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DIVISION: 06—WOOD AND PLASTICS
Section: 06051—Design Information

REPORT HOLDER:

APA—THE ENGINEERED WOOD ASSOCIATION
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EVALUATION SUBJECT:

GLUED-LAMINATED TIMBER COMBINATIONS AND THE GAP2006 COMPUTER PROGRAM

ADDITIONAL LISTEES:

ANTHONY FOREST PRODUCTS CO.
309 NORTH WASHINGTON
EL DORADO, ARKANSAS 71730

CALVERT COMPANY, INC.
218 V STREET
VANCOUVER, WASHINGTON 98661

CASCADE STRUCTURAL LAMINATORS, INC.
195 RIBELIN ROAD
CHEHALIS, WASHINGTON 98532

ROSBORO, LLC
POST OFFICE BOX 20
SPRINGFIELD, OREGON 97477

STANDARD STRUCTURES INC.
5900 PRUITT AVENUE
WINDSOR, CALIFORNIA 95492

WESTERN STRUCTURES, INC.
1381 BAILEY HILL ROAD
EUGENE, OREGON 97402

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

Property evaluated:

Structural

2.0 USES

The GAP2006 computer program is utilized to determine design stresses for the specific layups of glued-laminated timbers listed in Tables 1 and 2 of this report.

Glued-laminated timbers manufactured to the glued-laminated timber combinations or single grade layups that have been developed using the GAP2006 program, and that are produced at the facilities listed in Table 3, are recognized as being in compliance with the design parameters indicated in Section 3.0 of this report.

3.0 DESCRIPTION

The GAP2006 computer program is based on the principles of ASTM D 3737. It is an alternative method for determining associated allowable design stresses for a given layup combination of glued-laminated timber. The GAP2006 computer program complies with the IBC and the IRC for allowable stress design. The design assumptions discussed in Sections 3.1 through 3.4 of this report are basic parameters utilized with the development of the allowable design stresses for the combinations listed in Table 1 or single grade layups listed in Table 2. See Section 5.4 for requirements applicable to these parameters.

3.1 Adhesive:

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

3.2 End Joints:

End joints comply with ANSI A190.1 and ASTM D 3737.

3.3 Lumber:

Lumber having a nominal thickness of 2 inches or less is glued-laminated into rectangular cross sections complying with industry standards for depth, width, and appearance. Lumber that is E-rated or visually graded complies with rules of applicable approved lumber grading agencies and the procedures set forth in the manufacturer's quality control documentation. Quality control for E-rating and beam fabrication is conducted under the supervision of an approved third-party inspection agency. Grade specifications are included in rules of the applicable approved lumber grading agencies and follow industry classifications and nomenclature as provided in the applicable code.

3.4 Layup:

Beams are fabricated in accordance with ANSI A190.1 using the grade combinations noted in Table 1 or single grade layups noted in Table 2 of this report. Combinations are in accordance with ASTM D 3737 requirements. Resawn purlin

beams, manufactured by ripping nominally 6-inch beams vertically through their depth into two members of equal width, are permitted to be produced from Canadian spruce-pine (CSP) and spruce-pine-fir (SPF) combinations in this width without any variation in basic grade description or layup procedures.

4.0 DESIGN

The design requirements of structural glued-laminated timber must comply with Section 2306 or 2307 of the IBC, or Sections R502.2 and R802.2 of the IRC, as applicable. Modifications of values for duration of load must comply with the IBC or the IRC, as applicable.

5.0 CONDITIONS OF USE

The specific layups for the glued-laminated timbers described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The application of the GAP2006 computer program is limited to the layup combinations shown in Tables 1 or 2. Design stresses for normal conditions of loading must not exceed those set forth in Tables 1 or 2.

5.2 Design stresses for combinations, as noted in Tables 1 or 2, are for members with four or more laminations stressed primarily in bending due to loads applied perpendicular to the wide faces of the laminations.

5.3 The effects of checking of the members are outside the scope of this report.

5.4 Glued-laminated timber manufactured to the glued-laminated timber combinations or single grade layups that have been developed using the GAP2006 program, listed in Tables 1 and 2, and that are produced at the facilities listed in Table 3, are recognized as being in compliance with the design parameters indicated in Section 3.0 of this report.

