14940	13690	12440	9968	112.2	94.67	91.58	83.35
43-1/2	16030	14690	13350	10690	116.2	98.05	94.85	86.33
45	17150	15720	14280	11440	120.2	101.4	98.12	89.30
46-1/2	18310	16780	15250	12220	124.2	104.8	101.4	92.28
48	19510	17880	16250	13020	128.2	108.2	104.7	95.26
49-1/2	20750	19020	17280	13850	132.2	111.6	107.9	98.23
51	22030	20190	18340	14700	136.2	115.0	111.2	101.2
52-1/2	23340	21390	19440	15570	140.2	118.3	114.5	104.2
54	24700	22630	20570	16480	144.2	121.7	117.7	107.2
55-1/2	26090	23910	21720	17410	148.2	125.1	121.0	110.1
57	27520	25210	22910	18360	152.2	128.5	124.3	113.1
58-1/2	28980	26560	24140	19340	156.2	131.9	127.6	116.1
60	30490	27940	25390	20340	160.2	135.2	130.8	119.1

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.2 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Southern Pine* Glued Laminated Timber

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is						$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is	
d (in.)	7.12 (28F)	6.61 (26F)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.575	0.260
2-1/2 in. Width								
5-1/2	61.02	56.65	52.28	47.91	43.54	34.88	3.163	1.430
6-7/8	95.35	88.52	81.69	74.86	68.03	54.51	3.953	1.788
8-1/4	137.3	127.5	117.6	107.8	97.96	78.49	4.744	2.145
9-5/8	186.9	173.5	160.1	146.7	133.3	106.8	5.534	2.503
11	244.1	226.6	209.1	191.6	174.2	139.5	6.325	2.860
12-3/8	308.9	286.8	264.7	242.5	220.4	176.6	7.116	3.218
13-3/4	381.4	354.1	326.8	299.4	272.1	218.0	7.906	3.575
15-1/8	461.5	428.4	395.4	362.3	329.3	263.8	8.697	3.933
16-1/2	549.2	509.9	470.5	431.2	391.9	313.9	9.488	4.290
17-7/8	644.6	598.4	552.2	506.1	459.9	368.5	10.28	4.648
19-1/4	747.5	694.0	640.5	586.9	533.4	427.3	11.07	5.005
20-5/8	858.2	796.7	735.2	673.7	612.3	490.5	11.86	5.363
22	976.4	906.5	836.5	766.6	696.6	558.1	12.65	5.720
23-3/8	1102	1023	944.3	865.4	786.4	630.1	13.44	6.078
3 in. Width								
5-1/2	73.23	67.98	62.74	57.49	52.25	41.86	3.795	1.716
6-7/8	114.4	106.2	98.03	89.83	81.64	65.41	4.744	2.145
8-1/4	164.8	153.0	141.2	129.4	117.6	94.18	5.693	2.574
9-5/8	224.3	208.2	192.1	176.1	160.0	128.2	6.641	3.003
11	292.9	271.9	251.0	230.0	209.0	167.4	7.590	3.432
12-3/8	370.7	344.2	317.6	291.1	264.5	211.9	8.539	3.861
13-3/4	457.7	424.9	392.1	359.3	326.5	261.6	9.488	4.290
15-1/8	553.8	514.1	474.5	434.8	395.1	316.6	10.44	4.719
16-1/2	659.1	611.9	564.6	517.4	470.2	376.7	11.39	5.148
17-7/8	773.5	718.1	662.7	607.3	551.9	442.1	12.33	5.577
19-1/4	897.1	832.8	768.5	704.3	640.0	512.8	13.28	6.006
20-5/8	1030	956.0	882.3	808.5	734.7	588.7	14.23	6.435
22	1172	1088	1004	919.9	836.0	669.8	15.18	6.864
23-3/8	1323	1228	1133	1038	943.7	756.1	16.13	7.293
3-1/8 in. Width								
5-1/2	76.28	70.82	65.35	59.89	54.42	43.60	3.953	1.788
6-7/8	119.2	110.7	102.1	93.58	85.04	68.13	4.941	2.234
8-1/4	171.6	159.3	147.0	134.7	122.5	98.11	5.930	2.681
9-5/8	233.6	216.9	200.1	183.4	166.7	133.5	6.918	3.128
11	305.1	283.3	261.4	239.6	217.7	174.4	7.906	3.575
12-3/8	386.2	358.5	330.8	303.2	275.5	220.7	8.895	4.022
13-3/4	476.8	442.6	408.5	374.3	340.2	272.5	9.883	4.469
15-1/8	576.9	535.5	494.2	452.9	411.6	329.8	10.87	4.916
16-1/2	686.5	637.3	588.2	539.0	489.8	392.4	11.86	5.363
17-7/8	805.7	748.0	690.3	632.6	574.9	460.6	12.85	5.809
19-1/4	934.4	867.5	800.6	733.6	666.7	534.2	13.84	6.256
20-5/8	1073	995.9	919.0	842.2	765.3	613.2	14.82	6.703
22	1220	1133	1046	958.2	870.8	697.7	15.81	7.150
23-3/8	1378	1279	1180	1082	983.0	787.6	16.80	7.597

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.2 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is						$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is	
d (in.)	7.12 (28F)	6.61 (26F)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.575	0.260
5 in. Width								
6-7/8	190.7	177.0	163.4	149.7	136.1	109.0	7.906	3.575
8-1/4	274.6	254.9	235.3	215.6	195.9	157.0	9.488	4.290
9-5/8	373.8	347.0	320.2	293.5	266.7	213.7	11.07	5.005
11	488.2	453.2	418.3	383.3	348.3	279.1	12.65	5.720
12-3/8	617.9	573.6	529.4	485.1	440.8	353.2	14.23	6.435
13-3/4	762.8	708.2	653.5	598.9	544.2	436.0	15.81	7.150
15-1/8	923.0	856.9	790.8	724.7	658.5	527.6	17.39	7.865
16-1/2	1098	1020	941.1	862.4	783.7	627.9	18.98	8.580
17-7/8	1289	1197	1104	1012	919.8	736.9	20.56	9.295
19-1/4	1495	1388	1281	1174	1067	854.6	22.14	10.01
20-5/8	1716	1593	1470	1347	1225	981.1	23.72	10.73
22	1953	1813	1673	1533	1393	1116	25.30	11.44
23-3/8	2205	2047	1889	1731	1573	1260	26.88	12.16
24-3/4	2471	2294	2117	1940	1763	1413	28.46	12.87
26-1/8	2754	2556	2359	2162	1965	1574	30.04	13.59
27-1/2	3051	2833	2614	2396	2177	1744	31.63	14.30
28-7/8	3364	3123	2882	2641	2400	1923	33.21	15.02
30-1/4	3692	3428	3163	2899	2634	2110	34.79	15.73
31-5/8	4035	3746	3457	3168	2879	2307	36.37	16.45
33	4394	4079	3764	3450	3135	2512	37.95	17.16
34-3/8	4768	4426	4085	3743	3402	2725	39.53	17.88
35-3/4	5157	4787	4418	4048	3679	2948	41.11	18.59
5-1/8 in. Width								
6-7/8	195.5	181.5	167.5	153.5	139.5	111.7	8.104	3.664
8-1/4	281.5	261.3	241.2	221.0	200.8	160.9	9.725	4.397
9-5/8	383.1	355.7	328.2	300.8	273.3	219.0	11.35	5.130
11	500.4	464.6	428.7	392.9	357.0	286.0	12.97	5.863
12-3/8	633.3	588.0	542.6	497.2	451.9	362.0	14.59	6.596
13-3/4	781.9	725.9	669.9	613.9	557.9	446.9	16.21	7.329
15-1/8	946.1	878.3	810.5	742.8	675.0	540.8	17.83	8.062
16-1/2	1126	1045	964.6	884.0	803.3	643.6	19.45	8.795
17-7/8	1321	1227	1132	1037	942.8	755.3	21.07	9.527
19-1/4	1532	1423	1313	1203	1093	876.0	22.69	10.26
20-5/8	1759	1633	1507	1381	1255	1006	24.31	10.99
22	2002	1858	1715	1571	1428	1144	25.93	11.73
23-3/8	2260	2098	1936	1774	1612	1292	27.55	12.46
24-3/4	2533	2352	2170	1989	1807	1448	29.17	13.19
26-1/8	2823	2620	2418	2216	2014	1613	30.79	13.92
27-1/2	3127	2903	2679	2455	2231	1788	32.42	14.66
28-7/8	3448	3201	2954	2707	2460	1971	34.04	15.39
30-1/4	3784	3513	3242	2971	2700	2163	35.66	16.12
31-5/8	4136	3840	3544	3247	2951	2364	37.28	16.86
33	4504	4181	3858	3536	3213	2574	38.90	17.59
34-3/8	4887	4537	4187	3837	3487	2793	40.52	18.32
35-3/4	5285	4907	4528	4150	3771	3021	42.14	19.05

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.2 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is						$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is	
d (in.)	7.12 (28F)	6.61 (26F)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.575	0.260
6-3/4 in. Width								
6-7/8	257.4	239.0	220.6	202.1	183.7	147.2	10.67	4.826
8-1/4	370.7	344.2	317.6	291.1	264.5	211.9	12.81	5.792
9-5/8	504.6	468.5	432.3	396.2	360.0	288.4	14.94	6.757
11	659.1	611.9	564.6	517.4	470.2	376.7	17.08	7.722
12-3/8	834.1	774.4	714.6	654.9	595.1	476.8	19.21	8.687
13-3/4	1030	956.0	882.3	808.5	734.7	588.7	21.35	9.653
15-1/8	1246	1157	1068	978.3	889.0	712.3	23.48	10.62
16-1/2	1483	1377	1270	1164	1058	847.7	25.62	11.58
17-7/8	1740	1616	1491	1366	1242	994.8	27.75	12.55
19-1/4	2018	1874	1729	1585	1440	1154	29.89	13.51
20-5/8	2317	2151	1985	1819	1653	1324	32.02	14.48
22	2636	2447	2259	2070	1881	1507	34.16	15.44
23-3/8	2976	2763	2550	2337	2123	1701	36.29	16.41
24-3/4	3337	3098	2859	2620	2381	1907	38.42	17.37
26-1/8	3718	3451	3185	2919	2652	2125	40.56	18.34
27-1/2	4119	3824	3529	3234	2939	2355	42.69	19.31
28-7/8	4541	4216	3891	3565	3240	2596	44.83	20.27
30-1/4	4984	4627	4270	3913	3556	2849	46.96	21.24
31-5/8	5448	5057	4667	4277	3887	3114	49.10	22.20
33	5932	5507	5082	4657	4232	3391	51.23	23.17
34-3/8	6436	5975	5514	5053	4592	3679	53.37	24.13
35-3/4	6961	6463	5964	5465	4967	3979	55.50	25.10
37-1/8	7507	6969	6432	5894	5356	4291	57.64	26.06
38-1/2	8074	7495	6917	6339	5760	4615	59.77	27.03
39-7/8	8660	8040	7420	6799	6179	4951	61.91	27.99
41-1/4	9268	8604	7940	7276	6613	5298	64.04	28.96
42-5/8	9896	9187	8479	7770	7061	5657	66.18	29.92
44	10550	9790	9034	8279	7524	6028	68.31	30.89
45-3/8	11210	10410	9608	8805	8001	6410	70.44	31.85
46-3/4	11900	11050	10200	9346	8494	6805	72.58	32.82
48-1/8	12610	11710	10810	9904	9000	7211	74.71	33.78
49-1/2	13350	12390	11430	10480	9522	7629	76.85	34.75
50-7/8	14100	13090	12080	11070	10060	8059	78.98	35.71
52-1/4	14870	13800	12740	11670	10610	8500	81.12	36.68
53-5/8	15660	14540	13420	12300	11180	8953	83.25	37.64
55	16480	15300	14120	12940	11760	9418	85.39	38.61
56-3/8	17310	16070	14830	13590	12350	9895	87.52	39.58
57-3/4	18170	16860	15560	14260	12960	10380	89.66	40.54
59-1/8	19040	17680	16310	14950	13590	10880	91.79	41.51
60-1/2	19940	18510	17080	15650	14220	11400	93.93	42.47

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.2 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is						$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is	
d (in.)	7.12 (28F)	6.61 (26F)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.575	0.260
8-1/2 in. Width								
9-5/8	635.4	589.9	544.4	498.9	453.4	363.2	18.82	8.509
11	829.9	770.5	711.0	651.6	592.1	474.4	21.51	9.724
12-3/8	1050	975.1	899.9	824.7	749.4	600.4	24.19	10.94
13-3/4	1297	1204	1111	1018	925.2	741.3	26.88	12.16
15-1/8	1569	1457	1344	1232	1120	896.9	29.57	13.37
16-1/2	1867	1734	1600	1466	1332	1067	32.26	14.59
17-7/8	2192	2035	1878	1721	1564	1253	34.95	15.80
19-1/4	2542	2360	2178	1995	1813	1453	37.63	17.02
20-5/8	2918	2709	2500	2291	2082	1668	40.32	18.23
22	3320	3082	2844	2606	2369	1898	43.01	19.45
23-3/8	3748	3479	3211	2942	2674	2142	45.70	20.66
24-3/4	4202	3901	3600	3299	2998	2402	48.39	21.88
26-1/8	4681	4346	4011	3675	3340	2676	51.07	23.09
27-1/2	5187	4816	4444	4072	3701	2965	53.76	24.31
28-7/8	5719	5309	4899	4490	4080	3269	56.45	25.53
30-1/4	6276	5827	5377	4928	4478	3588	59.14	26.74
31-5/8	6860	6369	5877	5386	4894	3921	61.83	27.96
33	7469	6934	6399	5864	5329	4270	64.52	29.17
34-3/8	8105	7524	6944	6363	5783	4633	67.20	30.39
35-3/4	8766	8138	7510	6882	6254	5011	69.89	31.60
37-1/8	9453	8776	8099	7422	6745	5404	72.58	32.82
38-1/2	10170	9438	8710	7982	7254	5812	75.27	34.03
39-7/8	10910	10120	9343	8562	7781	6234	77.96	35.25
41-1/4	11670	10830	9999	9163	8327	6671	80.64	36.47
42-5/8	12460	11570	10680	9784	8891	7124	83.33	37.68
44	13280	12330	11380	10430	9474	7591	86.02	38.90
45-3/8	14120	13110	12100	11090	10080	8072	88.71	40.11
46-3/4	14990	13920	12840	11770	10700	8569	91.40	41.33
48-1/8	15890	14750	13610	12470	11330	9081	94.08	42.54
49-1/2	16810	15600	14400	13190	11990	9607	96.77	43.76
50-7/8	17750	16480	15210	13940	12670	10150	99.46	44.97
52-1/4	18730	17380	16040	14700	13360	10700	102.1	46.19
53-5/8	19720	18310	16900	15490	14070	11270	104.8	47.40
55	20750	19260	17780	16290	14800	11860	107.5	48.62
56-3/8	21800	20240	18680	17110	15550	12460	110.2	49.84
57-3/4	22870	21240	19600	17960	16320	13080	112.9	51.05
59-1/8	23980	22260	20540	18820	17110	13710	115.6	52.27
60-1/2	25110	23310	21510	19710	17910	14350	118.3	53.48

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.2 Factored Reference Resistance[a] (λ = 0.80, ϕ_b = 0.85, ϕ_v = 0.75) for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	$\lambda\phi_b M$ (kip-in.) when F_{bx} (ksi) is						$\lambda\phi_v V$ (kips) when F_{vx} (ksi) is	
d (in.)	7.12 (28F)	6.61 (26F)	6.10 (24F)	5.59 (22F)	5.08 (20F)	4.07 (16F)	0.575	0.260
10-1/2 in. Width								
11	1025	951.8	878.3	804.9	731.5	586.0	26.57	12.01
12-3/8	1298	1205	1112	1019	925.8	741.7	29.89	13.51
13-3/4	1602	1487	1372	1258	1143	915.7	33.21	15.02
15-1/8	1938	1799	1661	1522	1383	1108	36.53	16.52
16-1/2	2307	2141	1976	1811	1646	1319	39.85	18.02
17-7/8	2707	2513	2319	2125	1932	1548	43.17	19.52
19-1/4	3140	2915	2690	2465	2240	1795	46.49	21.02
20-5/8	3604	3346	3088	2830	2572	2060	49.81	22.52
22	4101	3807	3513	3220	2926	2344	53.13	24.02
23-3/8	4629	4298	3966	3635	3303	2646	56.45	25.53
24-3/4	5190	4818	4447	4075	3703	2967	59.77	27.03
26-1/8	5783	5369	4954	4540	4126	3306	63.09	28.53
27-1/2	6408	5949	5490	5031	4572	3663	66.41	30.03
28-7/8	7064	6558	6052	5546	5040	4038	69.73	31.53
30-1/4	7753	7198	6642	6087	5532	4432	73.05	33.03
31-5/8	8474	7867	7260	6653	6046	4844	76.37	34.53
33	9227	8566	7905	7244	6583	5274	79.70	36.04
34-3/8	10010	9295	8578	7860	7143	5723	83.02	37.54
35-3/4	10830	10050	9277	8502	7726	6190	86.34	39.04
37-1/8	11680	10840	10000	9168	8332	6675	89.66	40.54
38-1/2	12560	11660	10760	9860	8960	7179	92.98	42.04
39-7/8	13470	12510	11540	10580	9612	7701	96.30	43.54
41-1/4	14420	13380	12350	11320	10290	8241	99.62	45.05
42-5/8	15390	14290	13190	12090	10980	8800	102.9	46.55
44	16400	15230	14050	12880	11700	9377	106.3	48.05
45-3/8	17440	16200	14950	13700	12450	9972	109.6	49.55
46-3/4	18520	17190	15860	14540	13210	10590	112.9	51.05
48-1/8	19620	18220	16810	15410	14000	11220	116.2	52.55
49-1/2	20760	19270	17790	16300	14810	11870	119.5	54.05
50-7/8	21930	20360	18790	17220	15650	12540	122.9	55.56
52-1/4	23130	21470	19820	18160	16500	13220	126.2	57.06
53-5/8	24360	22620	20870	19130	17380	13930	129.5	58.56
55	25630	23790	21960	20120	18290	14650	132.8	60.06
56-3/8	26930	25000	23070	21140	19210	15390	136.1	61.56
57-3/4	28260	26230	24210	22190	20160	16150	139.5	63.06
59-1/8	29620	27500	25380	23250	21130	16930	142.8	64.56
60-1/2	31010	28790	26570	24350	22130	17730	146.1	66.07

[a]Applicable when loading condition coefficient, K_L = 1.0. For other loading conditions, see Table 4.4.