Evaluation of glue-laminated timber manufactured in accordance with this report but produced by manufacturers not listed in Table 3 must be recognized in a current ICC-ES report as being in compliance with the design parameters indicated in Section 3.0 of this report.

5.5 The quality program for monitoring the use of the GAP2006 computer program must be in accordance with "Quality Control Requirements for the GAP Computer Program," dated July 26, 2006.

6.0 EVIDENCE SUBMITTED

6.1 Program Guide for the GAP2006 Computer Program.

6.2 Data in accordance with ASTM D 3737.

6.3 Quality system documentation.

7.0 IDENTIFICATION

Each glued-laminated beam manufactured using layup combinations determined in accordance with this report and produced at the facilities listed in Table 3 must be identified with the ICC-ES evaluation report number (ESR-1940).

TABLE 1 -- DESIGN VALUES FOR STRUCTURAL GLUED-LAMINATED SOFTWOOD TIMBER STRESSED PRIMARILY IN BENDING[1,2,3]

			Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)						Bending About Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)				Axially Loaded			Fasteners	
			Extreme Fiber in Bending[6]		Compression Perpendicular to Grain		Shear Parallel to Grain (Horizontal)[7,8]	Modulus of Elasticity[9]	Extreme Fiber in Bending[10]	Compression Perpendicular to Grain	Shear Parallel to Grain (Horizontal)[7,8,11]	Modulus of Elasticity[9]	Tension Parallel to Grain	Compression Parallel to Grain	Modulus of Elasticity	Specific Gravity for Dowel-Type Fastener Design	
			Tension Zone Stressed in Tension	Compression Zone Stressed in Tension	Tension Face	Compression Face										Top or Bottom Face	Side Face
Combination Symbol	Species[4] Outer/ Core	Balanced/ Unbalanced[5]	F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} (psi)	E_x (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} (psi)	E_y (10^6 psi)	F_t (psi)	F_c (psi)	E_{axial} (10^6 psi)	SG	
Western Species																	
EWS 16F-V3	DF/DF	U	1600	1150	560	560	265	1.5	1450	560	230	1.5	950	1550	1.5	0.50	0.50
EWS 20F-E/ES1[6,12]	ES/ES	B	2000	2000	560	560	200	1.8	1100	300	175	1.5	1050	1150	1.6	0.41	0.41
EWS 20F-E/SPF1[13]	SPF/SPF	B	2000	2000	425	425	215	1.5	875	425	190	1.4	425	1100	1.4	0.42	0.42
EWS 20F-E8	ES/ES	U	2000	1300	450	450	200	1.5	1400	315	175	1.4	800	1000	1.4	0.41	0.41
EWS 20F-E8M1	ES/ES	B	2000	2000	450	450	200	1.5	1400	315	175	1.4	800	1000	1.4	0.41	0.41
EWS 20F-V4	DF/DF	U	2000	1450	590	560	265	1.6	1450	560	230	1.6	975	1550	1.6	0.50	0.50
EWS 20F-V8	DF/DF	B	2000	2000	590	590	265	1.6	1450	560	230	1.6	975	1600	1.7	0.50	0.50
EWS 20F-V12	AC/AC	U	2000	1400	560	560	265	1.5	1250	470	230	1.4	900	1500	1.4	0.46	0.46
EWS 20F-V13	AC/AC	B	2000	2000	560	560	265	1.5	1250	470	230	1.4	925	1550	1.5	0.46	0.46
EWS 22F-V/POC1	POC/POC	B	2200	2200	560	560	265	1.8	1500	375	230	1.6	1150	1950	1.6	0.45	0.45
EWS 22F-V/POC2	POC/POC	U	2200	1600	560	560	265	1.8	1500	375	230	1.6	1150	1900	1.6	0.45	0.45
EWS 24F-E/CSP1	CSP/CSP	B	2400	2400	560	560	215	1.6	1150	470	190	1.6	1150	2000	1.7	0.42	0.42
EWS 24F-E/CSP2	CSP/CSP	B	2400	2400	560	560	215	1.8	1500	470	190	1.6	1150	2000	1.7	0.42	0.42
EWS 24F-E/CSP3	CSP/CSP	U	2400	1550	560	650	215	1.6	1200	470	195	1.5	900	1750	1.6	0.42	0.42
EWS 24F-E/CSP4	CSP/CSP	U	2400	1700	560	650	215	1.8	1400	470	200	1.6	1150	1900	1.7	0.42	0.42
EWS 24F-E/SPF1	SPF/SPF	B	2400	2400	560	560	215	1.6	1150	470	190	1.6	1150	2000	1.7	0.42	0.42
EWS 24F-E/SPF2	SPF/SPF	B	2400	2400	560	560	215	1.8	1500	470	190	1.6	1150	2000	1.7	0.42	0.42
EWS 24F-E/SPF3	SPF/SPF	U	2400	1550	560	650	215	1.6	1200	470	195	1.5	900	1750	1.6	0.42	0.42
EWS 24F-E/SPF4	SPF/SPF	U	2400	1700	560	650	215	1.8	1400	470	200	1.6	1150	1900	1.7	0.42	0.42
EWS 24F-E/ES1	ES/ES	U	2400	1700	560	560	200	1.7	1100	300	175	1.5	1050	1150	1.6	0.41	0.41
EWS 24F-E/ES1M1	ES/ES	B	2400	2400	560	560	200	1.8	1100	300	175	1.5	1050	1150	1.6	0.41	0.41
EWS 24F-E15M1	HF/HF	U	2400	1600	500	500	215	1.8	1200	375	190	1.5	975	1500	1.6	0.43	0.43
EWS 24F-V4	DF/DF	U	2400	1850	650	650	265	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V4M1[14]	DF/DF	U	2400	1850	650	650	265	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V4M2[14]	DF/DF	U	2400	1850	650	650	220	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V5	DF/HF	U	2400	1600	650	650	215	1.7	1200	375	200	1.5	1150	1450	1.6	0.50	0.43
EWS 24F-V5M1	DF/SPF	U	2400	1600	650	650	215	1.8	1200	375	200	1.5	1050	1450	1.6	0.50	0.42
EWS 24F-V5M2[12]	DF/HF	U	2400	1600	650	650	215	1.8	1200	375	200	1.5	1150	1450	1.6	0.50	0.43