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
2-1/2 in. Width										
6	90.00	85.50	81.00	76.50	72.00	67.50	63.00	58.50	54.00	49.50
7-1/2	175.8	167.0	158.2	149.4	140.6	131.8	123.0	114.3	105.5	96.68
9	303.8	288.6	273.4	258.2	243.0	227.8	212.6	197.4	182.3	167.1
10-1/2	482.3	458.2	434.1	410.0	385.9	361.8	337.6	313.5	289.4	265.3
12	720.0	684.0	648.0	612.0	576.0	540.0	504.0	468.0	432.0	396.0
13-1/2	1025	973.9	922.6	871.4	820.1	768.9	717.6	666.4	615.1	563.8
15	1406	1336	1266	1195	1125	1055	984.4	914.1	843.8	773.4
16-1/2	1872	1778	1685	1591	1497	1404	1310	1217	1123	1029
18	2430	2309	2187	2066	1944	1823	1701	1580	1458	1337
19-1/2	3090	2935	2781	2626	2472	2317	2163	2008	1854	1699
21	3859	3666	3473	3280	3087	2894	2701	2508	2315	2122
3 in. Width										
6	108.0	102.6	97.20	91.80	86.40	81.00	75.60	70.20	64.80	59.40
7-1/2	210.9	200.4	189.8	179.3	168.8	158.2	147.7	137.1	126.6	116.0
9	364.5	346.3	328.1	309.8	291.6	273.4	255.2	236.9	218.7	200.5
10-1/2	578.8	549.9	520.9	492.0	463.1	434.1	405.2	376.2	347.3	318.3
12	864.0	820.8	777.6	734.4	691.2	648.0	604.8	561.6	518.4	475.2
13-1/2	1230	1169	1107	1046	984.2	922.6	861.1	799.6	738.1	676.6
15	1688	1603	1519	1434	1350	1266	1181	1097	1013	928.1
16-1/2	2246	2134	2021	1909	1797	1685	1572	1460	1348	1235
18	2916	2770	2624	2479	2333	2187	2041	1895	1750	1604
19-1/2	3707	3522	3337	3151	2966	2781	2595	2410	2224	2039
21	4631	4399	4167	3936	3704	3473	3241	3010	2778	2547
22-1/2	5695	5411	5126	4841	4556	4271	3987	3702	3417	3132
24	6912	6566	6221	5875	5530	5184	4838	4493	4147	3802
3-1/8 in. Width										
6	112.5	106.9	101.3	95.63	90.00	84.38	78.75	73.13	67.50	61.88
7-1/2	219.7	208.7	197.8	186.8	175.8	164.8	153.8	142.8	131.8	120.8
9	379.7	360.7	341.7	322.7	303.8	284.8	265.8	246.8	227.8	208.8
10-1/2	602.9	572.8	542.6	512.5	482.3	452.2	422.1	391.9	361.8	331.6
12	900.0	855.0	810.0	765.0	720.0	675.0	630.0	585.0	540.0	495.0
13-1/2	1281	1217	1153	1089	1025	961.1	897.0	832.9	768.9	704.8
15	1758	1670	1582	1494	1406	1318	1230	1143	1055	966.8
16-1/2	2340	2223	2106	1989	1872	1755	1638	1521	1404	1287
18	3038	2886	2734	2582	2430	2278	2126	1974	1823	1671
19-1/2	3862	3669	3476	3283	3090	2896	2703	2510	2317	2124
21	4823	4582	4341	4100	3859	3618	3376	3135	2894	2653
22-1/2	5933	5636	5339	5043	4746	4449	4153	3856	3560	3263
24	7200	6840	6480	6120	5760	5400	5040	4680	4320	3960

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
5 in. Width										
6	180.0	171.0	162.0	153.0	144.0	135.0	126.0	117.0	108.0	99.00
7-1/2	351.6	334.0	316.4	298.8	281.3	263.7	246.1	228.5	210.9	193.4
9	607.5	577.1	546.8	516.4	486.0	455.6	425.3	394.9	364.5	334.1
10-1/2	964.7	916.5	868.2	820.0	771.8	723.5	675.3	627.0	578.8	530.6
12	1440	1368	1296	1224	1152	1080	1008	936.0	864.0	792.0
13-1/2	2050	1948	1845	1743	1640	1538	1435	1333	1230	1128
15	2813	2672	2531	2391	2250	2109	1969	1828	1688	1547
16-1/2	3743	3556	3369	3182	2995	2808	2620	2433	2246	2059
18	4860	4617	4374	4131	3888	3645	3402	3159	2916	2673
19-1/2	6179	5870	5561	5252	4943	4634	4325	4016	3707	3398
21	7718	7332	6946	6560	6174	5788	5402	5016	4631	4245
22-1/2	9492	9018	8543	8068	7594	7119	6645	6170	5695	5221
24	11520	10940	10370	9792	9216	8640	8064	7488	6912	6336
25-1/2	13820	13130	12440	11750	11050	10360	9672	8982	8291	7600
27	16400	15580	14760	13940	13120	12300	11480	10660	9842	9021
28-1/2	19290	18330	17360	16400	15430	14470	13500	12540	11570	10610
30	22500	21380	20250	19130	18000	16880	15750	14630	13500	12380
31-1/2	26050	24740	23440	22140	20840	19530	18230	16930	15630	14330
33	29950	28450	26950	25460	23960	22460	20960	19470	17970	16470
34-1/2	34220	32510	30800	29090	27380	25660	23950	22240	20530	18820
36	38880	36940	34990	33050	31100	29160	27220	25270	23330	21380
5-1/8 in. Width										
6	184.5	175.3	166.1	156.8	147.6	138.4	129.2	119.9	110.7	101.5
7-1/2	360.4	342.3	324.3	306.3	288.3	270.3	252.2	234.2	216.2	198.2
9	622.7	591.6	560.4	529.3	498.2	467.0	435.9	404.7	373.6	342.5
10-1/2	988.8	939.4	889.9	840.5	791.0	741.6	692.2	642.7	593.3	543.8
12	1476	1402	1328	1255	1181	1107	1033	959.4	885.6	811.8
13-1/2	2102	1996	1891	1786	1681	1576	1471	1366	1261	1156
15	2883	2739	2595	2450	2306	2162	2018	1874	1730	1586
16-1/2	3837	3645	3453	3261	3070	2878	2686	2494	2302	2110
18	4982	4732	4483	4234	3985	3736	3487	3238	2989	2740
19-1/2	6334	6017	5700	5384	5067	4750	4433	4117	3800	3483
21	7910	7515	7119	6724	6328	5933	5537	5142	4746	4351
22-1/2	9729	9243	8757	8270	7784	7297	6811	6324	5838	5351
24	11810	11220	10630	10040	9446	8856	8266	7675	7085	6494
25-1/2	14160	13460	12750	12040	11330	10620	9914	9206	8498	7790
27	16810	15970	15130	14290	13450	12610	11770	10930	10090	9247
28-1/2	19770	18780	17800	16810	15820	14830	13840	12850	11860	10880
30	23060	21910	20760	19600	18450	17300	16140	14990	13840	12680
31-1/2	26700	25360	24030	22690	21360	20020	18690	17350	16020	14680
33	30700	29160	27630	26090	24560	23020	21490	19950	18420	16880
34-1/2	35080	33320	31570	29810	28060	26310	24550	22800	21050	19290
36	39850	37860	35870	33870	31880	29890	27900	25900	23910	21920

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
6-3/4 in. Width										
7-1/2	474.6	450.9	427.1	403.4	379.7	356.0	332.2	308.5	284.8	261.0
9	820.1	779.1	738.1	697.1	656.1	615.1	574.1	533.1	492.1	451.1
10-1/2	1302	1237	1172	1107	1042	976.7	911.6	846.5	781.4	716.3
12	1944	1847	1750	1652	1555	1458	1361	1264	1166	1069
13-1/2	2768	2630	2491	2353	2214	2076	1938	1799	1661	1522
15	3797	3607	3417	3227	3038	2848	2658	2468	2278	2088
16-1/2	5054	4801	4548	4296	4043	3790	3538	3285	3032	2780
18	6561	6233	5905	5577	5249	4921	4593	4265	3937	3609
19-1/2	8342	7925	7508	7090	6673	6256	5839	5422	5005	4588
21	10420	9898	9377	8856	8335	7814	7293	6772	6251	5730
22-1/2	12810	12170	11530	10890	10250	9611	8970	8329	7689	7048
24	15550	14770	14000	13220	12440	11660	10890	10110	9331	8554
25-1/2	18650	17720	16790	15860	14920	13990	13060	12130	11190	10260
27	22140	21040	19930	18820	17710	16610	15500	14390	13290	12180
28-1/2	26040	24740	23440	22140	20830	19530	18230	16930	15630	14320
30	30380	28860	27340	25820	24300	22780	21260	19740	18230	16710
31-1/2	35160	33400	31650	29890	28130	26370	24610	22860	21100	19340
33	40430	38410	36390	34360	32340	30320	28300	26280	24260	22240
34-1/2	46200	43890	41580	39270	36960	34650	32340	30030	27720	25410
36	52490	49860	47240	44610	41990	39370	36740	34120	31490	28870
37-1/2	59330	56360	53390	50430	47460	44490	41530	38560	35600	32630
39	66730	63400	60060	56720	53390	50050	46710	43380	40040	36700
40-1/2	74730	71000	67260	63520	59790	56050	52310	48580	44840	41100
42	83350	79180	75010	70850	66680	62510	58340	54180	50010	45840
43-1/2	92600	87970	83340	78710	74080	69450	64820	60190	55560	50930
45	102500	97390	92260	87140	82010	76890	71760	66640	61510	56380
46-1/2	113100	107500	101800	96150	90490	84830	79180	73520	67870	62210
48	124400	118200	112000	105800	99530	93310	87090	80870	74650	68430
49-1/2	136400	129600	122800	116000	109200	102300	95510	88690	81870	75050
51	149200	141800	134300	126800	119400	111900	104500	97000	89540	82080
52-1/2	162800	154700	146500	138400	130200	122100	114000	105800	97670	89540
54	177100	168300	159400	150600	141700	132900	124000	115100	106300	97430
55-1/2	192300	182700	173100	163500	153900	144200	134600	125000	115400	105800
57	208300	197900	187500	177100	166700	156300	145800	135400	125000	114600
58-1/2	225200	214000	202700	191400	180200	168900	157700	146400	135100	123900
60	243000	230900	218700	206600	194400	182300	170100	158000	145800	133700

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
8-3/4 in. Width										
9	1063	1010	956.8	903.7	850.5	797.3	744.2	691.0	637.9	584.7
10-1/2	1688	1604	1519	1435	1351	1266	1182	1097	1013	928.5
12	2520	2394	2268	2142	2016	1890	1764	1638	1512	1386
13-1/2	3588	3409	3229	3050	2870	2691	2512	2332	2153	1973
15	4922	4676	4430	4184	3938	3691	3445	3199	2953	2707
16-1/2	6551	6223	5896	5568	5241	4913	4586	4258	3931	3603
18	8505	8080	7655	7229	6804	6379	5954	5528	5103	4678
19-1/2	10810	10270	9732	9191	8651	8110	7569	7029	6488	5947
21	13510	12830	12160	11480	10800	10130	9454	8779	8103	7428
22-1/2	16610	15780	14950	14120	13290	12460	11630	10800	9967	9136
24	20160	19150	18140	17140	16130	15120	14110	13100	12100	11090
25-1/2	24180	22970	21760	20550	19340	18140	16930	15720	14510	13300
27	28700	27270	25830	24400	22960	21530	20090	18660	17220	15790
28-1/2	33760	32070	30380	28700	27010	25320	23630	21940	20260	18570
30	39380	37410	35440	33470	31500	29530	27560	25590	23630	21660
31-1/2	45580	43300	41020	38740	36470	34190	31910	29630	27350	25070
33	52410	49790	47170	44550	41930	39310	36690	34070	31440	28820
34-1/2	59880	56890	53900	50900	47910	44910	41920	38920	35930	32940
36	68040	64640	61240	57830	54430	51030	47630	44230	40820	37420
37-1/2	76900	73060	69210	65370	61520	57680	53830	49990	46140	42300
39	86510	82180	77860	73530	69210	64880	60550	56230	51900	47580
40-1/2	96880	92030	87190	82350	77500	72660	67810	62970	58130	53280
42	108000	102600	97240	91840	86440	81030	75630	70230	64830	59420
43-1/2	120000	114000	108000	102000	96030	90030	84030	78030	72020	66020
45	132900	126200	119600	113000	106300	99670	93020	86380	79730	73090
46-1/2	146600	139300	132000	124600	117300	110000	102600	95310	87980	80650
48	161300	153200	145200	137100	129000	121000	112900	104800	96770	88700
49-1/2	176900	168000	159200	150300	141500	132700	123800	115000	106100	97280
51	193400	183800	174100	164400	154800	145100	135400	125700	116100	106400
52-1/2	211000	200500	189900	179400	168800	158300	147700	137200	126600	116100
54	229600	218200	206700	195200	183700	172200	160700	149300	137800	126300
55-1/2	249300	236800	224400	211900	199400	187000	174500	162100	149600	137100
57	270100	256600	243100	229600	216100	202600	189100	175500	162000	148500
58-1/2	292000	277400	262800	248200	233600	219000	204400	189800	175200	160600
60	315000	299300	283500	267800	252000	236300	220500	204800	189000	173300

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
10-3/4 in. Width										
12	3096	2941	2786	2632	2477	2322	2167	2012	1858	1703
13-1/2	4408	4188	3967	3747	3527	3306	3086	2865	2645	2424
15	6047	5745	5442	5140	4838	4535	4233	3930	3628	3326
16-1/2	8048	7646	7244	6841	6439	6036	5634	5231	4829	4427
18	10450	9927	9404	8882	8359	7837	7314	6792	6269	5747
19-1/2	13280	12620	11960	11290	10630	9964	9299	8635	7971	7307
21	16590	15760	14930	14100	13270	12440	11610	10790	9956	9126
22-1/2	20410	19390	18370	17350	16330	15310	14290	13270	12240	11220
24	24770	23530	22290	21050	19810	18580	17340	16100	14860	13620
25-1/2	29710	28220	26740	25250	23770	22280	20800	19310	17820	16340
27	35270	33500	31740	29980	28210	26450	24690	22920	21160	19400
28-1/2	41480	39400	37330	35250	33180	31110	29030	26960	24890	22810
30	48380	45960	43540	41120	38700	36280	33860	31440	29030	26610
31-1/2	56000	53200	50400	47600	44800	42000	39200	36400	33600	30800
33	64390	61170	57950	54730	51510	48290	45070	41850	38630	35410
34-1/2	73570	69890	66220	62540	58860	55180	51500	47820	44140	40460
36	83590	79410	75230	71050	66870	62690	58510	54330	50160	45980
37-1/2	94480	89760	85030	80310	75590	70860	66140	61410	56690	51970
39	106300	101000	95650	90340	85020	79710	74400	69080	63770	58450
40-1/2	119000	113100	107100	101200	95220	89270	83310	77360	71410	65460
42	132700	126100	119500	112800	106200	99560	92920	86280	79640	73010
43-1/2	147500	140100	132700	125400	118000	110600	103200	95860	88490	81110
45	163300	155100	146900	138800	130600	122400	114300	106100	97960	89800
46-1/2	180100	171100	162100	153100	144100	135100	126100	117100	108100	99080
48	198100	188200	178300	168400	158500	148600	138700	128800	118900	109000
49-1/2	217300	206400	195600	184700	173800	163000	152100	141200	130400	119500
51	237700	225800	213900	202000	190100	178200	166400	154500	142600	130700
52-1/2	259300	246300	233300	220400	207400	194400	181500	168500	155600	142600
54	282100	268000	253900	239800	225700	211600	197500	183400	169300	155200
55-1/2	306300	291000	275700	260300	245000	229700	214400	199100	183800	168500
57	331800	315200	298600	282000	265400	248900	232300	215700	199100	182500
58-1/2	358700	340800	322800	304900	287000	269000	251100	233200	215200	197300
60	387000	367700	348300	329000	309600	290300	270900	251600	232200	212900

Table 5.3 Reference Stiffness for Bending about X-X Axis *Western Species* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
12-1/4 in. Width										
13-1/2	5023	4772	4521	4270	4019	3767	3516	3265	3014	2763
15	6891	6546	6202	5857	5513	5168	4823	4479	4134	3790
16-1/2	9171	8713	8254	7796	7337	6879	6420	5961	5503	5044
18	11910	11310	10720	10120	9526	8930	8335	7740	7144	6549
19-1/2	15140	14380	13620	12870	12110	11350	10600	9840	9083	8326
21	18910	17960	17020	16070	15130	14180	13240	12290	11340	10400
22-1/2	23260	22090	20930	19770	18600	17440	16280	15120	13950	12790
24	28220	26810	25400	23990	22580	21170	19760	18350	16930	15520
25-1/2	33850	32160	30470	28780	27080	25390	23700	22000	20310	18620
27	40190	38180	36170	34160	32150	30140	28130	26120	24110	22100
28-1/2	47260	44900	42540	40170	37810	35450	33080	30720	28360	25990
30	55130	52370	49610	46860	44100	41340	38590	35830	33080	30320
31-1/2	63810	60620	57430	54240	51050	47860	44670	41480	38290	35100
33	73370	69700	66030	62370	58700	55030	51360	47690	44020	40350
34-1/2	83840	79650	75450	71260	67070	62880	58690	54490	50300	46110
36	95260	90490	85730	80970	76200	71440	66680	61920	57150	52390
37-1/2	107700	102300	96900	91520	86130	80750	75370	69980	64600	59220
39	121100	115100	109000	102900	96890	90830	84780	78720	72670	66610
40-1/2	135600	128800	122100	115300	108500	101700	94940	88160	81380	74600
42	151300	143700	136100	128600	121000	113400	105900	98320	90760	83190
43-1/2	168100	159700	151200	142800	134400	126000	117600	109200	100800	92430
45	186000	176700	167400	158100	148800	139500	130200	120900	111600	102300
46-1/2	205300	195000	184800	174500	164200	154000	143700	133400	123200	112900
48	225800	214500	203200	191900	180600	169300	158100	146800	135500	124200
49-1/2	247600	235200	222900	210500	198100	185700	173300	161000	148600	136200
51	270800	257300	243700	230200	216700	203100	189600	176000	162500	149000
52-1/2	295400	280700	265900	251100	236300	221600	206800	192000	177300	162500
54	321500	305400	289300	273300	257200	241100	225000	209000	192900	176800
55-1/2	349000	331600	314100	296700	279200	261800	244300	226900	209400	192000
57	378100	359200	340300	321400	302500	283600	264700	245800	226900	208000
58-1/2	408700	388300	367900	347400	327000	306600	286100	265700	245200	224800
60	441000	419000	396900	374900	352800	330800	308700	286700	264600	242600

Table 5.4 Reference Stiffness for Bending about X-X Axis *Southern Pine* Glued Laminated Timber

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
2-1/2 in. Width										
5-1/2	69.32	65.86	62.39	58.92	55.46	51.99	48.53	45.06	41.59	38.13
6-7/8	135.4	128.6	121.9	115.1	108.3	101.5	94.78	88.01	81.24	74.47
8-1/4	234.0	222.3	210.6	198.9	187.2	175.5	163.8	152.1	140.4	128.7
9-5/8	371.5	353.0	334.4	315.8	297.2	278.6	260.1	241.5	222.9	204.3
11	554.6	526.9	499.1	471.4	443.7	415.9	388.2	360.5	332.8	305.0
12-3/8	789.6	750.1	710.7	671.2	631.7	592.2	552.7	513.3	473.8	434.3
13-3/4	1083	1029	974.9	920.7	866.5	812.4	758.2	704.1	649.9	595.7
15-1/8	1442	1370	1298	1225	1153	1081	1009	937.1	865.0	792.9
16-1/2	1872	1778	1685	1591	1497	1404	1310	1217	1123	1029
17-7/8	2380	2261	2142	2023	1904	1785	1666	1547	1428	1309
19-1/4	2972	2824	2675	2526	2378	2229	2081	1932	1783	1635
20-5/8	3656	3473	3290	3107	2925	2742	2559	2376	2193	2011
22	4437	4215	3993	3771	3549	3328	3106	2884	2662	2440
23-3/8	5322	5056	4789	4523	4257	3991	3725	3459	3193	2927
3 in. Width										
5-1/2	83.19	79.03	74.87	70.71	66.55	62.39	58.23	54.07	49.91	45.75
6-7/8	162.5	154.4	146.2	138.1	130.0	121.9	113.7	105.6	97.49	89.36
8-1/4	280.8	266.7	252.7	238.6	224.6	210.6	196.5	182.5	168.5	154.4
9-5/8	445.8	423.5	401.2	379.0	356.7	334.4	312.1	289.8	267.5	245.2
11	665.5	632.2	599.0	565.7	532.4	499.1	465.9	432.6	399.3	366.0
12-3/8	947.6	900.2	852.8	805.4	758.0	710.7	663.3	615.9	568.5	521.2
13-3/4	1300	1235	1170	1105	1040	974.9	909.9	844.9	779.9	714.9
15-1/8	1730	1644	1557	1471	1384	1298	1211	1125	1038	951.5
16-1/2	2246	2134	2021	1909	1797	1685	1572	1460	1348	1235
17-7/8	2856	2713	2570	2427	2285	2142	1999	1856	1713	1571
19-1/4	3567	3388	3210	3032	2853	2675	2497	2318	2140	1962
20-5/8	4387	4167	3948	3729	3509	3290	3071	2851	2632	2413
22	5324	5058	4792	4525	4259	3993	3727	3461	3194	2928
23-3/8	6386	6067	5747	5428	5109	4789	4470	4151	3832	3512
3-1/8 in. Width										
5-1/2	86.65	82.32	77.99	73.66	69.32	64.99	60.66	56.32	51.99	47.66
6-7/8	169.2	160.8	152.3	143.9	135.4	126.9	118.5	110.0	101.5	93.08
8-1/4	292.5	277.8	263.2	248.6	234.0	219.3	204.7	190.1	175.5	160.9
9-5/8	464.4	441.2	418.0	394.7	371.5	348.3	325.1	301.9	278.6	255.4
11	693.2	658.6	623.9	589.2	554.6	519.9	485.3	450.6	415.9	381.3
12-3/8	987.0	937.7	888.3	839.0	789.6	740.3	690.9	641.6	592.2	542.9
13-3/4	1354	1286	1219	1151	1083	1015	947.8	880.1	812.4	744.7
15-1/8	1802	1712	1622	1532	1442	1352	1261	1171	1081	991.2
16-1/2	2340	2223	2106	1989	1872	1755	1638	1521	1404	1287
17-7/8	2975	2826	2677	2528	2380	2231	2082	1934	1785	1636
19-1/4	3715	3530	3344	3158	2972	2786	2601	2415	2229	2043
20-5/8	4570	4341	4113	3884	3656	3427	3199	2970	2742	2513
22	5546	5269	4991	4714	4437	4159	3882	3605	3328	3050
23-3/8	6652	6319	5987	5654	5322	4989	4656	4324	3991	3659

Table 5.4 Reference Stiffness for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
5 in. Width										
6-7/8	270.8	257.3	243.7	230.2	216.6	203.1	189.6	176.0	162.5	148.9
8-1/4	467.9	444.5	421.1	397.7	374.3	350.9	327.6	304.2	280.8	257.4
9-5/8	743.1	705.9	668.7	631.6	594.4	557.3	520.1	483.0	445.8	408.7
11	1109	1054	998.3	942.8	887.3	831.9	776.4	721.0	665.5	610.0
12-3/8	1579	1500	1421	1342	1263	1184	1105	1027	947.6	868.6
13-3/4	2166	2058	1950	1841	1733	1625	1516	1408	1300	1191
15-1/8	2883	2739	2595	2451	2307	2163	2018	1874	1730	1586
16-1/2	3743	3556	3369	3182	2995	2808	2620	2433	2246	2059
17-7/8	4759	4521	4284	4046	3808	3570	3332	3094	2856	2618
19-1/4	5944	5647	5350	5053	4756	4458	4161	3864	3567	3269
20-5/8	7311	6946	6580	6215	5849	5484	5118	4752	4387	4021
22	8873	8430	7986	7542	7099	6655	6211	5768	5324	4880
23-3/8	10640	10110	9579	9047	8515	7982	7450	6918	6386	5854
24-3/4	12630	12000	11370	10740	10110	9476	8844	8212	7580	6949
26-1/8	14860	14120	13370	12630	11890	11140	10400	9658	8915	8172
27-1/2	17330	16460	15600	14730	13860	13000	12130	11260	10400	9532
28-7/8	20060	19060	18060	17050	16050	15050	14040	13040	12040	11030
30-1/4	23070	21910	20760	19610	18450	17300	16150	14990	13840	12690
31-5/8	26360	25040	23720	22400	21090	19770	18450	17130	15810	14500
33	29950	28450	26950	25460	23960	22460	20960	19470	17970	16470
34-3/8	33850	32160	30460	28770	27080	25390	23690	22000	20310	18620
35-3/4	38080	36170	34270	32360	30460	28560	26650	24750	22850	20940
5-1/8 in. Width										
6-7/8	277.6	263.7	249.8	235.9	222.0	208.2	194.3	180.4	166.5	152.7
8-1/4	479.6	455.6	431.7	407.7	383.7	359.7	335.7	311.8	287.8	263.8
9-5/8	761.6	723.5	685.5	647.4	609.3	571.2	533.1	495.1	457.0	418.9
11	1137	1080	1023	966.4	909.5	852.7	795.8	739.0	682.1	625.3
12-3/8	1619	1538	1457	1376	1295	1214	1133	1052	971.2	890.3
13-3/4	2220	2109	1998	1887	1776	1665	1554	1443	1332	1221
15-1/8	2955	2808	2660	2512	2364	2217	2069	1921	1773	1626
16-1/2	3837	3645	3453	3261	3070	2878	2686	2494	2302	2110
17-7/8	4878	4635	4391	4147	3903	3659	3415	3171	2927	2683
19-1/4	6093	5788	5484	5179	4874	4570	4265	3960	3656	3351
20-5/8	7494	7119	6745	6370	5995	5621	5246	4871	4497	4122
22	9095	8640	8186	7731	7276	6821	6367	5912	5457	5002
23-3/8	10910	10360	9818	9273	8727	8182	7637	7091	6546	6000
24-3/4	12950	12300	11650	11010	10360	9712	9065	8417	7770	7122
26-1/8	15230	14470	13710	12950	12180	11420	10660	9900	9138	8377
27-1/2	17760	16880	15990	15100	14210	13320	12430	11550	10660	9770
28-7/8	20560	19540	18510	17480	16450	15420	14390	13370	12340	11310
30-1/4	23640	22460	21280	20100	18920	17730	16550	15370	14190	13000
31-5/8	27020	25670	24320	22960	21610	20260	18910	17560	16210	14860
33	30700	29160	27630	26090	24560	23020	21490	19950	18420	16880
34-3/8	34700	32960	31230	29490	27760	26020	24290	22550	20820	19080
35-3/4	39030	37080	35120	33170	31220	29270	27320	25370	23420	21470

Table 5.4 Reference Stiffness for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
6-3/4 in. Width										
6-7/8	365.6	347.3	329.0	310.7	292.5	274.2	255.9	237.6	219.3	201.1
8-1/4	631.7	600.1	568.5	536.9	505.4	473.8	442.2	410.6	379.0	347.4
9-5/8	1003	953.0	902.8	852.7	802.5	752.3	702.2	652.0	601.9	551.7
11	1497	1423	1348	1273	1198	1123	1048	973.3	898.4	823.6
12-3/8	2132	2025	1919	1812	1706	1599	1492	1386	1279	1173
13-3/4	2925	2778	2632	2486	2340	2193	2047	1901	1755	1609
15-1/8	3893	3698	3503	3309	3114	2919	2725	2530	2336	2141
16-1/2	5054	4801	4548	4296	4043	3790	3538	3285	3032	2780
17-7/8	6425	6104	5783	5461	5140	4819	4498	4176	3855	3534
19-1/4	8025	7624	7222	6821	6420	6019	5617	5216	4815	4414
20-5/8	9870	9377	8883	8390	7896	7403	6909	6416	5922	5429
22	11980	11380	10780	10180	9583	8984	8385	7786	7187	6588
23-3/8	14370	13650	12930	12210	11490	10780	10060	9339	8621	7903
24-3/4	17060	16200	15350	14500	13640	12790	11940	11090	10230	9381
26-1/8	20060	19060	18050	17050	16050	15040	14040	13040	12040	11030
27-1/2	23400	22230	21060	19890	18720	17550	16380	15210	14040	12870
28-7/8	27080	25730	24380	23020	21670	20310	18960	17600	16250	14900
30-1/4	31140	29580	28030	26470	24910	23360	21800	20240	18680	17130
31-5/8	35580	33800	32020	30250	28470	26690	24910	23130	21350	19570
33	40430	38410	36390	34360	32340	30320	28300	26280	24260	22240
34-3/8	45700	43410	41130	38840	36560	34270	31990	29700	27420	25130
35-3/4	51400	48830	46260	43690	41120	38550	35980	33410	30840	28270
37-1/8	57560	54690	51810	48930	46050	43170	40290	37420	34540	31660
38-1/2	64200	60990	57780	54570	51360	48150	44940	41730	38520	35310
39-7/8	71330	67760	64190	60630	57060	53500	49930	46360	42800	39230
41-1/4	78960	75010	71070	67120	63170	59220	55270	51330	47380	43430
42-5/8	87130	82770	78410	74060	69700	65340	60990	56630	52280	47920
44	95830	91040	86250	81460	76670	71870	67080	62290	57500	52710
45-3/8	105100	99840	94590	89330	84080	78820	73570	68310	63060	57800
46-3/4	114900	109200	103500	97700	91960	86210	80460	74720	68970	63220
48-1/8	125400	119100	112900	106600	100300	94040	87770	81500	75230	68960
49-1/2	136400	129600	122800	116000	109200	102300	95510	88690	81870	75050
50-7/8	148100	140700	133300	125900	118500	111100	103700	96290	88880	81480
52-1/4	160500	152500	144400	136400	128400	120400	112300	104300	96290	88260
53-5/8	173500	164800	156100	147500	138800	130100	121400	112800	104100	95420
55	187200	177800	168500	159100	149700	140400	131000	121700	112300	102900
56-3/8	201600	191500	181400	171300	161300	151200	141100	131000	120900	110900
57-3/4	216700	205800	195000	184200	173300	162500	151700	140800	130000	119200
59-1/8	232500	220900	209300	197600	186000	174400	162800	151100	139500	127900
60-1/2	249100	236700	224200	211800	199300	186800	174400	161900	149500	137000

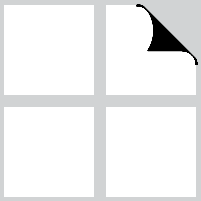
Table 5.4 Reference Stiffness for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
8-1/2 in. Width										
9-5/8	1263	1200	1137	1074	1011	947.4	884.2	821.1	757.9	694.8
11	1886	1791	1697	1603	1508	1414	1320	1226	1131	1037
12-3/8	2685	2551	2416	2282	2148	2014	1879	1745	1611	1477
13-3/4	3683	3499	3315	3130	2946	2762	2578	2394	2210	2026
15-1/8	4902	4657	4412	4167	3921	3676	3431	3186	2941	2696
16-1/2	6364	6046	5727	5409	5091	4773	4455	4136	3818	3500
17-7/8	8091	7687	7282	6877	6473	6068	5664	5259	4855	4450
19-1/4	10110	9600	9095	8590	8084	7579	7074	6569	6063	5558
20-5/8	12430	11810	11190	10560	9944	9322	8701	8079	7458	6836
22	15080	14330	13580	12820	12070	11310	10560	9805	9051	8297
23-3/8	18090	17190	16280	15380	14470	13570	12670	11760	10860	9951
24-3/4	21480	20400	19330	18260	17180	16110	15030	13960	12890	11810
26-1/8	25260	24000	22730	21470	20210	18950	17680	16420	15160	13890
27-1/2	29460	27990	26520	25040	23570	22100	20620	19150	17680	16200
28-7/8	34110	32400	30700	28990	27280	25580	23870	22170	20460	18760
30-1/4	39210	37250	35290	33330	31370	29410	27450	25490	23530	21570
31-5/8	44810	42570	40330	38090	35850	33610	31370	29130	26890	24640
33	50910	48370	45820	43270	40730	38180	35640	33090	30550	28000
34-3/8	57540	54670	51790	48910	46030	43160	40280	37400	34530	31650
35-3/4	64730	61490	58260	55020	51780	48550	45310	42070	38840	35600
37-1/8	72490	68860	65240	61610	57990	54370	50740	47120	43490	39870
38-1/2	80840	76800	72760	68720	64680	60630	56590	52550	48510	44460
39-7/8	89820	85330	80840	76350	71860	67360	62870	58380	53890	49400
41-1/4	99440	94460	89490	84520	79550	74580	69600	64630	59660	54690
42-5/8	109700	104200	98740	93260	87770	82290	76800	71310	65830	60340
44	120700	114600	108600	102600	96540	90510	84470	78440	72410	66370
45-3/8	132300	125700	119100	112500	105900	99260	92640	86030	79410	72790
46-3/4	144700	137500	130300	123000	115800	108600	101300	94090	86850	79610
48-1/8	157900	150000	142100	134200	126300	118400	110500	102600	94740	86840
49-1/2	171800	163200	154600	146100	137500	128900	120300	111700	103100	94500
50-7/8	186500	177200	167900	158600	149200	139900	130600	121300	111900	102600
52-1/4	202100	192000	181900	171800	161700	151600	141500	131400	121200	111100
53-5/8	218500	207500	196600	185700	174800	163800	152900	142000	131100	120200
55	235700	223900	212100	200300	188600	176800	165000	153200	141400	129600
56-3/8	253800	241100	228400	215700	203100	190400	177700	165000	152300	139600
57-3/4	272800	259200	245600	231900	218300	204600	191000	177400	163700	150100
59-1/8	292800	278200	263500	248900	234200	219600	205000	190300	175700	161000
60-1/2	313700	298000	282300	266700	251000	235300	219600	203900	188200	172500

Table 5.4 Reference Stiffness for Bending about X-X Axis *Southern Pine* Glued Laminated Timber (Cont.)

Depth	EI (10^3 kip-in^2) when E (ksi) is									
d (in.)	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100
10-1/2 in. Width										
11	2329	2213	2096	1980	1863	1747	1630	1514	1398	1281
12-3/8	3316	3151	2985	2819	2653	2487	2322	2156	1990	1824
13-3/4	4549	4322	4094	3867	3639	3412	3185	2957	2730	2502
15-1/8	6055	5752	5450	5147	4844	4541	4239	3936	3633	3330
16-1/2	7861	7468	7075	6682	6289	5896	5503	5110	4717	4324
17-7/8	9995	9495	8995	8496	7996	7496	6996	6497	5997	5497
19-1/4	12480	11860	11230	10610	9987	9362	8738	8114	7490	6866
20-5/8	15350	14590	13820	13050	12280	11520	10750	9980	9212	8445
22	18630	17700	16770	15840	14910	13980	13040	12110	11180	10250
23-3/8	22350	21230	20120	19000	17880	16760	15650	14530	13410	12290
24-3/4	26530	25210	23880	22550	21230	19900	18570	17250	15920	14590
26-1/8	31200	29640	28080	26520	24960	23400	21840	20280	18720	17160
27-1/2	36390	34570	32760	30940	29120	27300	25480	23660	21840	20020
28-7/8	42130	40020	37920	35810	33700	31600	29490	27390	25280	23170
30-1/4	48440	46020	43600	41170	38750	36330	33910	31490	29060	26640
31-5/8	55350	52580	49820	47050	44280	41510	38750	35980	33210	30440
33	62890	59750	56600	53460	50310	47170	44020	40880	37730	34590
34-3/8	71080	67530	63970	60420	56870	53310	49760	46200	42650	39100
35-3/4	79960	75960	71960	67960	63970	59970	55970	51970	47980	43980
37-1/8	89540	85070	80590	76110	71640	67160	62680	58200	53730	49250
38-1/2	99870	94870	89880	84890	79890	74900	69910	64910	59920	54930
39-7/8	111000	105400	99860	94310	88760	83210	77670	72120	66570	61020
41-1/4	122800	116700	110500	104400	98270	92120	85980	79840	73700	67560
42-5/8	135500	128800	122000	115200	108400	101600	94870	88090	81320	74540
44	149100	141600	134200	126700	119300	111800	104400	96900	89440	81990
45-3/8	163500	155300	147100	139000	130800	122600	114400	106300	98090	89920
46-3/4	178800	169900	160900	152000	143000	134100	125200	116200	107300	98340
48-1/8	195100	185300	175500	165800	156000	146300	136500	126800	117000	107300
49-1/2	212300	201600	191000	180400	169800	159200	148600	138000	127400	116700
50-7/8	230400	218900	207400	195900	184300	172800	161300	149800	138300	126700
52-1/4	249600	237100	224700	212200	199700	187200	174700	162300	149800	137300
53-5/8	269900	256400	242900	229400	215900	202400	188900	175400	161900	148400
55	291200	276600	262000	247500	232900	218400	203800	189300	174700	160100
56-3/8	313500	297900	282200	266500	250800	235200	219500	203800	188100	172400
57-3/4	337000	320200	303300	286500	269600	252800	235900	219100	202200	185400
59-1/8	361700	343600	325500	307400	289400	271300	253200	235100	217000	198900
60-1/2	387500	368200	348800	329400	310000	290600	271300	251900	232500	213100

OTHER CONSIDERATIONS



6.1 General

The section contains information concerning physical properties of glued laminated timber members. Other design considerations, such as fire protection, are also given.