EWS 24F-V5M3[12]	DF/HF	U	2400	1600	650	650	215	1.8	1200	375	200	1.5	1150	1450	1.6	0.50	0.43
EWS 24F-V8	DF/DF	B	2400	2400	650	650	265	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V8M1[14]	DF/DF	B	2400	2400	650	650	265	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V8M2[14]	DF/DF	B	2400	2400	650	650	220	1.8	1450	560	230	1.6	1100	1650	1.7	0.50	0.50
EWS 24F-V10	DF/HF	B	2400	2400	650	650	215	1.8	1450	375	200	1.5	1100	1550	1.6	0.50	0.43
EWS 24F-V/DF1[12]	DF/SW	U	2400	1600	650	650	195	1.8	900[15]	255	205	1.4	1000	1250	1.5	0.50	0.42
EWS 26F-E/DF1[12]	DF/DF	U	2600	1950[15]	650	650	265	2.0	1850	560	230	1.8	1400	1800	1.8	0.50	0.50
EWS 26F-E/DF1M1[12]	DF/DF	B	2600	2600	650	650	265	2.0	1850	560	230	1.8	1400	1800	1.8	0.50	0.50
EWS 24F-1.8E Glulam Header[16]	WS,SP/WS, SP	U	2400	1600	500	500	215	1.8	1300	375	200	1.5	950	1200	1.6	0.42	0.42
Southern Pine																	
EWS 16F-V5M1[14]	SP/SP	B	1600	1600	650	650	200	1.4	1750	650	260	1.4	1000	1500	1.5	0.55	0.55
EWS 24F-E/SP1[13]	SP/SP	B	2400	2400	740	740	300	1.8	1650	650	265	1.6	1150	1650	1.6	0.55	0.55
EWS 24F-V1	SP/SP	U	2400	1750	740	650	300	1.7	1450	650	265	1.5	1100	1550	1.6	0.55	0.55
EWS 24F-V3	SP/SP	U	2400	1950	740	740	300	1.8	1750	650	265	1.6	1150	1650	1.7	0.55	0.55
EWS 24F-V3M1[14]	SP/SP	U	2400	1950	740	740	300	1.8	1750	650	265	1.6	1150	1650	1.7	0.55	0.55
EWS 24F-V3M2[14]	SP/SP	U	2400	1950	740	740	250	1.8	1750	650	265	1.6	1150	1650	1.7	0.55	0.55
EWS 24F-V4[22]	SP/SP	U	2400	1450	740	650	210	1.7	1050	470	185	1.3	875	1000	1.5	0.55	0.43
EWS 24F-V5	SP/SP	B	2400	2400	740	740	300	1.7	1750	650	265	1.5	1150	1650	1.6	0.55	0.55
EWS 24F-V5M1	SP/SP	B	2400	2400	740	740	300	1.8	1750	650	265	1.5	1150	1650	1.6	0.55	0.55
EWS 24F-V5M2[14]	SP/SP	B	2400	2400	740	740	300	1.8	1750	650	265	1.5	1150	1650	1.6	0.55	0.55
EWS 24F-V5M3[14]	SP/SP	B	2400	2400	740	740	250	1.8	1750	650	265	1.5	1150	1650	1.6	0.55	0.55
EWS 26F-V1	SP/SP	U	2600	1950	740	740	300	1.8	1900	650	265	1.6	1150	1600	1.7	0.55	0.55
EWS 26F-V2	SP/SP	U	2600	2100	740	740	300	1.9	2200	740	265	1.8	1250	1650	1.9	0.55	0.55
EWS 26F-V3	SP/SP	U	2600	2100	740	740	300	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
Wet-use factors			0.8		0.53		0.875	0.833	0.8	0.53	0.875	0.833	0.8	0.73	0.833	See NDS	