6.2 Specific Gravity

Table 6.1 provides specific gravity values for some most common wood species used for glued laminated timber. These values are used in determining various physical and connection properties. Further, weight factors are provided at four moisture contents. When the cross-sectional area (in.^{2}) is multiplied by the appropriate weight factor, it provides the weight of the glued laminated timber member per linear foot of length. For other moisture contents, the tabulated weight factors can be interpolated or extrapolated.

Glued laminated timber members often are manufactured using different species at different portions of the cross section. In this case the weight of the glued laminated timber may be computed by the sum of the products of the cross-sectional area and the weight factor for each species.

Table 6.1 Average Specific Gravity and Weight Factor

Species Combination	Specific Gravity[(a)]	Weight Factor[(b)]			
		12%	15%	19%	25%
California Redwood (Close Grain)	0.44	0.195	0.198	0.202	0.208
Douglas Fir-Larch	0.50	0.235	0.238	0.242	0.248
Douglas Fir (South)	0.46	0.221	0.225	0.229	0.235
Eastern Spruce	0.41	0.191	0.194	0.198	0.203
Hem-Fir	0.43	0.195	0.198	0.202	0.208
Red Maple	0.58	0.261	0.264	0.268	0.274
Red Oak	0.67	0.307	0.310	0.314	0.319
Southern Pine	0.55	0.252	0.255	0.259	0.265
Spruce-Pine-Fir (North)	0.42	0.195	0.198	0.202	0.208
Yellow Poplar	0.43	0.213	0.216	0.220	0.226

[(a)] Specific gravity is based on weight and volume when oven-dry.
[(b)] Weight factor shall be multiplied by cross-sectional area in in.^{2} to obtain weight in pounds per lineal foot.

6.3 Moisture Expansion

Due to the hygroscopic nature of wood, it changes dimensions as its moisture content is altered below the fiber saturation point. For most species the longitudinal shrinkage of normal wood drying from fiber saturation point to oven-dry condition is approximately 0.1 to 0.2 percent. However, certain atypical types of wood may exhibit excessive longitudinal shrinkage and these types should be avoided in use where longitudinal stability is important.

The change in radial (R), tangential (T) and volumetric (V) dimensions are computed as:

$$X = X_o(\Delta MC)e_{ME} \quad [6.1]$$

where:

X_o = initial dimension or volume,

X = new dimension or volume,

e_{ME} = coefficient of moisture expansion (in./in./%MC for linear expansion, in.^{3}/in.^{3}/%MC for volumetric expansion), as given in Table 6.2, and

ΔMC = moisture content change (%), as defined as follows:

$$\Delta MC = M - M_o \quad [6.2]$$

where:

M_o = initial moisture content % ($M_o \le FSP$),

M = new moisture content % ($M \le FSP$), and

FSP = fiber saturation point, as given in Table 6.2 for selected species.

Table 6.2 Coefficient of Moisture Expansion, e_{ME}, and Fiber Saturation Point, FSP, for Solid Woods

Species	e_{ME} Radial (in./in./%)	e_{ME} Tangential (in./in./%)	e_{ME} Volumetric ($in.^3/in.^3/\%$)	FSP (%)
Alaska Cedar	0.0010	0.0021	0.0033	28
Douglas Fir-Larch	0.0018	0.0033	0.0050	28
Englemann Spruce	0.0013	0.0024	0.0037	30
Redwood	0.0012	0.0022	0.0032	22
Red Oak	0.0017	0.0038	0.0063	30
Southern Pine	0.0020	0.0030	0.0047	26
Western Hemlock	0.0015	0.0028	0.0044	28
Yellow Poplar	0.0015	0.0026	0.0041	31

6.4 Thermal Expansion

The thermal expansion of solid wood, including glued laminated timber, is computed by the relationship:

$$X = X_o(\Delta T)e_{TE} \quad [6.3]$$

where:

X_o = reference dimension at T_o,

X = computed dimension at T,

e_{TE} = coefficient of thermal expansion (in./in./°F), see Table 6.3, and

ΔT = temperature change (°F), as defined as follows:

$$\Delta T = T - T_o \quad [6.4]$$

where:

T_o = reference temperature (°F), $-60°F \le T_o \le 130°F$, and

T = new temperature (°F), $-60°F \le T_o \le 130°F$.

The coefficient of thermal expansion of oven-dry wood parallel to grain appears to be independent of specific gravity and species. In tests of both hardwoods and softwoods, the parallel-to-grain values have ranged from about $1.7x10^{-6}$ to $2.5x10^{-6}$ per °F.

The linear expansion coefficients across the grain (radial and tangential) are proportional to the density of wood. These coefficients are about 5 to 10 times greater than the parallel-to-grain coefficients. The radial and tangential thermal expansion coefficients for oven-dry wood in the oven-dry specific gravity (SG) range of about 0.1 to 0.8 can be approximated by the following equations.

Radial:

$$e_{TE} = [18(SG) + 5.5] \quad (10^{-6}\, in./in./°F) \quad [6.5]$$

Tangential:

$$e_{TE} = [18(SG) + 10.2] \quad (10^{-6}\, in./in./°F) \quad [6.6]$$

where:

SG = specific gravity provided in Table 6.1.

Table 6.3 provides the numerical values for e_{TE} for the most commonly used commercial species or species groups.

Wood that contains moisture reacts to varying temperature differently than does dry wood. When moist wood is heated, it tends to expand because of normal thermal expansion and to shrink because of loss in moisture content. Unless the wood is very dry initially (perhaps 3 or 4 percent MC or less), the shrinkage due to moisture loss on heating will be greater than the thermal expansion, so the net dimensional change on heating will be negative.

Wood at intermediate moisture levels (about 8 to 20 percent) will expand when first heated, then gradually shrink to a volume smaller than the initial volume, as the wood gradually loses water while in the heated condition.

Even in the longitudinal (grain) direction, where dimensional change due to moisture change is very small, such changes will still predominate over corresponding dimensional changes due to thermal expansion unless the wood is very dry initially. For wood at usual moisture levels, net dimensional changes will generally be negative after prolonged heating.

Computation of actual changes in dimensions can be accomplished by determining the equilibrium moisture content of wood at the temperature value and relative humidity of interest. Then the relative dimensional changes due to temperature change alone and moisture content change alone are computed. By combining these two changes the final dimension of lumber and timber can be established.

Table 6.3 Coefficient of Thermal Expansion, e_{TE}, for Solid Woods

Species	e_{TE}	
	Radial (10^{-6} in./in./°F)	Tangential (10^{-6} in./in./°F)
California Redwood	13	18
Douglas Fir-Larch[a]	15	19
Douglas Fir, *South*	14	19
Eastern Spruce	13	18
Hem-Fir[a]	13	18
Red Oak	18	22
Southern Pine	15	20
Spruce-Pine-Fir	13	18
Yellow Poplar	14	18

[a] Also applies when species name includes the designation "North."

6.5 Fire Considerations

Fires do not normally start in structural framing, but rather in the building's contents. These fires generally reach temperatures of between 1290°F and 1650°F. Glued laminated timber members perform very well under these conditions. Unprotected steel members typically suffer severe buckling and twisting during fires, often collapsing catastrophically.

Wood ignites at about 480°F, but charring may begin as low as 300°F. Wood typically chars at 1/40 in. per minute. Thus, after half an hour's fire exposure, only the outer 3/4 in. of the glued laminated timber will be damaged. Char insulates a wood member and hence raises the temperature it can withstand. Most of the cross section will remain intact, and the member will continue supporting its service load.

It is important to note that neither building materials alone, nor building features alone, nor detection and fire extinguishing equipment alone can provide adequate safety from fire in buildings. To ensure a safe structure in the event of fire, authorities base fire and building code requirements on research and testing, as well as fire histories. The model building codes classify Heavy Timber as a specific type of construction and give minimum sizes for roof and floor beams.

The requirements set out for Heavy Timber construction in model building codes do not constitute one-hour fire resistance. However, procedures are available to estimate the glued laminated timber size required for projects in which one-hour fire resistance is required (see 1994 Uniform Building Code Volume 3, Uniform Building Code Standard 7-7, Part VI). The minimum depths for selected glued laminated timber sizes that can be adopted for one-hour fire ratings are given in Table 6.4 for glued laminated timber beams.

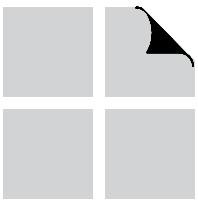
To adopt beams whose dimensions qualify them for one-hour fire rating, the basic layup must be modified - one core lamination must be removed from the center and the tension face augmented with the addition of a tension lamination.

Table 6.4 Minimum Depths at Which Selected Beam Sizes Can Be Adopted for One-Hour Fire Ratings[a, b]

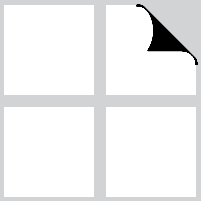
Beam Width (in.)	Beam Depth (in.)	
	3 Sides Exposed	4 Sides Exposed
6-3/4	13-1/2 or 13-3/4	27 or 27-1/2
8-1/2	7-1/2 or 8-1/4	15 or 15-1/8
8-3/4	6-7/8 or 7-1/2	13-1/2 or 13-3/4
10-1/2	6 or 6-7/8	12 or 12-3/8
10-3/4	6 or 6-7/8	12 or 12-3/8

[a] Assuming a load factor of 1.0 (design loads are equal to the resistance of the member). The minimum depths may be reduced when the design loads are less than the member resistance.

[b] One-Hour fire rated glued laminated timbers must have an additional tension lamination installed at time of manufacture.



LOAD AND SPAN TABLES



7.1 General

The section contains load-span tables for selected glued laminated timber bending members made of Douglas fir-Larch (24F-V4/WS) or Southern Pine (24F-V3/SP) when subjected to uniform loads in simple-span applications. These tables can be used to size such members for preliminary design. ***Final design should include a complete analysis, including bearing stresses, lateral stability, and other applicable design considerations.***

7.2 Load and Span Tables for Selected Members

Table 7.1 Design Loads for Simple Span Douglas Fir-Larch Glued Laminated Timber Beams

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.545 ksi

Beam Width = 3-1/8 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	4.6	810	519	360	265	203	160	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7-1/2	5.7	1266	810	563	413	316	250	203	167	---	---	---	---	---	---	---	---	---	---	---	---	---
9	6.8	1823	1167	810	595	456	360	292	241	203	173	---	---	---	---	---	---	---	---	---	---	---
10-1/2	8.0	2289	1588	1103	810	620	490	397	328	276	235	203	176	---	---	---	---	---	---	---	---	---
12	9.1	2725	2044	1440	1058	810	640	519	429	360	307	265	230	203	179	159	---	---	---	---	---	---
13-1/2	10.3	3199	2373	1823	1339	1025	810	656	542	456	388	335	292	255	225	199	178	160	---	---	---	---
15	11.4	3716	2725	2151	1653	1266	1000	810	670	563	479	413	357	312	274	243	217	195	176	160	---	---
16-1/2	12.5	4282	3101	2430	1998	1532	1210	980	810	681	578	495	428	374	329	292	260	234	211	191	174	159
18	13.7	4905	3504	2725	2230	1823	1440	1167	964	807	682	584	505	441	388	344	307	276	249	226	206	188
19-1/2	14.8	5593	3936	3036	2472	2084	1690	1369	1127	939	794	679	588	513	452	401	358	321	290	263	240	219
21	16.0	6358	4402	3366	2725	2289	1960	1585	1298	1081	914	782	677	591	520	461	412	370	334	303	276	252
22-1/2	17.1	7213	4905	3716	2991	2503	2151	1807	1480	1232	1042	892	771	674	593	526	470	422	381	345	314	287
24	18.2	8175	5450	4088	3270	2725	2336	2043	1673	1393	1178	1008	872	761	670	595	531	477	430	390	355	325

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 3-1/8 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	4.6	293	150	87	55	37	26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7-1/2	5.7	572	293	170	107	72	50	37	28	---	---	---	---	---	---	---	---	---	---	---	---	---
9	6.8	989	506	293	184	124	87	63	48	37	29	---	---	---	---	---	---	---	---	---	---	---
10-1/2	8.0	1570	804	465	293	196	138	100	75	58	46	37	30	---	---	---	---	---	---	---	---	---
12	9.1	2344	1200	694	437	293	206	150	113	87	68	55	44	37	31	26	---	---	---	---	---	---
13-1/2	10.3	3337	1709	989	623	417	293	214	160	124	97	78	63	52	43	37	31	27	---	---	---	---
15	11.4	4578	2344	1356	854	572	402	293	220	170	133	107	87	72	60	50	43	37	32	28	---	---
16-1/2	12.5	6093	3120	1805	1137	762	535	390	293	226	177	142	116	95	79	67	57	49	42	37	32	28
18	13.7	7910	4050	2344	1476	989	694	506	380	293	230	184	150	124	103	87	74	63	55	48	42	37
19-1/2	14.8	10057	5149	2980	1877	1257	883	644	484	372	293	235	191	157	131	110	94	80	70	60	53	47
21	16.0	12561	6431	3722	2344	1570	1103	804	604	465	366	293	238	196	164	138	117	100	87	75	66	58
22-1/2	17.1	15450	7910	4578	2883	1931	1356	989	743	572	450	360	293	241	201	170	144	124	107	93	81	72
24	18.2	18750	9600	5556	3499	2344	1646	1200	902	694	546	437	356	293	244	206	175	150	130	113	99	87

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.1 Design Loads for Simple Span Douglas Fir-Larch Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.545 ksi

Beam Width = 5-1/8 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	7.5	1329	850	591	434	332	262	213	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7-1/2	9.3	2076	1329	923	678	519	410	332	275	231	197	---	---	---	---	---	---	---	---	---	---	---	---
9	11.2	2989	1913	1329	976	747	591	478	395	332	283	244	211	184	---	---	---	---	---	---	---	---	---
10-1/2	13.1	3754	2604	1808	1329	1017	804	651	538	452	382	327	283	247	218	193	---	---	---	---	---	---	---
12	14.9	4469	3352	2362	1735	1329	1050	850	699	583	493	422	365	318	280	249	222	199	180	---	---	---	---
13-1/2	16.8	5246	3892	2989	2196	1682	1329	1069	875	729	616	527	456	398	351	311	278	249	225	204	186	170
15	18.7	6094	4469	3528	2712	2076	1629	1306	1069	890	753	644	557	487	428	380	339	305	275	249	227	208
16-1/2	20.6	7023	5085	3986	3277	2500	1952	1565	1281	1067	902	772	668	583	514	455	407	365	329	299	272	249
18	22.4	8044	5746	4469	3656	2950	2303	1846	1511	1259	1064	911	788	688	606	537	480	431	389	353	321	294
19-1/2	24.3	9173	6455	4980	4053	3417	2682	2149	1760	1466	1239	1060	917	801	705	626	558	501	453	410	374	342
21	26.2	10428	7219	5521	4469	3754	3087	2474	2026	1687	1426	1221	1056	922	812	720	643	577	521	472	430	394
22-1/2	28.0	11830	8044	6094	4905	4104	3520	2821	2309	1924	1626	1392	1204	1051	926	821	733	658	594	539	491	449
24	29.9	13407	8938	6704	5363	4469	3831	3189	2611	2175	1838	1573	1361	1189	1046	928	828	744	671	609	555	507
25-1/2	31.8	15195	9910	7352	5844	4849	4144	3578	2929	2440	2063	1765	1527	1334	1174	1041	930	835	753	683	622	569
27	33.6	17238	10969	8044	6351	5246	4469	3892	3265	2720	2299	1968	1702	1487	1309	1161	1036	930	840	762	694	634
28-1/2	35.5	19595	12130	8784	6885	5661	4806	4176	3619	3014	2548	2181	1887	1647	1451	1286	1148	1031	931	844	769	703
30	37.4	22345	13407	9576	7448	6094	5157	4469	3943	3323	2809	2404	2080	1816	1599	1418	1266	1137	1026	930	848	775
31-1/2	39.2	25595	14818	10428	8044	6548	5521	4772	4202	3646	3082	2637	2282	1993	1754	1556	1389	1247	1126	1021	930	850
33	41.1	29495	16386	11344	8675	7023	5899	5085	4469	3983	3366	2881	2493	2177	1916	1700	1517	1362	1230	1115	1016	929
34-1/2	43.0	34262	18139	12334	9344	7521	6293	5410	4744	4224	3663	3135	2712	2368	2085	1849	1651	1482	1338	1213	1105	1011
36	44.8	40221	20111	13407	10055	8044	6704	5746	5028	4469	3972	3399	2941	2568	2261	2005	1790	1607	1451	1316	1198	1096

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 5-1/8 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	7.5	480	246	142	90	60	42	31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7-1/2	9.3	938	480	278	175	117	82	60	45	35	27	---	---	---	---	---	---	---	---	---	---	---	---
9	11.2	1622	830	480	303	203	142	104	78	60	47	38	31	25	---	---	---	---	---	---	---	---	---
10-1/2	13.1	2575	1318	763	480	322	226	165	124	95	75	60	49	40	34	28	---	---	---	---	---	---	---
12	14.9	3844	1968	1139	717	480	337	246	185	142	112	90	73	60	50	42	36	31	27	---	---	---	---
13-1/2	16.8	5473	2802	1622	1021	684	480	350	263	203	159	128	104	86	71	60	51	44	38	33	29	25
15	18.7	7507	3844	2224	1401	938	659	480	361	278	219	175	142	117	98	82	70	60	52	45	39	35
16-1/2	20.6	9992	5116	2961	1864	1249	877	640	480	370	291	233	189	156	130	110	93	80	69	60	53	46
18	22.4	12973	6642	3844	2421	1622	1139	830	624	480	378	303	246	203	169	142	121	104	90	78	68	60
19-1/2	24.3	16494	8445	4887	3078	2062	1448	1056	793	611	480	385	313	258	215	181	154	132	114	99	87	76
21	26.2	20600	10547	6104	3844	2575	1809	1318	991	763	600	480	391	322	268	226	192	165	142	124	108	95
22-1/2	28.0	25337	12973	7507	4728	3167	2224	1622	1218	938	738	591	480	396	330	278	236	203	175	152	133	117
24	29.9	30750	15744	9111	5738	3844	2700	1968	1479	1139	896	717	583	480	401	337	287	246	213	185	162	142
25-1/2	31.8	36883	18884	10928	6882	4610	3238	2361	1774	1366	1074	860	699	576	480	405	344	295	255	222	194	171
27	33.6	43783	22417	12973	8169	5473	3844	2802	2105	1622	1275	1021	830	684	570	480	409	350	303	263	230	203
28-1/2	35.5	51493	26364	15257	9608	6437	4521	3296	2476	1907	1500	1201	976	805	671	565	480	412	356	309	271	238
30	37.4	60059	30750	17795	11206	7507	5273	3844	2888	2224	1750	1401	1139	938	782	659	560	480	415	361	316	278
31-1/2	39.2	69525	35597	20600	12973	8691	6104	4450	3343	2575	2025	1622	1318	1086	906	763	649	556	480	418	366	322
33	41.1	79938	40928	23685	14916	9992	7018	5116	3844	2961	2329	1864	1516	1249	1041	877	746	640	552	480	420	370
34-1/2	43.0	91342	46767	27064	17043	11418	8019	5846	4392	3383	2661	2130	1732	1427	1190	1002	852	731	631	549	480	423
36	44.8	103781	53136	30750	19364	12973	9111	6642	4990	3844	3023	2421	1968	1622	1352	1139	968	830	717	624	546	480

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.1 Design Loads for Simple Span Douglas Fir-Larch Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.545 ksi

Beam Width = 6-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
9	14.8	2520	1750	1286	984	778	630	519	432	365	313	271	236	208	---	---	---	---	---	---	---	---
10-1/2	17.2	3430	2382	1750	1340	1059	850	695	579	490	419	363	317	279	247	221	198	---	---	---	---	---
12	19.7	4415	3111	2286	1749	1366	1095	896	747	631	540	467	408	359	319	284	255	231	209	190	---	---
13-1/2	22.1	5127	3937	2893	2188	1709	1369	1121	934	789	676	584	510	449	399	356	319	288	261	238	218	200
15	24.6	5886	4647	3538	2673	2087	1673	1370	1141	964	825	714	624	549	487	435	390	352	319	291	266	244
16-1/2	27.1	6698	5250	4241	3204	2502	2005	1641	1367	1156	989	856	747	658	584	521	468	422	383	349	319	293
18	29.5	7568	5886	4816	3780	2951	2366	1936	1613	1363	1167	1010	882	776	688	615	552	498	452	411	376	345
19-1/2	32.0	8502	6559	5338	4400	3436	2754	2255	1878	1587	1359	1175	1026	904	802	715	642	580	526	479	438	402
21	34.5	9508	7271	5886	4944	3956	3171	2595	2162	1827	1564	1353	1182	1040	923	824	740	668	605	551	504	463
22-1/2	36.9	10595	8026	6460	5406	4510	3615	2959	2465	2083	1783	1543	1347	1186	1052	939	843	761	690	629	575	528
24	39.4	11772	8829	7063	5886	5045	4086	3345	2786	2355	2016	1744	1523	1341	1189	1062	953	860	780	711	650	597
25-1/2	41.8	13052	9683	7697	6387	5458	4585	3753	3127	2643	2262	1957	1709	1505	1334	1191	1069	965	875	797	729	669
27	44.3	14447	10595	8364	6910	5886	5111	4184	3485	2946	2521	2181	1905	1677	1487	1328	1192	1076	976	889	813	746
28-1/2	46.8	15976	11569	9068	7456	6330	5500	4637	3862	3265	2794	2417	2111	1859	1648	1471	1321	1193	1082	985	901	827
30	49.2	17658	12613	9810	8026	6792	5886	5111	4258	3599	3080	2665	2327	2049	1817	1622	1456	1315	1192	1086	993	912
31-1/2	51.7	19517	13734	10595	8624	7271	6285	5535	4671	3948	3379	2924	2553	2248	1994	1780	1598	1442	1308	1191	1090	1000
33	54.1	21582	14941	11426	9249	7770	6698	5886	5103	4313	3692	3194	2789	2456	2178	1944	1746	1576	1429	1302	1190	1092
34-1/2	56.6	23890	16245	12307	9906	8288	7125	6248	5553	4693	4017	3475	3035	2672	2370	2115	1899	1714	1555	1416	1295	1189
36	59.1	26487	17658	13244	10595	8829	7568	6622	5886	5089	4355	3768	3290	2897	2569	2294	2059	1859	1686	1536	1404	1289
37-1/2	61.5	29430	19193	14240	11319	9393	8026	7007	6218	5499	4707	4072	3556	3131	2777	2479	2225	2009	1822	1659	1518	1393
39	64.0	32793	20869	15304	12082	9981	8502	7405	6559	5886	5071	4387	3831	3373	2991	2670	2398	2164	1963	1788	1635	1501
40-1/2	66.4	36674	22703	16440	12886	10595	8996	7816	6910	6192	5448	4713	4116	3624	3214	2869	2576	2325	2109	1921	1756	1612
42	68.9	41202	24721	17658	13734	11237	9508	8240	7271	6506	5837	5050	4410	3883	3444	3074	2760	2491	2259	2058	1882	1727

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 6-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
9	14.8	1094	633	399	267	188	137	103	79	62	50	41	33	28	---	---	---	---	---	---	---	---
10-1/2	17.2	1736	1005	633	424	298	217	163	126	99	79	64	53	44	37	32	27	---	---	---	---	---
12	19.7	2592	1500	945	633	444	324	243	188	147	118	96	79	66	56	47	41	35	30	27	---	---
13-1/2	22.1	3691	2136	1345	901	633	461	347	267	210	168	137	113	94	79	67	58	50	43	38	33	30
15	24.6	5063	2930	1845	1236	868	633	475	366	288	231	188	154	129	109	92	79	68	59	52	46	41
16-1/2	27.1	6738	3899	2456	1645	1155	842	633	487	383	307	250	206	171	144	123	105	91	79	69	61	54
18	29.5	8748	5063	3188	2136	1500	1094	822	633	498	399	324	267	223	188	159	137	118	103	90	79	70
19-1/2	32.0	11122	6437	4053	2715	1907	1390	1045	805	633	507	412	339	283	238	203	174	150	131	114	101	89
21	34.5	13892	8039	5063	3391	2382	1736	1305	1005	790	633	515	424	353	298	253	217	188	163	143	126	111
22-1/2	36.9	17086	9888	6227	4171	2930	2136	1605	1236	972	778	633	521	435	366	311	267	231	201	176	154	137
24	39.4	20736	12000	7557	5063	3556	2592	1947	1500	1180	945	768	633	528	444	378	324	280	243	213	188	166
25-1/2	41.8	24872	14394	9064	6072	4265	3109	2336	1799	1415	1133	921	759	633	533	453	389	336	292	256	225	199
27	44.3	29525	17086	10760	7208	5063	3691	2773	2136	1680	1345	1094	901	751	633	538	461	399	347	303	267	236
28-1/2	46.8	34724	20095	12654	8477	5954	4340	3261	2512	1976	1582	1286	1060	883	744	633	543	469	408	357	314	278
30	49.2	40500	23438	14759	9888	6944	5063	3804	2930	2304	1845	1500	1236	1030	868	738	633	547	475	416	366	324
31-1/2	51.7	46884	27132	17086	11446	8039	5860	4403	3391	2667	2136	1736	1431	1193	1005	854	733	633	550	482	424	375
33	54.1	53906	31195	19645	13161	9243	6738	5063	3899	3067	2456	1997	1645	1372	1155	982	842	728	633	554	487	431
34-1/2	56.6	61595	35646	22447	15038	10562	7699	5785	4456	3505	2806	2281	1880	1567	1320	1123	962	831	723	633	557	493
36	59.1	69984	40500	25504	17086	12000	8748	6573	5063	3982	3188	2592	2136	1781	1500	1275	1094	945	822	719	633	560
37-1/2	61.5	79102	45776	28827	19312	13563	9888	7429	5722	4501	3603	2930	2414	2013	1695	1442	1236	1068	929	813	715	633
39	64.0	88979	51492	32427	21723	15257	11122	8356	6437	5063	4053	3296	2715	2264	1907	1622	1390	1201	1045	914	805	712
40-1/2	66.4	99645	57665	36314	24327	17086	12456	9358	7208	5669	4539	3691	3041	2535	2136	1816	1557	1345	1170	1024	901	797
42	68.9	111132	64313	40500	27132	19056	13892	10437	8039	6323	5063	4116	3391	2827	2382	2025	1736	1500	1305	1142	1005	889

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.1 Design Loads for Simple Span Douglas Fir-Larch Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.545 ksi

Beam Width = 8-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
12	25.5	5723	4033	2925	2210	1725	1383	1132	943	797	682	590	515	454	402	359	323	291	264	241	220	202
13-1/2	28.7	6645	5057	3658	2764	2158	1730	1416	1180	997	853	738	645	568	503	449	403	364	330	301	275	253
15	31.9	7630	6024	4469	3376	2636	2113	1730	1441	1218	1042	902	788	693	615	549	493	445	403	368	336	308
16-1/2	35.1	8682	6805	5356	4047	3160	2533	2073	1727	1460	1249	1081	944	831	737	658	591	533	484	440	403	370
18	38.3	9810	7630	6243	4774	3728	2988	2446	2037	1722	1474	1275	1114	980	870	776	697	629	571	520	475	436
19-1/2	41.5	11021	8502	6920	5558	4340	3479	2848	2372	2005	1716	1485	1296	1141	1012	904	811	732	664	605	553	508
21	44.7	12325	9425	7630	6398	4996	4005	3278	2731	2308	1976	1709	1493	1314	1165	1040	934	843	765	697	637	585
22-1/2	47.9	13734	10405	8374	7007	5696	4566	3737	3113	2632	2252	1949	1702	1498	1329	1186	1065	961	872	794	726	667
24	51.0	15260	11445	9156	7630	6439	5161	4225	3519	2975	2546	2203	1924	1694	1502	1341	1204	1087	986	898	821	753
25-1/2	54.2	16919	12553	9978	8279	7075	5791	4741	3949	3338	2857	2472	2158	1900	1685	1505	1351	1219	1106	1007	921	845
27	57.4	18728	13734	10843	8957	7630	6456	5285	4402	3721	3185	2755	2406	2118	1879	1677	1506	1359	1233	1123	1027	942
28-1/2	60.6	20710	14997	11754	9665	8206	7130	5856	4878	4124	3529	3053	2666	2348	2082	1859	1669	1506	1366	1244	1138	1044
30	63.8	22890	16350	12717	10405	8804	7630	6456	5378	4546	3891	3366	2939	2588	2295	2049	1840	1660	1506	1372	1254	1151
31-1/2	67.0	25299	17803	13734	11179	9425	8147	7083	5900	4987	4268	3693	3225	2839	2518	2248	2018	1822	1652	1505	1376	1263
33	70.2	27977	19368	14811	11990	10072	8682	7630	6445	5448	4663	4034	3523	3102	2751	2456	2205	1990	1805	1644	1503	1380
34-1/2	73.4	30969	21059	15954	12841	10744	9236	8100	7013	5928	5074	4389	3833	3375	2993	2672	2399	2165	1964	1789	1636	1502
36	76.6	34335	22890	17168	13734	11445	9810	8584	7604	6428	5501	4759	4156	3659	3245	2897	2601	2348	2129	1940	1774	1628
37-1/2	79.8	38150	24880	18460	14673	12176	10405	9083	8060	6946	5945	5143	4491	3954	3507	3131	2811	2537	2301	2096	1917	1759
39	82.9	42510	27052	19838	15662	12938	11021	9599	8502	7483	6405	5541	4839	4260	3778	3373	3028	2733	2479	2258	2065	1895
40-1/2	86.1	47541	29430	21311	16704	13734	11661	10132	8957	8026	6881	5953	5198	4577	4059	3624	3254	2937	2663	2426	2219	2036
42	89.3	53410	32046	22890	17803	14566	12325	10682	9425	8433	7373	6379	5570	4904	4350	3883	3486	3147	2854	2600	2377	2182
43-1/2	92.5	60346	34937	24586	18966	15437	13016	11251	9908	8851	7882	6818	5954	5242	4650	4150	3727	3364	3051	2779	2541	2332
45	95.7	68670	38150	26412	20197	16350	13734	11840	10405	9280	8374	7272	6350	5591	4959	4427	3975	3588	3254	2964	2710	2488

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 8-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
12	25.5	3360	1944	1224	820	576	420	316	243	191	153	124	103	85	72	61	53	45	39	35	30	27
13-1/2	28.7	4784	2769	1743	1168	820	598	449	346	272	218	177	146	122	103	87	75	65	56	49	43	38
15	31.9	6563	3798	2392	1602	1125	820	616	475	373	299	243	200	167	141	120	103	89	77	67	59	53
16-1/2	35.1	8735	5055	3183	2132	1498	1092	820	632	497	398	324	267	222	187	159	136	118	103	90	79	70
18	38.3	11340	6563	4133	2769	1944	1418	1065	820	645	517	420	346	289	243	207	177	153	133	117	103	91
19-1/2	41.5	14418	8344	5254	3520	2472	1802	1354	1043	820	657	534	440	367	309	263	225	195	169	148	130	115
21	44.7	18008	10421	6563	4396	3088	2251	1691	1303	1025	820	667	550	458	386	328	281	243	211	185	163	144
22-1/2	47.9	22148	12817	8072	5407	3798	2769	2080	1602	1260	1009	820	676	564	475	404	346	299	260	228	200	177
24	51.0	26880	15556	9796	6563	4609	3360	2524	1944	1529	1224	996	820	684	576	490	420	363	316	276	243	215
25-1/2	54.2	32242	18658	11750	7871	5528	4030	3028	2332	1834	1469	1194	984	820	691	588	504	435	378	331	292	258
27	57.4	38273	22148	13948	9344	6563	4784	3594	2769	2178	1743	1418	1168	974	820	697	598	517	449	393	346	306
28-1/2	60.6	45012	26049	16404	10989	7718	5627	4227	3256	2561	2050	1667	1374	1145	965	820	703	608	528	462	407	360
30	63.8	52500	30382	19133	12817	9002	6563	4931	3798	2987	2392	1944	1602	1336	1125	957	820	709	616	539	475	420
31-1/2	67.0	60775	35171	22148	14838	10421	7597	5708	4396	3458	2769	2251	1855	1546	1303	1108	950	820	713	624	550	486
33	70.2	69878	40438	25466	17060	11982	8735	6563	5055	3976	3183	2588	2132	1778	1498	1273	1092	943	820	718	632	559
34-1/2	73.4	79846	46207	29098	19494	13691	9981	7499	5776	4543	3637	2957	2437	2031	1711	1455	1248	1078	937	820	722	639
36	76.6	90720	52500	33061	22148	15556	11340	8520	6563	5162	4133	3360	2769	2308	1944	1653	1418	1224	1065	932	820	726
37-1/2	79.8	102539	59340	37368	25034	17582	12817	9630	7417	5834	4671	3798	3129	2609	2198	1869	1602	1384	1204	1053	927	820
39	82.9	115343	66749	42034	28160	19778	14418	10832	8344	6563	5254	4272	3520	2935	2472	2102	1802	1557	1354	1185	1043	923
40-1/2	86.1	129170	74751	47074	31536	22148	16146	12131	9344	7349	5884	4784	3942	3286	2769	2354	2018	1743	1516	1327	1168	1033
42	89.3	144060	83368	52500	35171	24702	18008	13529	10421	8196	6563	5336	4396	3665	3088	2625	2251	1944	1691	1480	1303	1152
43-1/2	92.5	160053	92623	58328	39075	27444	20007	15031	11578	9106	7291	5928	4884	4072	3430	2917	2501	2160	1879	1644	1447	1280
45	95.7	177188	102539	64573	43259	30382	22148	16640	12817	10081	8072	6563	5407	4508	3798	3229	2769	2392	2080	1820	1602	1418

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.2 Design Loads for Simple Span Southern Pine Glued Laminated Timber Beams

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.575 ksi

Beam Width = 3 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
5-1/2	4.1	654	418	290	213	163	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6-7/8	5.2	1021	654	454	333	255	202	163	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8-1/4	6.2	1470	941	654	480	368	290	235	194	163	---	---	---	---	---	---	---	---	---	---	---	---	---
9-5/8	7.2	2001	1281	890	654	500	395	320	265	222	189	163	---	---	---	---	---	---	---	---	---	---	---
11	8.3	2462	1673	1162	854	654	516	418	346	290	247	213	186	163	---	---	---	---	---	---	---	---	---
12-3/8	9.3	2876	2117	1470	1080	827	654	529	437	368	313	270	235	207	183	163	---	---	---	---	---	---	---
13-3/4	10.3	3324	2462	1815	1334	1021	807	654	540	454	387	333	290	255	225	200	179	161	---	---	---	---	---
15-1/8	11.3	3809	2791	2197	1614	1236	976	791	654	549	468	403	351	307	271	241	216	194	176	160	---	---	---
16-1/2	12.4	4337	3141	2462	1921	1470	1162	941	778	654	557	478	415	364	321	286	256	230	208	189	173	158
17-7/8	13.4	4913	3513	2735	2238	1726	1364	1104	913	767	651	559	486	425	376	334	299	269	244	221	202	185
19-1/4	14.4	5544	3911	3022	2462	2001	1581	1281	1059	886	752	646	561	491	434	386	346	311	281	256	234	214
20-5/8	15.5	6238	4337	3324	2695	2266	1815	1470	1212	1014	861	739	642	562	497	442	395	356	322	293	267	245
22	16.5	7006	4794	3643	2938	2462	2065	1671	1375	1150	976	838	728	638	563	501	448	404	365	332	303	278
23-3/8	17.5	7860	5285	3980	3192	2665	2287	1881	1547	1294	1098	944	819	718	634	564	505	454	411	374	341	313