TABLE 1 -- DESIGN VALUES FOR STRUCTURAL GLUED-LAMINATED SOFTWOOD TIMBER STRESSED PRIMARILY IN BENDING[1,2,3] (Continued)

			Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)						Bending About Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)				Axially Loaded			Fasteners	
			Extreme Fiber in Bending[6]		Compression Perpendicular to Grain		Shear Parallel to Grain (Horizontal)[7,8]	Modulus of Elasticity[9]	Extreme Fiber in Bending[10]	Compression Perpendicular to Grain	Shear Parallel to Grain (Horizontal)[7,8,11]	Modulus of Elasticity[9]	Tension Parallel to Grain	Compression Parallel to Grain	Modulus of Elasticity	Specific Gravity for Dowel-Type Fastener Design	
			Tension Zone Stressed in Tension	Compression Zone Stressed in Tension	Tension Face	Compression Face										Top or Bottom Face	Side Face
Combination Symbol	Species[4] Outer/ Core	Balanced/ Unbalanced[5]	F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} (psi)	E_x (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} (psi)	E_y (10^6 psi)	F_t (psi)	F_c (psi)	E_{axial} (10^6 psi)	SG	
Southern Pine (Continued)																	
EWS 26F-V3M1[14]	SP/SP	U	2600	2100	740	740	300	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
EWS 26F-V3M2[14]	SP/SP	U	2600	2100	740	740	250	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
EWS 26F-V4	SP/SP	B	2600	2600	740	740	300	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
EWS 26F-V4M1[14]	SP/SP	B	2600	2600	740	740	300	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
EWS 26F-V4M2[14]	SP/SP	B	2600	2600	740	740	250	1.9	2100	650	265	1.8	1200	1600	1.9	0.55	0.55
EWS 28F-E1	SP/SP	U	2800	2300	805	805	300	2.1[21]	1600	650	265	1.7	1300	1850	1.7	0.55	0.55
EWS 28F-E1M1	SP/SP	U	2800	2300	805	805	300	2.1	1600	650	265	1.7	1300	1850	1.7	0.55	0.55
EWS 28F-E2	SP/SP	B	2800	2800	805	805	300	2.1[21]	2000	650	265	1.7	1300	1850	1.7	0.55	0.55
EWS 28F-E2M1	SP/SP	B	2800	2800	805	805	300	2.1	2000	650	265	1.7	1300	1850	1.7	0.55	0.55
EWS 30F-E1[17]	SP/SP	U	3000	2400	805	805	300	2.1[21]	1750	650	265	1.7	1250	1750	1.7	0.55	0.55
EWS 30F-E1M1[17]	SP/SP	U	3000	2400	805	805	300	2.1	1750	650	265	1.7	1250	1750	1.7	0.55	0.55
EWS 30F-E1M2[18]	LVL/SP	U	3000[19]	2400	650[20]	740	300	2.1	1750	650	265	1.7	1250	1750	1.7	0.50	0.50
EWS 30F-E2[17]	SP/SP	B	3000	3000	805	805	300	2.1[21]	1750	650	265	1.7	1350	1750	1.7	0.55	0.55
EWS 30F-E2M1[17]	SP/SP	B	3000	3000	805	805	300	2.1	1750	650	265	1.7	1350	1750	1.7	0.55	0.55
EWS 30F-E2M2[18]	LVL/SP	B	3000[19]	3000[19]	650[20]	650[20]	300	2.1	1750	650	265	1.7	1350	1750	1.7	0.50	0.50
EWS 30F-E2M3[18]	LVL/SP	B	3000[19]	3000[19]	650[20]	650[20]	300	2.1	1750	650	265	1.7	1350	1750	1.7	0.50	0.50
Wet-use factors			0.8		0.53		0.875	0.833	0.8	0.53	0.875	0.833	0.8	0.73	0.833	See NDS	