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 3 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
5-1/2	4.1	217	111	64	40	27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6-7/8	5.2	423	217	125	79	53	37	27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8-1/4	6.2	731	374	217	136	91	64	47	35	27	---	---	---	---	---	---	---	---	---	---	---	---	---
9-5/8	7.2	1161	594	344	217	145	102	74	56	43	34	27	---	---	---	---	---	---	---	---	---	---	---
11	8.3	1733	887	514	323	217	152	111	83	64	50	40	33	27	---	---	---	---	---	---	---	---	---
12-3/8	9.3	2468	1263	731	460	308	217	158	119	91	72	58	47	39	32	27	---	---	---	---	---	---	---
13-3/4	10.3	3385	1733	1003	632	423	297	217	163	125	99	79	64	53	44	37	32	27	---	---	---	---	---
15-1/8	11.3	4505	2307	1335	841	563	396	288	217	167	131	105	85	70	59	49	42	36	31	27	---	---	---
16-1/2	12.4	5849	2995	1733	1091	731	514	374	281	217	170	136	111	91	76	64	55	47	40	35	31	27
17-7/8	13.4	7437	3808	2203	1388	930	653	476	358	275	217	173	141	116	97	82	69	59	51	45	39	34
19-1/4	14.4	9288	4756	2752	1733	1161	815	594	447	344	271	217	176	145	121	102	87	74	64	56	49	43
20-5/8	15.5	11424	5849	3385	2132	1428	1003	731	549	423	333	266	217	179	149	125	107	91	79	69	60	53
22	16.5	13865	7099	4108	2587	1733	1217	887	667	514	404	323	263	217	181	152	129	111	96	83	73	64
23-3/8	17.5	16630	8515	4927	3103	2079	1460	1064	800	616	484	388	315	260	217	182	155	133	115	100	87	77

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.2 Design Loads for Simple Span Southern Pine Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.575 ksi

Beam Width = 5 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6-7/8	8.6	1702	1089	756	556	425	336	272	225	189	---	---	---	---	---	---	---	---	---	---	---	---
8-1/4	10.3	2451	1568	1089	800	613	484	392	324	272	232	200	---	---	---	---	---	---	---	---	---	---
9-5/8	12.0	3336	2135	1483	1089	834	659	534	441	371	316	272	236	207	183	---	---	---	---	---	---	---
11	13.8	4103	2788	1936	1423	1089	861	697	576	484	410	353	306	268	237	211	189	---	---	---	---	---
12-3/8	15.5	4794	3529	2451	1801	1379	1089	882	727	608	516	444	385	337	298	265	237	214	193	---	---	---
13-3/4	17.2	5540	4103	3026	2223	1702	1345	1086	893	747	634	545	473	414	366	325	291	262	237	216	197	180
15-1/8	18.9	6349	4651	3661	2690	2059	1623	1308	1076	900	764	656	569	499	441	392	351	316	286	260	237	217
16-1/2	20.6	7229	5234	4103	3201	2448	1923	1549	1274	1066	905	777	675	591	522	464	416	374	339	308	281	257
17-7/8	22.3	8188	5856	4558	3730	2862	2248	1811	1490	1246	1058	909	789	691	610	543	486	437	396	360	328	301
19-1/4	24.1	9240	6519	5036	4103	3306	2597	2093	1721	1440	1222	1050	911	798	705	627	561	505	457	416	379	348
20-5/8	25.8	10397	7229	5540	4491	3776	2971	2394	1969	1647	1398	1201	1043	913	807	717	642	578	523	476	434	398
22	27.5	11677	7989	6072	4897	4103	3370	2715	2233	1868	1586	1362	1182	1036	915	814	728	656	593	539	492	451
23-3/8	29.2	13099	8808	6634	5321	4442	3793	3056	2513	2103	1785	1533	1331	1166	1030	916	820	738	668	607	554	508
24-3/4	30.9	14690	9689	7229	5765	4794	4103	3416	2810	2351	1995	1714	1488	1303	1151	1024	916	825	746	679	619	568
26-1/8	32.7	16481	10643	7859	6229	5160	4403	3796	3122	2612	2217	1904	1653	1448	1279	1138	1018	917	829	754	688	631
27-1/2	34.4	18512	11677	8528	6717	5540	4714	4103	3451	2887	2450	2105	1827	1601	1414	1257	1125	1013	917	833	761	697
28-7/8	36.1	20835	12802	9240	7229	5936	5036	4373	3795	3175	2695	2315	2010	1760	1555	1383	1238	1114	1008	916	837	767
30-1/4	37.8	23518	14032	9999	7767	6349	5369	4651	4103	3477	2950	2535	2200	1928	1702	1514	1355	1220	1104	1003	916	840
31-5/8	39.5	26652	15381	10809	8333	6779	5714	4938	4348	3791	3218	2764	2400	2102	1857	1651	1478	1330	1204	1094	999	916
33	41.3	30360	16867	11677	8929	7229	6072	5234	4600	4103	3496	3003	2607	2284	2017	1794	1606	1446	1308	1189	1085	995
34-3/8	43.0	34817	18512	12608	9559	7698	6443	5540	4859	4327	3786	3252	2823	2473	2184	1943	1739	1565	1416	1288	1175	1077
35-3/4	44.7	40273	20344	13610	10225	8188	6828	5856	5126	4558	4087	3511	3048	2670	2358	2097	1877	1690	1529	1390	1269	1163

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 5 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6-7/8	8.6	705	361	209	132	88	62	45	34	26	---	---	---	---	---	---	---	---	---	---	---	---
8-1/4	10.3	1219	624	361	227	152	107	78	59	45	35	28	---	---	---	---	---	---	---	---	---	---
9-5/8	12.0	1935	991	573	361	242	170	124	93	72	56	45	37	30	25	---	---	---	---	---	---	---
11	13.8	2888	1479	856	539	361	254	185	139	107	84	67	55	45	38	32	27	---	---	---	---	---
12-3/8	15.5	4113	2106	1219	767	514	361	263	198	152	120	96	78	64	54	45	38	33	28	---	---	---
13-3/4	17.2	5642	2888	1672	1053	705	495	361	271	209	164	132	107	88	73	62	53	45	39	34	30	26
15-1/8	18.9	7509	3845	2225	1401	939	659	481	361	278	219	175	142	117	98	82	70	60	52	45	39	35
16-1/2	20.6	9749	4991	2888	1819	1219	856	624	469	361	284	227	185	152	127	107	91	78	67	59	51	45
17-7/8	22.3	12394	6346	3672	2313	1549	1088	793	596	459	361	289	235	194	161	136	116	99	86	74	65	57
19-1/4	24.1	15480	7926	4587	2888	1935	1359	991	744	573	451	361	294	242	202	170	144	124	107	93	81	72
20-5/8	25.8	19040	9749	5642	3553	2380	1672	1219	916	705	555	444	361	298	248	209	178	152	132	114	100	88
22	27.5	23108	11831	6847	4312	2888	2029	1479	1111	856	673	539	438	361	301	254	216	185	160	139	122	107
23-3/8	29.2	27717	14191	8212	5172	3465	2433	1774	1333	1027	807	646	526	433	361	304	259	222	192	167	146	128
24-3/4	30.9	32901	16845	9749	6139	4113	2888	2106	1582	1219	958	767	624	514	429	361	307	263	227	198	173	152
26-1/8	32.7	38695	19812	11465	7220	4837	3397	2476	1861	1433	1127	903	734	605	504	425	361	310	267	233	204	179
27-1/2	34.4	45132	23108	13372	8421	5642	3962	2888	2170	1672	1315	1053	856	705	588	495	421	361	312	271	237	209
28-7/8	36.1	52246	26750	15480	9749	6531	4587	3344	2512	1935	1522	1219	991	816	681	573	487	418	361	314	275	242
30-1/4	37.8	60071	30756	17799	11209	7509	5274	3845	2888	2225	1750	1401	1139	939	783	659	561	481	415	361	316	278
31-5/8	39.5	68640	35144	20338	12808	8580	6026	4393	3301	2542	2000	1601	1302	1073	894	753	640	549	474	413	361	318
33	41.3	77988	39930	23108	14552	9749	6847	4991	3750	2888	2272	1819	1479	1219	1016	856	728	624	539	469	410	361
34-3/8	43.0	88149	45132	26118	16448	11019	7739	5642	4239	3265	2568	2056	1672	1377	1148	967	822	705	609	530	464	408
35-3/4	44.7	99155	50767	29379	18501	12394	8705	6346	4768	3672	2888	2313	1880	1549	1292	1088	925	793	685	596	522	459

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.2 Design Loads for Simple Span Southern Pine Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.575 ksi

Beam Width = 6-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
9-5/8	16.2	2882	2001	1470	1126	890	720	592	496	421	361	314	275	243	216	---	---	---	---	---	---	---
11	18.6	3764	2614	1921	1470	1160	935	769	643	546	469	407	357	315	280	251	226	204	---	---	---	---
12-3/8	20.9	4764	3308	2431	1858	1459	1176	967	809	687	590	512	449	396	352	315	284	257	234	213	195	---
13-3/4	23.2	5539	4085	3000	2282	1792	1444	1188	994	843	724	629	551	487	433	387	349	316	287	262	240	221
15-1/8	25.5	6279	4942	3613	2748	2158	1739	1430	1197	1016	872	757	663	586	521	466	420	380	345	315	289	266
16-1/2	27.8	7067	5539	4281	3256	2557	2060	1695	1418	1203	1034	897	786	694	618	553	498	450	409	374	342	315
17-7/8	30.2	7905	6153	5004	3806	2989	2409	1981	1657	1407	1208	1049	919	812	722	646	582	526	478	437	400	368
19-1/4	32.5	8801	6799	5539	4397	3454	2783	2289	1915	1625	1396	1212	1062	938	834	747	672	608	553	505	462	425
20-5/8	34.8	9759	7479	6063	5031	3951	3184	2619	2191	1859	1597	1387	1215	1073	954	854	769	696	632	577	529	487
22	37.1	10786	8197	6611	5539	4481	3611	2970	2485	2109	1812	1573	1378	1217	1082	969	872	789	717	655	600	552
23-3/8	39.4	11890	8956	7183	5996	5044	4064	3343	2797	2373	2039	1770	1551	1369	1218	1090	981	888	807	737	675	621
24-3/4	41.8	13081	9759	7782	6471	5539	4543	3737	3126	2653	2279	1979	1733	1531	1362	1219	1097	993	902	824	755	694
26-1/8	44.1	14368	10609	8410	6965	5945	5048	4152	3474	2948	2533	2199	1926	1701	1513	1354	1219	1103	1003	915	839	772
27-1/2	46.4	15764	11513	9068	7479	6364	5539	4589	3839	3258	2799	2430	2129	1880	1672	1497	1347	1219	1108	1012	927	853
28-7/8	48.7	17283	12474	9759	8014	6799	5903	5047	4223	3584	3078	2672	2341	2068	1839	1646	1482	1341	1219	1113	1020	938
30-1/4	51.0	18943	13498	10485	8571	7248	6279	5526	4624	3924	3371	2926	2564	2264	2014	1802	1622	1468	1335	1218	1117	1027
31-5/8	53.4	20764	14593	11249	9152	7714	6667	5870	5042	4279	3676	3191	2796	2469	2196	1966	1769	1601	1455	1329	1218	1120
33	55.7	22770	15764	12055	9759	8197	7067	6210	5478	4649	3994	3467	3038	2683	2386	2136	1923	1740	1581	1444	1323	1217
34-3/8	58.0	24991	17021	12905	10392	8698	7479	6560	5842	5035	4325	3755	3289	2905	2584	2313	2082	1884	1712	1563	1433	1318
35-3/4	60.3	27465	18373	13804	11054	9218	7905	6920	6153	5435	4669	4053	3551	3136	2789	2496	2247	2033	1848	1687	1546	1422
37-1/8	62.6	30236	19832	14755	11748	9759	8346	7290	6471	5818	5025	4363	3822	3375	3002	2687	2419	2189	1990	1816	1665	1531
38-1/2	65.0	33361	21411	15764	12474	10320	8801	7671	6799	6104	5395	4683	4103	3623	3223	2885	2597	2350	2136	1950	1787	1643
39-7/8	67.3	36913	23124	16836	13236	10905	9271	8064	7134	6397	5777	5015	4393	3880	3451	3089	2781	2516	2287	2088	1913	1760

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 6-3/4 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
9-5/8	16.2	1337	774	487	327	229	167	126	97	76	61	50	41	34	29	---	---	---	---	---	---	---
11	18.6	1997	1155	728	487	342	250	188	144	114	91	74	61	51	43	36	31	27	---	---	---	---
12-3/8	20.9	2843	1645	1036	694	487	355	267	206	162	129	105	87	72	61	52	44	38	33	29	26	---
13-3/4	23.2	3899	2257	1421	952	669	487	366	282	222	178	144	119	99	84	71	61	53	46	40	35	31
15-1/8	25.5	5190	3004	1891	1267	890	649	487	375	295	236	192	158	132	111	95	81	70	61	53	47	42
16-1/2	27.8	6738	3899	2456	1645	1155	842	633	487	383	307	250	206	171	144	123	105	91	79	69	61	54
17-7/8	30.2	8567	4958	3122	2092	1469	1071	805	620	487	390	317	261	218	184	156	134	116	101	88	77	69
19-1/4	32.5	10700	6192	3899	2612	1835	1337	1005	774	609	487	396	327	272	229	195	167	144	126	110	97	86
20-5/8	34.8	13161	7616	4796	3213	2257	1645	1236	952	749	600	487	402	335	282	240	206	178	154	135	119	105
22	37.1	15972	9243	5821	3899	2739	1997	1500	1155	909	728	592	487	406	342	291	250	216	188	164	144	128
23-3/8	39.4	19158	11087	6982	4677	3285	2395	1799	1386	1090	873	710	585	487	411	349	299	259	225	197	173	153
24-3/4	41.8	22741	13161	8288	5552	3899	2843	2136	1645	1294	1036	842	694	579	487	414	355	307	267	234	206	182
26-1/8	44.1	26746	15478	9747	6530	4586	3343	2512	1935	1522	1218	991	816	680	573	487	418	361	314	275	242	214
27-1/2	46.4	31195	18053	11369	7616	5349	3899	2930	2257	1775	1421	1155	952	794	669	569	487	421	366	320	282	250
28-7/8	48.7	36112	20898	13161	8817	6192	4514	3391	2612	2055	1645	1337	1102	919	774	658	564	487	424	371	327	289
30-1/4	51.0	41521	24028	15132	10137	7120	5190	3899	3004	2362	1891	1538	1267	1056	890	757	649	560	487	427	375	332
31-5/8	53.4	47444	27456	17290	11583	8135	5931	4456	3432	2699	2161	1757	1448	1207	1017	865	741	640	557	487	429	380
33	55.7	53906	31195	19645	13161	9243	6738	5063	3899	3067	2456	1997	1645	1372	1155	982	842	728	633	554	487	431
34-3/8	58.0	60928	35259	22204	14875	10447	7616	5722	4407	3467	2776	2257	1859	1550	1306	1110	952	822	715	626	551	487
35-3/4	60.3	68536	39662	24977	16732	11752	8567	6437	4958	3899	3122	2538	2092	1744	1469	1249	1071	925	805	704	620	548
37-1/8	62.6	76752	44417	27971	18738	13161	9594	7208	5552	4367	3496	2843	2342	1953	1645	1399	1199	1036	901	789	694	614
38-1/2	65.0	85600	49537	31195	20898	14678	10700	8039	6192	4870	3899	3170	2612	2178	1835	1560	1337	1155	1005	879	774	685
39-7/8	67.3	95103	55036	34658	23218	16307	11888	8932	6880	5411	4332	3522	2902	2420	2038	1733	1486	1284	1116	977	860	761

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0

Table 7.2 Design Loads for Simple Span Southern Pine Glued Laminated Timber Beams (Cont.)

Maximum Factored Total Loads (lbf/ft) -- Strength Consideration (λ = 0.80)
F_b = 6.10 ksi; F_v = 0.545 ksi

Beam Width = 8-1/2 inches

Depth	Beam	Span (ft)																					
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
11	23.4	4740	3292	2417	1838	1444	1163	957	801	679	584	507	444	392	349	312	281	254	231	211	---	---
12-3/8	26.3	5999	4166	3041	2313	1817	1464	1204	1007	855	734	637	558	493	439	393	353	320	291	265	243	224
13-3/4	29.2	6975	5122	3734	2840	2231	1798	1479	1237	1050	902	783	686	606	539	482	434	393	357	326	299	275
15-1/8	32.1	7907	6169	4497	3420	2687	2165	1780	1490	1264	1086	943	826	729	649	581	523	473	430	393	360	331
16-1/2	35.1	8899	6975	5329	4053	3183	2565	2110	1765	1498	1287	1117	979	864	769	688	619	560	509	465	426	392
17-7/8	38.0	9955	7748	6229	4737	3721	2998	2466	2063	1751	1504	1306	1144	1010	899	804	724	655	596	544	498	458
19-1/4	40.9	11082	8561	6975	5474	4300	3464	2850	2384	2023	1738	1509	1322	1167	1038	929	837	757	688	628	576	529
20-5/8	43.8	12289	9418	7635	6262	4919	3963	3260	2727	2315	1988	1726	1512	1335	1188	1063	957	866	787	719	659	606
22	46.8	13582	10322	8325	6975	5578	4495	3697	3093	2625	2255	1958	1715	1515	1347	1206	1085	982	893	815	747	687
23-3/8	49.7	14973	11278	9045	7551	6279	5059	4161	3481	2954	2538	2203	1930	1705	1516	1357	1222	1105	1005	917	841	773
24-3/4	52.6	16472	12289	9800	8149	6975	5655	4652	3892	3303	2837	2463	2158	1906	1695	1517	1366	1236	1123	1025	940	864
26-1/8	55.5	18093	13360	10590	8771	7486	6284	5169	4324	3670	3153	2737	2398	2118	1883	1686	1518	1373	1248	1139	1044	960
27-1/2	58.4	19851	14498	11419	9418	8014	6945	5713	4779	4056	3484	3025	2650	2340	2082	1863	1677	1518	1379	1259	1154	1061
28-7/8	61.4	21764	15708	12289	10092	8561	7434	6283	5256	4461	3832	3327	2914	2574	2289	2049	1845	1669	1517	1385	1269	1167
30-1/4	64.3	23854	16998	13203	10793	9128	7907	6879	5755	4884	4196	3643	3191	2818	2507	2244	2020	1827	1661	1517	1390	1278
31-5/8	67.2	26147	18376	14166	11525	9714	8395	7392	6277	5327	4576	3972	3480	3073	2734	2447	2203	1993	1812	1654	1516	1394
33	70.1	28673	19851	15180	12289	10322	8899	7820	6820	5788	4972	4316	3781	3339	2970	2659	2393	2165	1968	1797	1647	1515
34-3/8	73.0	31471	21434	16251	13086	10953	9418	8261	7356	6267	5384	4674	4095	3616	3216	2879	2591	2345	2132	1946	1783	1640
35-3/4	76.0	34585	23136	17382	13920	11608	9955	8714	7748	6765	5812	5045	4420	3904	3472	3108	2797	2531	2301	2101	1925	1771
37-1/8	78.9	38074	24974	18580	14793	12289	10509	9180	8149	7282	6256	5431	4758	4202	3737	3345	3011	2725	2477	2261	2072	1906
38-1/2	81.8	42010	26961	19851	15708	12996	11082	9660	8561	7687	6715	5830	5107	4510	4012	3591	3232	2925	2659	2427	2224	2046
39-7/8	84.7	46483	29120	21200	16668	13732	11675	10154	8984	8056	7191	6243	5469	4830	4296	3845	3461	3132	2847	2599	2382	2191
41-1/4	87.7	51612	31471	22637	17675	14498	12289	10664	9418	8433	7635	6669	5843	5160	4589	4108	3698	3346	3042	2777	2545	2340

Notes:

(1) This table does NOT consider serviceability and shall be used in combination with the Serviceability Consideration table given below.

(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total factored load including beam weight.

(5) Volume factor is included.

(6) Maximum beam shear is located at a distance from the support equal to the beam depth.

(7) Upper right area limited by bending strength and lower left area limited by shear strength.

Maximum Unfactored Loads (lbf/ft) -- Serviceability Consideration (Deflection Limit = Span/360)
E_x = 1800 ksi

Beam Width = 8-1/2 inches

Depth	Beam	Span (ft)																				
(in.)	wt. (plf)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
11	23.4	2514	1455	916	614	431	314	236	182	143	115	93	77	64	54	46	39	34	30	26	---	---
12-3/8	26.3	3580	2072	1305	874	614	447	336	259	204	163	133	109	91	77	65	56	48	42	37	32	29
13-3/4	29.2	4910	2842	1789	1199	842	614	461	355	279	224	182	150	125	105	89	77	66	58	50	44	39
15-1/8	32.1	6536	3782	2382	1596	1121	817	614	473	372	298	242	199	166	140	119	102	88	77	67	59	52
16-1/2	35.1	8485	4910	3092	2072	1455	1061	797	614	483	387	314	259	216	182	155	133	115	100	87	77	68
17-7/8	38.0	10788	6243	3932	2634	1850	1349	1013	780	614	491	400	329	274	231	197	169	146	127	111	98	86
19-1/4	40.9	13474	7797	4910	3290	2310	1684	1265	975	767	614	499	411	343	289	246	211	182	158	138	122	108
20-5/8	43.8	16573	9591	6040	4046	2842	2072	1556	1199	943	755	614	506	422	355	302	259	224	195	170	150	133
22	46.8	20113	11639	7330	4910	3449	2514	1889	1455	1144	916	745	614	512	431	367	314	271	236	207	182	161
23-3/8	49.7	24125	13961	8792	5890	4137	3016	2266	1745	1373	1099	894	736	614	517	440	377	326	283	248	218	193
24-3/4	52.6	28637	16573	10436	6992	4910	3580	2689	2072	1629	1305	1061	874	729	614	522	447	387	336	294	259	229
26-1/8	55.5	33680	19491	12274	8223	5775	4210	3163	2436	1916	1534	1247	1028	857	722	614	526	455	395	346	305	269
27-1/2	58.4	39283	22733	14316	9591	6736	4910	3689	2842	2235	1789	1455	1199	999	842	716	614	530	461	404	355	314
28-7/8	61.4	45475	26317	16573	11102	7797	5684	4271	3290	2587	2072	1684	1388	1157	975	829	711	614	534	467	411	364
30-1/4	64.3	52286	30258	19055	12765	8965	6536	4910	3782	2975	2382	1937	1596	1330	1121	953	817	706	614	537	473	418
31-5/8	67.2	59745	34574	21773	14586	10244	7468	5611	4322	3399	2722	2213	1823	1520	1281	1089	934	806	701	614	540	478
33	70.1	67881	39283	24738	16573	11639	8485	6375	4910	3862	3092	2514	2072	1727	1455	1237	1061	916	797	697	614	543
34-3/8	73.0	76725	44401	27961	18732	13156	9591	7206	5550	4365	3495	2842	2341	1952	1644	1398	1199	1036	901	788	694	614
35-3/4	76.0	86305	49945	31452	21070	14798	10788	8105	6243	4910	3932	3196	2634	2196	1850	1573	1349	1165	1013	887	780	690
37-1/8	78.9	96651	55932	35223	23596	16573	12081	9077	6992	5499	4403	3580	2950	2459	2072	1761	1510	1305	1135	993	874	773
38-1/2	81.8	107793	62380	39283	26317	18483	13474	10123	7797	6133	4910	3992	3290	2743	2310	1964	1684	1455	1265	1107	975	862
39-7/8	84.7	119759	69305	43644	29238	20535	14970	11247	8663	6814	5455	4436	3655	3047	2567	2183	1871	1616	1406	1230	1083	958
41-1/4	87.7	132580	76725	48316	32368	22733	16573	12451	9591	7543	6040	4910	4046	3373	2842	2416	2072	1789	1556	1362	1199	1061

Notes:

(1) This table does NOT consider strength and shall be used in combination with the Strength Consideration table given above.

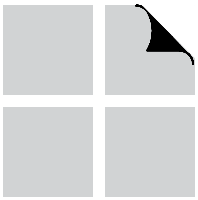
(2) Span = simply supported beam.

(3) Service conditions = dry.

(4) Uniform load = total unfactored load including beam weight.

(5) Multiply the tabulated value by a factor given below for other selected deflection limits:

Deflection Limit	Multiply the tabulated value by
Span/240	360/240 or 1.5
Span/180	360/180 or 2.0



DESIGN EXAMPLES

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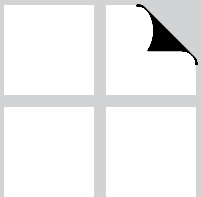


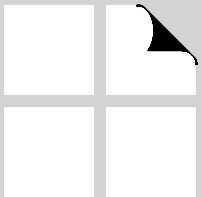
8.1 General

General design examples for tension members, compression members, and bending members are available in the LRFD Manual of Wood Construction. The following associations are available for technical assistance:

APA - The Engineered Wood Association
Engineered Wood Systems
7011 South 19th Street
Tacoma, WA 98466
Phone: (206) 565-6600
Fax: (206) 565-7265

American Institute of Timber Construction
7012 South Revere Parkway, Suite 140
Englewood, CO 80112
Phone: (303) 792-9559
Fax: (303) 792-0669

SECTION PROPERTIES



9.1 Cross-Sectional Properties

Cross-sectional properties are provided for glued laminated timber manufactured from Western species in Table 9.1 and from Southern Pine in Table 9.2. These tables list the beam depths; the reference and actual beam widths, the cross-sectional areas, moments of inertia, section moduli and radii of gyration. Note that the plane of the glueline is in the X-X direction. Further, the width of glued laminated timber is in the X-X direction and its depth is in the Y-Y direction. The thickness of each lamination provided here for Western species and Southern Pine glued laminated timber members is 1-1/2 and 1-3/8 inches, respectively. However, other lamination thicknesses may be used in glued laminated timber manufacturing and the availability shall be verified prior to design.

Table 9.1 Section Properties *Western Species* Glued Laminated Timber

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
2-1/2 in. Width (r_y = 0.722 in.)						
6	15.00	45.00	15.00	1.732	7.813	6.250
7-1/2	18.75	87.89	23.44	2.165	9.766	7.813
9	22.50	151.9	33.75	2.598	11.72	9.375
10-1/2	26.25	241.2	45.94	3.031	13.67	10.94
12	30.00	360.0	60.00	3.464	15.63	12.50
13-1/2	33.75	512.6	75.94	3.897	17.58	14.06
15	37.50	703.1	93.75	4.330	19.53	15.63
16-1/2	41.25	935.9	113.4	4.763	21.48	17.19
18	45.00	1215	135.0	5.196	23.44	18.75
19-1/2	48.75	1545	158.4	5.629	25.39	20.31
21	52.50	1929	183.8	6.062	27.34	21.88
3 in. Width (r_y = 0.866 in.)						
6	18.00	54.00	18.00	1.732	13.50	9.000
7-1/2	22.50	105.5	28.13	2.165	16.88	11.25
9	27.00	182.3	40.50	2.598	20.25	13.50
10-1/2	31.50	289.4	55.13	3.031	23.63	15.75
12	36.00	432.0	72.00	3.464	27.00	18.00
13-1/2	40.50	615.1	91.13	3.897	30.38	20.25
15	45.00	843.8	112.5	4.330	33.75	22.50
16-1/2	49.50	1123	136.1	4.763	37.13	24.75
18	54.00	1458	162.0	5.196	40.50	27.00
19-1/2	58.50	1854	190.1	5.629	43.88	29.25
21	63.00	2315	220.5	6.062	47.25	31.50
22-1/2	67.50	2848	253.1	6.495	50.63	33.75
24	72.00	3456	288.0	6.928	54.00	36.00
3-1/8 in. Width (r_y = 0.902 in.)						
6	18.75	56.25	18.75	1.732	15.26	9.766
7-1/2	23.44	109.9	29.30	2.165	19.07	12.21
9	28.13	189.8	42.19	2.598	22.89	14.65
10-1/2	32.81	301.5	57.42	3.031	26.70	17.09
12	37.50	450.0	75.00	3.464	30.52	19.53
13-1/2	42.19	640.7	94.92	3.897	34.33	21.97
15	46.88	878.9	117.2	4.330	38.15	24.41
16-1/2	51.56	1170	141.8	4.763	41.96	26.86
18	56.25	1519	168.8	5.196	45.78	29.30
19-1/2	60.94	1931	198.0	5.629	49.59	31.74
21	65.63	2412	229.7	6.062	53.41	34.18
22-1/2	70.31	2966	263.7	6.495	57.22	36.62
24	75.00	3600	300.0	6.928	61.04	39.06

Table 9.1 Section Properties *Western Species* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
5 in. Width (r_y = 1.443 in.)						
6	30.00	90.00	30.00	1.732	62.50	25.00
7-1/2	37.50	175.8	46.88	2.165	78.13	31.25
9	45.00	303.8	67.50	2.598	93.75	37.50
10-1/2	52.50	482.3	91.88	3.031	109.4	43.75
12	60.00	720.0	120.0	3.464	125.0	50.00
13-1/2	67.50	1025	151.9	3.897	140.6	56.25
15	75.00	1406	187.5	4.330	156.3	62.50
16-1/2	82.50	1872	226.9	4.763	171.9	68.75
18	90.00	2430	270.0	5.196	187.5	75.00
19-1/2	97.50	3090	316.9	5.629	203.1	81.25
21	105.0	3859	367.5	6.062	218.8	87.50
22-1/2	112.5	4746	421.9	6.495	234.4	93.75
24	120.0	5760	480.0	6.928	250.0	100.0
25-1/2	127.5	6909	541.9	7.361	265.6	106.3
27	135.0	8201	607.5	7.794	281.3	112.5
28-1/2	142.5	9645	676.9	8.227	296.9	118.8
30	150.0	11250	750.0	8.660	312.5	125.0
31-1/2	157.5	13020	826.9	9.093	328.1	131.3
33	165.0	14970	907.5	9.526	343.8	137.5
34-1/2	172.5	17110	991.9	9.959	359.4	143.8
36	180.0	19440	1080	10.39	375.0	150.0
5-1/8 in. Width (r_y = 1.479 in.)						
6	30.75	92.25	30.75	1.732	67.31	26.27
7-1/2	38.44	180.2	48.05	2.165	84.13	32.83
9	46.13	311.3	69.19	2.598	101.0	39.40
10-1/2	53.81	494.4	94.17	3.031	117.8	45.96
12	61.50	738.0	123.0	3.464	134.6	52.53
13-1/2	69.19	1051	155.7	3.897	151.4	59.10
15	76.88	1441	192.2	4.330	168.3	65.66
16-1/2	84.56	1919	232.5	4.763	185.1	72.23
18	92.25	2491	276.8	5.196	201.9	78.80
19-1/2	99.94	3167	324.8	5.629	218.7	85.36
21	107.6	3955	376.7	6.062	235.6	91.93
22-1/2	115.3	4865	432.4	6.495	252.4	98.50
24	123.0	5904	492.0	6.928	269.2	105.1
25-1/2	130.7	7082	555.4	7.361	286.0	111.6
27	138.4	8406	622.7	7.794	302.9	118.2
28-1/2	146.1	9887	693.8	8.227	319.7	124.8
30	153.8	11530	768.8	8.660	336.5	131.3
31-1/2	161.4	13350	847.5	9.093	353.4	137.9
33	169.1	15350	930.2	9.526	370.2	144.5
34-1/2	176.8	17540	1017	9.959	387.0	151.0
36	184.5	19930	1107	10.39	403.8	157.6

Table 9.1 Section Properties *Western Species* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
6-3/4 in. Width (r_y = 1.949 in.)						
7-1/2	50.63	237.3	63.28	2.165	192.2	56.95
9	60.75	410.1	91.13	2.598	230.7	68.34
10-1/2	70.88	651.2	124.0	3.031	269.1	79.73
12	81.00	972.0	162.0	3.464	307.5	91.13
13-1/2	91.13	1384	205.0	3.897	346.0	102.5
15	101.3	1898	253.1	4.330	384.4	113.9
16-1/2	111.4	2527	306.3	4.763	422.9	125.3
18	121.5	3281	364.5	5.196	461.3	136.7
19-1/2	131.6	4171	427.8	5.629	499.8	148.1
21	141.8	5209	496.1	6.062	538.2	159.5
22-1/2	151.9	6407	569.5	6.495	576.7	170.9
24	162.0	7776	648.0	6.928	615.1	182.3
25-1/2	172.1	9327	731.5	7.361	653.5	193.6
27	182.3	11070	820.1	7.794	692.0	205.0
28-1/2	192.4	13020	913.8	8.227	730.4	216.4
30	202.5	15190	1013	8.660	768.9	227.8
31-1/2	212.6	17580	1116	9.093	807.3	239.2
33	222.8	20210	1225	9.526	845.8	250.6
34-1/2	232.9	23100	1339	9.959	884.2	262.0
36	243.0	26240	1458	10.39	922.6	273.4
37-1/2	253.1	29660	1582	10.83	961.1	284.8
39	263.3	33370	1711	11.26	999.5	296.2
40-1/2	273.4	37370	1845	11.69	1038	307.5
42	283.5	41670	1985	12.12	1076	318.9
43-1/2	293.6	46300	2129	12.56	1115	330.3
45	303.8	51260	2278	12.99	1153	341.7
46-1/2	313.9	56560	2433	13.42	1192	353.1
48	324.0	62210	2592	13.86	1230	364.5
49-1/2	334.1	68220	2757	14.29	1269	375.9
51	344.3	74620	2926	14.72	1307	387.3
52-1/2	354.4	81400	3101	15.16	1346	398.7
54	364.5	88570	3281	15.59	1384	410.1
55-1/2	374.6	96160	3465	16.02	1422	421.5
57	384.8	104200	3655	16.45	1461	432.8
58-1/2	394.9	112600	3850	16.89	1499	444.2
60	405.0	121500	4050	17.32	1538	455.6

Table 9.1 Section Properties *Western Species* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
8-3/4 in. Width (r_y = 1.949 in.)						
9	78.75	531.6	118.1	2.598	502.4	114.8
10-1/2	91.88	844.1	160.8	3.031	586.2	134.0
12	105.0	1260	210.0	3.464	669.9	153.1
13-1/2	118.1	1794	265.8	3.897	753.7	172.3
15	131.3	2461	328.1	4.330	837.4	191.4
16-1/2	144.4	3276	397.0	4.763	921.1	210.5
18	157.5	4253	472.5	5.196	1005	229.7
19-1/2	170.6	5407	554.5	5.629	1089	248.8
21	183.8	6753	643.1	6.062	1172	268.0
22-1/2	196.9	8306	738.3	6.495	1256	287.1
24	210.0	10080	840.0	6.928	1340	306.3
25-1/2	223.1	12090	948.3	7.361	1424	325.4
27	236.3	14350	1063	7.794	1507	344.5
28-1/2	249.4	16880	1185	8.227	1591	363.7
30	262.5	19690	1313	8.660	1675	382.8
31-1/2	275.6	22790	1447	9.093	1759	402.0
33	288.8	26200	1588	9.526	1842	421.1
34-1/2	301.9	29940	1736	9.959	1926	440.2
36	315.0	34020	1890	10.39	2010	459.4
37-1/2	328.1	38450	2051	10.83	2094	478.5
39	341.3	43250	2218	11.26	2177	497.7
40-1/2	354.4	48440	2392	11.69	2261	516.8
42	367.5	54020	2573	12.12	2345	535.9
43-1/2	380.6	60020	2760	12.56	2428	555.1
45	393.8	66450	2953	12.99	2512	574.2
46-1/2	406.9	73310	3153	13.42	2596	593.4
48	420.0	80640	3360	13.86	2680	612.5
49-1/2	433.1	88440	3573	14.29	2763	631.6
51	446.3	96720	3793	14.72	2847	650.8
52-1/2	459.4	105500	4020	15.16	2931	669.9
54	472.5	114800	4253	15.59	3015	689.1
55-1/2	485.6	124700	4492	16.02	3098	708.2
57	498.8	135000	4738	16.45	3182	727.3
58-1/2	511.9	146000	4991	16.89	3266	746.5
60	525.0	157500	5250	17.32	3350	765.6