For **SI**: 1 psi = 6,895 Pa

1. The combinations in this table are applicable to members consisting of 4 or more laminations, unless otherwise noted, and are intended primarily for members stressed in bending due to loads applied perpendicular to the wide faces of the laminations.
2. The tabulated design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the factors shown at the bottom of the table.
3. The tabulated design values are for normal duration of loading. For other durations of loading, see applicable building code.
4. The symbols used for species are AC = Alaska cedar, CSP = Canadian spruce-pine, DF = Douglas fir-larch, ES = Eastern spruce, HF = Hem-fir, POC = Port Orford cedar; SP = Southern pine, SPF = Spruce-pine-fir, and SW = Softwood species.
5. The unbalanced layups are intended primarily for simple-span applications and the balanced layups are intended primarily for continuous or cantilevered applications.
6. The tabulated design values in bending, F_{bx}, are based on members 5-1/8 inches in width by 12 inches in depth by 21 feet in length. For members with a larger volume, F_{bx} must be multiplied by a volume factor, C_v, determined in accordance with applicable building code. The tabulated F_{bx} values require the use of special tension laminations. If these special tension laminations are omitted, the F_{bx} values must be multiplied by 0.75 for members greater than or equal to 15 inches or by 0.85 for members less than 15 inches in depth. EWS 20F-E/ES1 does not require special tension laminations.
7. For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the design value for shear must be multiplied by a factor of 0.72.
8. F_{vx} and F_{vy} values do not include adjustments for checking.
9. The tabulated E_x and E_y values already include a 5% shear deflection (also known as "apparent E"). For beam and column stability calculations, E_{min} must be determined by multiplying the tabulated modulus of elasticity by 0.518.
10. The values of F_{by} were calculated based on members 12 inches in depth (bending about Y-Y axis). For depths other than 12 inches, the F_{by} values are permitted to be increased by multiplying by the size factor, $(12/d)^{1/9}$, where d is the beam depth in inches. When d is less than 3 inches, use the size adjustment factor for 3 inches.
11. Design values are for timbers with laminations made from a single piece of lumber across the width or multiple pieces that have been edge bonded. For timber manufactured from multiple piece laminations (across width) that are not edge bonded, value must be multiplied by 0.4 for members with 5, 7, or 9 laminations or by 0.5 for all other members. This reduction must be cumulative with the adjustment in Footnote 7.
12. The beam depth limitation is as follows - 20F-E/ES1: 15 inches; 24F-V5M2/DF: 27 inches; 24F-V5M3/DF and 24F-V/DF1: 24 inches; 26F-E/DF1 and 26F-E/DF1M1: 9-1/2, 11-7/8, 14, and 16 inches.
13. 20F-E/SPF1 is limited to 1-1/2 to 3-1/2 inches in width, and 7-1/2, 9, 9-1/2, 11-7/8, and 14 inches in depth. 24F-E/SP1 is limited to 9-1/2, 11-7/8, 14, 16, and 18 inches in depth.
14. When containing wane, this combination must be used in dry conditions only. In this case, wet-use factors must not be applied. Because of the wane, this combination is available only for an industrial appearance characteristic. If wane is omitted, these restrictions must not apply. This combination is limited to 9 to 20 laminations in depth except for 16F-V5M1/SP, which contains a maximum of 1/6 wane on each side and must be 4 laminations or more in depth.
15. For 26F-E/DF1, the F_{bx}^{-} value is permitted to be increased to 2,200 psi for beam depths less than 16 inches. For 24F-V/DF1, the F_{by} value is permitted to be increased to 1,300 psi for beam depths of at least 10-1/2 inches.
16. This combination must be manufactured from either EWS 24F-V4/WS, EWS 24F-V5M1/WS, EWS 24F-V5M2/WS, EWS 24F-V5M3/WS, EWS 24F-E15M1/WS, EWS 24F-E/SPF4, or EWS 24F-V3/SP, and is intended primarily for use in header applications.
17. This layup combination is limited to nominal 6 inches or less in width. In addition, 30F-E1M1/SP and 30F-E2M1/SP are limited to 18 inches or less in depth.
18. The beam depth is limited to 16 inches or less for 30F-E2M2/SP, and 30 inches or less for 30F-E1M2/SP and 30F-E2M3/SP. The tension lamination requirements for these layups must not be omitted.
19. The tabulated design values in bending, F_{bx}, must be multiplied by a volume factor, C_v, determined in accordance with applicable building code using 1/10 as the exponent.
20. The allowable compressive stress perpendicular to grain of the beam must be permitted to be increased to the published allowable compressive stress perpendicular to grain of the outermost laminated veneer lumber.
21. For members of more than 15 laminations, $E_x = 2.0 \times 10^6$ psi.
22. This combination may contain wane. If wane lumber is used, F_{vx} must be multiplied by 0.67 if wane is allowed on both sides. If wane is limited to one side, F_{vx} must be multiplied by 0.83. This reduction is cumulative with the adjustment in Footnote 7.

TABLE 2 -- DESIGN VALUES FOR STRUCTURAL GLUED-LAMINATED SOFTWOOD TIMBER STRESSED PRIMARILY IN AXIAL TENSION AND COMPRESSION[1,2,3]