Table 9.1 Section Properties *Western Species* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
10-3/4 in. Width (r_y = 3.103 in.)						
12	129.0	1548	258.0	3.464	1242	231.1
13-1/2	145.1	2204	326.5	3.897	1398	260.0
15	161.3	3023	403.1	4.330	1553	288.9
16-1/2	177.4	4024	487.8	4.763	1708	317.8
18	193.5	5225	580.5	5.196	1863	346.7
19-1/2	209.6	6642	681.3	5.629	2019	375.6
21	225.8	8296	790.1	6.062	2174	404.5
22-1/2	241.9	10200	907.0	6.495	2329	433.4
24	258.0	12380	1032	6.928	2485	462.3
25-1/2	274.1	14850	1165	7.361	2640	491.1
27	290.3	17630	1306	7.794	2795	520.0
28-1/2	306.4	20740	1455	8.227	2950	548.9
30	322.5	24190	1613	8.660	3106	577.8
31-1/2	338.6	28000	1778	9.093	3261	606.7
33	354.8	32190	1951	9.526	3416	635.6
34-1/2	370.9	36790	2133	9.959	3572	664.5
36	387.0	41800	2322	10.39	3727	693.4
37-1/2	403.1	47240	2520	10.83	3882	722.3
39	419.3	53140	2725	11.26	4037	751.2
40-1/2	435.4	59510	2939	11.69	4193	780.0
42	451.5	66370	3161	12.12	4348	808.9
43-1/2	467.6	73740	3390	12.56	4503	837.8
45	483.8	81630	3628	12.99	4659	866.7
46-1/2	499.9	90070	3874	13.42	4814	895.6
48	516.0	99070	4128	13.86	4969	924.5
49-1/2	532.1	108700	4390	14.29	5124	953.4
51	548.3	118800	4660	14.72	5280	982.3
52-1/2	564.4	129600	4938	15.16	5435	1011
54	580.5	141100	5225	15.59	5590	1040
55-1/2	596.6	153100	5519	16.02	5746	1069
57	612.8	165900	5821	16.45	5901	1098
58-1/2	628.9	179300	6132	16.89	6056	1127
60	645.0	193500	6450	17.32	6211	1156

Table 9.1 Section Properties *Western Species* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
12-1/4 in. Width (r_y = 3.536 in.)						
13-1/2	165.4	2512	372.1	3.897	2068	337.6
15	183.8	3445	459.4	4.330	2298	375.2
16-1/2	202.1	4586	555.8	4.763	2528	412.7
18	220.5	5954	661.5	5.196	2757	450.2
19-1/2	238.9	7569	776.3	5.629	2987	487.7
21	257.3	9454	900.4	6.062	3217	525.2
22-1/2	275.6	11630	1034	6.495	3447	562.7
24	294.0	14110	1176	6.928	3677	600.3
25-1/2	312.4	16930	1328	7.361	3906	637.8
27	330.8	20090	1488	7.794	4136	675.3
28-1/2	349.1	23630	1658	8.227	4366	712.8
30	367.5	27560	1838	8.660	4596	750.3
31-1/2	385.9	31910	2026	9.093	4825	787.8
33	404.3	36690	2223	9.526	5055	825.3
34-1/2	422.6	41920	2430	9.959	5285	862.9
36	441.0	47630	2646	10.39	5515	900.4
37-1/2	459.4	53830	2871	10.83	5745	937.9
39	477.8	60550	3105	11.26	5974	975.4
40-1/2	496.1	67810	3349	11.69	6204	1013
42	514.5	75630	3602	12.12	6434	1050
43-1/2	532.9	84030	3863	12.56	6664	1088
45	551.3	93020	4134	12.99	6893	1125
46-1/2	569.6	102600	4415	13.42	7123	1163
48	588.0	112900	4704	13.86	7353	1201
49-1/2	606.4	123800	5003	14.29	7583	1238
51	624.8	135400	5310	14.72	7813	1276
52-1/2	643.1	147700	5627	15.16	8042	1313
54	661.5	160700	5954	15.59	8272	1351
55-1/2	679.9	174500	6289	16.02	8502	1388
57	698.3	189100	6633	16.45	8732	1426
58-1/2	716.6	204400	6987	16.89	8962	1463
60	735.0	220500	7350	17.32	9191	1501

Table 9.2 Section Properties *Southern Pine* Glued Laminated Timber

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
2-1/2 in. Width (r_y = 0.722 in.)						
5-1/2	13.75	34.66	12.60	1.588	7.161	5.729
6-7/8	17.19	67.70	19.69	1.985	8.952	7.161
8-1/4	20.63	117.0	28.36	2.382	10.74	8.594
9-5/8	24.06	185.8	38.60	2.778	12.53	10.03
11	27.50	277.3	50.42	3.175	14.32	11.46
12-3/8	30.94	394.8	63.81	3.572	16.11	12.89
13-3/4	34.38	541.6	78.78	3.969	17.90	14.32
15-1/8	37.81	720.9	95.32	4.366	19.69	15.76
16-1/2	41.25	935.9	113.4	4.763	21.48	17.19
17-7/8	44.69	1190	133.1	5.160	23.27	18.62
19-1/4	48.13	1486	154.4	5.557	25.07	20.05
20-5/8	51.56	1828	177.2	5.954	26.86	21.48
22	55.00	2218	201.7	6.351	28.65	22.92
23-3/8	58.44	2661	227.7	6.748	30.44	24.35
3 in. Width (r_y = 0.866 in.)						
5-1/2	16.50	41.59	15.13	1.588	12.38	8.250
6-7/8	20.63	81.24	23.63	1.985	15.47	10.31
8-1/4	24.75	140.4	34.03	2.382	18.56	12.38
9-5/8	28.88	222.9	46.32	2.778	21.66	14.44
11	33.00	332.8	60.50	3.175	24.75	16.50
12-3/8	37.13	473.8	76.57	3.572	27.84	18.56
13-3/4	41.25	649.9	94.53	3.969	30.94	20.63
15-1/8	45.38	865.0	114.4	4.366	34.03	22.69
16-1/2	49.50	1123	136.1	4.763	37.13	24.75
17-7/8	53.63	1428	159.8	5.160	40.22	26.81
19-1/4	57.75	1783	185.3	5.557	43.31	28.88
20-5/8	61.88	2193	212.7	5.954	46.41	30.94
22	66.00	2662	242.0	6.351	49.50	33.00
23-3/8	70.13	3193	273.2	6.748	52.59	35.06
3-1/8 in. Width (r_y = 0.902 in.)						
5-1/2	17.19	43.33	15.76	1.588	13.99	8.952
6-7/8	21.48	84.62	24.62	1.985	17.48	11.19
8-1/4	25.78	146.2	35.45	2.382	20.98	13.43
9-5/8	30.08	232.2	48.25	2.778	24.48	15.67
11	34.38	346.6	63.02	3.175	27.97	17.90
12-3/8	38.67	493.5	79.76	3.572	31.47	20.14
13-3/4	42.97	677.0	98.47	3.969	34.97	22.38
15-1/8	47.27	901.1	119.1	4.366	38.46	24.62
16-1/2	51.56	1170	141.8	4.763	41.96	26.86
17-7/8	55.86	1487	166.4	5.160	45.46	29.09
19-1/4	60.16	1858	193.0	5.557	48.96	31.33
20-5/8	64.45	2285	221.6	5.954	52.45	33.57
22	68.75	2773	252.1	6.351	55.95	35.81
23-3/8	73.05	3326	284.6	6.748	59.45	38.05

Table 9.2 Section Properties *Southern Pine* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
5 in. Width (r_y = 1.443 in.)						
6-7/8	34.38	135.4	39.39	1.985	71.61	28.65
8-1/4	41.25	234.0	56.72	2.382	85.94	34.38
9-5/8	48.13	371.5	77.20	2.778	100.3	40.10
11	55.00	554.6	100.8	3.175	114.6	45.83
12-3/8	61.88	789.6	127.6	3.572	128.9	51.56
13-3/4	68.75	1083	157.6	3.969	143.2	57.29
15-1/8	75.63	1442	190.6	4.366	157.6	63.02
16-1/2	82.50	1872	226.9	4.763	171.9	68.75
17-7/8	89.38	2380	266.3	5.160	186.2	74.48
19-1/4	96.25	2972	308.8	5.557	200.5	80.21
20-5/8	103.1	3656	354.5	5.954	214.8	85.94
22	110.0	4437	403.3	6.351	229.2	91.67
23-3/8	116.9	5322	455.3	6.748	243.5	97.40
24-3/4	123.8	6317	510.5	7.145	257.8	103.1
26-1/8	130.6	7429	568.8	7.542	272.1	108.9
27-1/2	137.5	8665	630.2	7.939	286.5	114.6
28-7/8	144.4	10030	694.8	8.335	300.8	120.3
30-1/4	151.3	11530	762.6	8.732	315.1	126.0
31-5/8	158.1	13180	833.5	9.129	329.4	131.8
33	165.0	14970	907.5	9.526	343.8	137.5
34-3/8	171.9	16920	984.7	9.923	358.1	143.2
35-3/4	178.8	19040	1065	10.32	372.4	149.0
5-1/8 in. Width (r_y = 1.479 in.)						
6-7/8	35.23	138.8	40.37	1.985	77.12	30.10
8-1/4	42.28	239.8	58.14	2.382	92.55	36.12
9-5/8	49.33	380.8	79.13	2.778	108.0	42.13
11	56.38	568.4	103.4	3.175	123.4	48.15
12-3/8	63.42	809.4	130.8	3.572	138.8	54.17
13-3/4	70.47	1110	161.5	3.969	154.2	60.19
15-1/8	77.52	1478	195.4	4.366	169.7	66.21
16-1/2	84.56	1919	232.5	4.763	185.1	72.23
17-7/8	91.61	2439	272.9	5.160	200.5	78.25
19-1/4	98.66	3047	316.5	5.557	215.9	84.27
20-5/8	105.7	3747	363.4	5.954	231.4	90.29
22	112.8	4548	413.4	6.351	246.8	96.31
23-3/8	119.8	5455	466.7	6.748	262.2	102.3
24-3/4	126.8	6475	523.2	7.145	277.6	108.3
26-1/8	133.9	7615	583.0	7.542	293.1	114.4
27-1/2	140.9	8882	646.0	7.939	308.5	120.4
28-7/8	148.0	10280	712.2	8.335	323.9	126.4
30-1/4	155.0	11820	781.6	8.732	339.3	132.4
31-5/8	162.1	13510	854.3	9.129	354.8	138.4
33	169.1	15350	930.2	9.526	370.2	144.5
34-3/8	176.2	17350	1009	9.923	385.6	150.5
35-3/4	183.2	19510	1092	10.32	401.0	156.5

Table 9.2 Section Properties *Southern Pine* Glued Laminated Timber (Cont.)

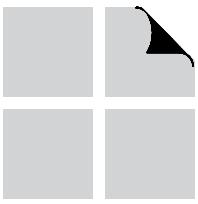
Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
6-3/4 in. Width (r_y = 1.949 in.)						
6-7/8	46.41	182.8	53.17	1.985	176.2	52.21
8-1/4	55.69	315.9	76.57	2.382	211.4	62.65
9-5/8	64.97	501.6	104.2	2.778	246.7	73.09
11	74.25	748.7	136.1	3.175	281.9	83.53
12-3/8	83.53	1066	172.3	3.572	317.2	93.97
13-3/4	92.81	1462	212.7	3.969	352.4	104.4
15-1/8	102.1	1946	257.4	4.366	387.6	114.9
16-1/2	111.4	2527	306.3	4.763	422.9	125.3
17-7/8	120.7	3213	359.5	5.160	458.1	135.7
19-1/4	129.9	4012	416.9	5.557	493.4	146.2
20-5/8	139.2	4935	478.6	5.954	528.6	156.6
22	148.5	5990	544.5	6.351	563.8	167.1
23-3/8	157.8	7184	614.7	6.748	599.1	177.5
24-3/4	167.1	8528	689.1	7.145	634.3	187.9
26-1/8	176.3	10030	767.8	7.542	669.6	198.4
27-1/2	185.6	11700	850.8	7.939	704.8	208.8
28-7/8	194.9	13540	938.0	8.335	740.0	219.3
30-1/4	204.2	15570	1029	8.732	775.3	229.7
31-5/8	213.5	17790	1125	9.129	810.5	240.2
33	222.8	20210	1225	9.526	845.8	250.6
34-3/8	232.0	22850	1329	9.923	881.0	261.0
35-3/4	241.3	25700	1438	10.32	916.2	271.5
37-1/8	250.6	28780	1551	10.72	951.5	281.9
38-1/2	259.9	32100	1668	11.11	986.7	292.4
39-7/8	269.2	35660	1789	11.51	1022	302.8
41-1/4	278.4	39480	1914	11.91	1057	313.2
42-5/8	287.7	43560	2044	12.30	1092	323.7
44	297.0	47920	2178	12.70	1128	334.1
45-3/8	306.3	52550	2316	13.10	1163	344.6
46-3/4	315.6	57470	2459	13.50	1198	355.0
48-1/8	324.8	62700	2606	13.89	1233	365.4
49-1/2	334.1	68220	2757	14.29	1269	375.9
50-7/8	343.4	74070	2912	14.69	1304	386.3
52-1/4	352.7	80240	3071	15.08	1339	396.8
53-5/8	362.0	86740	3235	15.48	1374	407.2
55	371.3	93590	3403	15.88	1410	417.7
56-3/8	380.5	100800	3575	16.27	1445	428.1
57-3/4	389.8	108300	3752	16.67	1480	438.5
59-1/8	399.1	116300	3933	17.07	1515	449.0
60-1/2	408.4	124600	4118	17.46	1551	459.4

Table 9.2 Section Properties *Southern Pine* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
8-1/2 in. Width (r_y = 2.454 in.)						
9-5/8	81.81	631.6	131.2	2.778	492.6	115.9
11	93.50	942.8	171.4	3.175	562.9	132.5
12-3/8	105.2	1342	216.9	3.572	633.3	149.0
13-3/4	116.9	1841	267.8	3.969	703.7	165.6
15-1/8	128.6	2451	324.1	4.366	774.1	182.1
16-1/2	140.3	3182	385.7	4.763	844.4	198.7
17-7/8	151.9	4046	452.6	5.160	914.8	215.2
19-1/4	163.6	5053	525.0	5.557	985.2	231.8
20-5/8	175.3	6215	602.6	5.954	1056	248.4
22	187.0	7542	685.7	6.351	1126	264.9
23-3/8	198.7	9047	774.1	6.748	1196	281.5
24-3/4	210.4	10740	867.8	7.145	1267	298.0
26-1/8	222.1	12630	966.9	7.542	1337	314.6
27-1/2	233.8	14730	1071	7.939	1407	331.1
28-7/8	245.4	17050	1181	8.335	1478	347.7
30-1/4	257.1	19610	1296	8.732	1548	364.3
31-5/8	268.8	22400	1417	9.129	1618	380.8
33	280.5	25460	1543	9.526	1689	397.4
34-3/8	292.2	28770	1674	9.923	1759	413.9
35-3/4	303.9	32360	1811	10.32	1830	430.5
37-1/8	315.6	36240	1953	10.72	1900	447.0
38-1/2	327.3	40420	2100	11.11	1970	463.6
39-7/8	338.9	44910	2253	11.51	2041	480.2
41-1/4	350.6	49720	2411	11.91	2111	496.7
42-5/8	362.3	54860	2574	12.30	2181	513.3
44	374.0	60340	2743	12.70	2252	529.8
45-3/8	385.7	66170	2917	13.10	2322	546.4
46-3/4	397.4	72370	3096	13.50	2393	562.9
48-1/8	409.1	78950	3281	13.89	2463	579.5
49-1/2	420.8	85910	3471	14.29	2533	596.1
50-7/8	432.4	93270	3667	14.69	2604	612.6
52-1/4	444.1	101000	3868	15.08	2674	629.2
53-5/8	455.8	109200	4074	15.48	2744	645.7
55	467.5	117800	4285	15.88	2815	662.3
56-3/8	479.2	126900	4502	16.27	2885	678.8
57-3/4	490.9	136400	4725	16.67	2955	695.4
59-1/8	502.6	146400	4952	17.07	3026	712.0
60-1/2	514.3	156900	5185	17.46	3096	728.5

Table 9.2 Section Properties *Southern Pine* Glued Laminated Timber (Cont.)

Depth	Area	X-X Axis			Y-Y Axis	
d (in.)	A (in.^{2})	I_x (in.^{4})	S_x (in.^{3})	r_x (in.)	I_y (in.^{4})	S_y (in.^{3})
10-1/2 in. Width (r_y = 3.031 in.)						
11	115.5	1165	211.8	3.175	1061	202.1
12-3/8	129.9	1658	268.0	3.572	1194	227.4
13-3/4	144.4	2275	330.9	3.969	1326	252.7
15-1/8	158.8	3028	400.3	4.366	1459	277.9
16-1/2	173.3	3931	476.4	4.763	1592	303.2
17-7/8	187.7	4997	559.2	5.160	1724	328.5
19-1/4	202.1	6242	648.5	5.557	1857	353.7
20-5/8	216.6	7677	744.4	5.954	1990	379.0
22	231.0	9317	847.0	6.351	2122	404.3
23-3/8	245.4	11180	956.2	6.748	2255	429.5
24-3/4	259.9	13270	1072	7.145	2388	454.8
26-1/8	274.3	15600	1194	7.542	2520	480.0
27-1/2	288.8	18200	1323	7.939	2653	505.3
28-7/8	303.2	21070	1459	8.335	2786	530.6
30-1/4	317.6	24220	1601	8.732	2918	555.8
31-5/8	332.1	27680	1750	9.129	3051	581.1
33	346.5	31440	1906	9.526	3183	606.4
34-3/8	360.9	35540	2068	9.923	3316	631.6
35-3/4	375.4	39980	2237	10.32	3449	656.9
37-1/8	389.8	44770	2412	10.72	3581	682.2
38-1/2	404.3	49930	2594	11.11	3714	707.4
39-7/8	418.7	55480	2783	11.51	3847	732.7
41-1/4	433.1	61420	2978	11.91	3979	758.0
42-5/8	447.6	67760	3180	12.30	4112	783.2
44	462.0	74540	3388	12.70	4245	808.5
45-3/8	476.4	81740	3603	13.10	4377	833.8
46-3/4	490.9	89400	3825	13.50	4510	859.0
48-1/8	505.3	97530	4053	13.89	4643	884.3
49-1/2	519.8	106100	4288	14.29	4775	909.6
50-7/8	534.2	115200	4529	14.69	4908	934.8
52-1/4	548.6	124800	4778	15.08	5040	960.1
53-5/8	563.1	134900	5032	15.48	5173	985.4
55	577.5	145600	5294	15.88	5306	1011
56-3/8	591.9	156800	5562	16.27	5438	1036
57-3/4	606.4	168500	5836	16.67	5571	1061
59-1/8	620.8	180900	6118	17.07	5704	1086
60-1/2	635.3	193800	6405	17.46	5836	1112



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