					Axially Loaded			Bending about Y-Y Axis				Bending about X-X Axis		Fasteners
					Tension Parallel to Grain	Compression Parallel to Grain		(Loaded Parallel to Wide Faces of Laminations)				(Loaded Perpendicular to Wide Faces of Laminations)		
								Bending			Shear Parallel to Grain	Bending	Shear Parallel to Grain	Specific Gravity for Dowel-Type Fastener Design
Comb Symbol	Species	Grade	Modulus of Elasticity[4] **E** 10^6 psi	Compression Perpendicular to Grain $F_{c\perp}$ psi	2 or More Lams F_t psi	4 or More Lams F_c psi	2 or 3 Lams F_c psi	4 or More Lams F_{by} psi	3 Lams F_{by} psi	2 Lams F_{by} psi	See Notes 5 and 6 F_{vy} psi	2 Lams to 15 in. Deep[7] F_{bx} psi	See Note 8 F_{vx} psi	**SG**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Western Species														
EWS 1	DF	L3	1.5	560	900	1,550	1,200	1,450	1,250	1,000	230	1,250	265	0.50
EWS 2	DF	L2	1.6	560	1,250	1,950	1,600	1,800	1,600	1,300	230	1,700	265	0.50
EWS 3	DF	L2D	1.9	650	1,450	2,300	1,850	2,100	1,850	1,550	230	2,000	265	0.50
EWS 5	DF	L1	2.0	650	1,600	2,400	2,100	2,400	2,100	1,800	230	2,200	265	0.50
EWS 22[9]	SW	L3	1.0	315	525	850	675	800	700	550	170	725	195	0.35
EWS 70	AC	L2	1.3	470	975	1,450	1,450	1,400	1,250	1,000	230	1,350	265	0.46
Southern Pine														
EWS 47	SP	N2M14	1.4	650	1,200	1,900	1,150	1,750	1,550	1,300	260	1,400	300	0.55
EWS 48	SP	N2D14	1.7	740	1,400	2,200	1,350	2,000	1,800	1,500	260	1,600	300	0.55
EWS 49	SP	N1M16	1.7	650	1,350	2,100	1,450	1,950	1,750	1,500	260	1,800	300	0.55
EWS 50	SP	N1D14	1.9	740	1,550	2,300	1,700	2,300	2,100	1,750	260	2,100	300	0.55
Wet-use factors			0.833	0.53	0.8	0.73		0.8			0.875	0.8	0.875	see NDS

For **SI**: 1 psi = 6,895 Pa

1. The tabulated design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the factors shown at the bottom of the table.
2. The tabulated design values are for normal duration of loading. For other durations of loading, see applicable building code.
3. The symbols used for species are AC = Alaska cedar, DF = Douglas fir-larch, SP = Southern pine, and SW = Softwood species.
4. For beam and column stability calculations, E_{min} must be determined by multiplying the tabulated modulus of elasticity by 0.518.
5. The tabulated F_{vy} values are for members of 4 or more lams. The tabulated F_{vy} values must be multiplied by a factor of 0.95 for 3 lams and 0.84 for 2 lams.
6. For members with 5, 7, or 9 lams manufactured from multiple-piece lams with unbonded edge joints, the tabulated F_{vy} values must be multiplied by a factor of 0.4. For all other members manufactured from multiple-piece lams with unbonded edge joints, the tabulated F_{vy} values must be multiplied by a factor of 0.5. This adjustment must be cumulative with the adjustment given in Footnote No. 5.
7. The tabulated F_{bx} values are for members without special tension lams up to 15 inches in depth. If the member depth is greater than 15 inches without special tension lams, the tabulated F_{bx} values must be multiplied by a factor of 0.88. If special tension lams are used, the tabulated F_{bx} values are permitted to be increased by a factor of 1.18 regardless of the member depth.
8. For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the tabulated F_{vx} values must be multiplied by 0.72.
9. When Western Cedars, Western Cedars (North), Western Woods, and Redwood (open grain) are used in combinations for Softwood Species (SW), the design values for modulus of elasticity (E_x and E_y) must be reduced by 100,000 psi. When Coast Sitka Spruce, Coast Species, Western White Pine, and Eastern White Pine are used in combinations for Softwood Species (SW), design values for shear parallel to grain (F_{vx} and F_{vy}) must be reduced by 10 psi before applying any adjustments.

TABLE 3 -- MANUFACTURING LOCATIONS USING GAP 2006 PROGRAM

MANUFACTURER	LOCATION
Anthony Forest Products Co.	256 Cooper Drive, El Dorado, AR 71730
Anthony Forest Products Co.	256 Edison Road, Washington, GA 30676
Calvert Company, Inc.	218 V Street, Vancouver, WA 98661
Calvert Company, Inc.	3559 Truman Road, Washougal, WA 98671
Cascade Structural Laminators, Inc.	195 Ribelin Road, Chehalis, WA 98532
Rosboro	22833 Vaughn Road, Veneta, OR 97487
Rosboro	2509 Main Street, Springfield, OR 97477
Standard Structures, Inc.	5900 Pruitt Avenue, Windsor, CA 95492
Western Sructures, Inc.	1381 Bailey Hill Road, Eugene, OR 97402