Joint Evaluation Report

ESR-1940

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES **Section: 06 02 00—Design Information**	**REPORT HOLDER: APA—THE ENGINEERED WOOD ASSOCIATION** **ADDITIONAL LISTEES:** **ANTHONY FOREST PRODUCTS CO.** **WFP ENGINEERED PRODUCTS, LLC**	**EVALUATION SUBJECT:** **GLUED-LAMINATED TIMBER COMBINATIONS AND THE GAP COMPUTER PROGRAM**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015 and 2012 *International Building Code*® (IBC)
- 2021, 2018, 2015 and 2012 *International Residential Code*® (IRC)

Property evaluated:

- Structural

2.0 USES

The GAP 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 GAP 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 GAP computer program is based on the principles of ASTM D3737. It is an alternative method for determining associated allowable design stresses for a given layup combination of glued-laminated timber. The GAP 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 D2559 for exterior or wet use.

3.2 End Joints:

End joints comply with ANSI A190.1 and ASTM D3737.

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 D3737 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 GAP 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 noted in Table 1 are for members with four or more laminations stressed primarily in bending due to loads applied perpendicular to the wide faces of the laminations. Design values are included, however, for axial stresses and stresses from bending due to loads applied parallel to the wide faces of the laminations.

5.3 Design stresses for combinations noted in Table 2 are for members with two or more laminations stressed primarily axially or in bending due to loads applied parallel to the wide faces of the laminations. Design values are included, however, for stresses from bending due to loads applied perpendicular to the wide faces of the laminations.

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

5.5 Glued-laminated timber manufactured to the glued-laminated timber combinations or single grade layups that have been developed using the GAP 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.

5.6 The quality program for monitoring the use of the GAP 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 GAP Computer Program.

6.2 Data in accordance with ASTM D3737.

6.3 Quality system documentation.

7.0 IDENTIFICATION

7.1 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).

7.2 The report holder's contact information is the following:

APA—THE ENGINEERED WOOD ASSOCIATION
7011 SOUTH 19TH STREET
TACOMA, WASHINGTON 98466
(253) 565-6600
www.apawood.org

7.3 The additional listees' contact information is the following:

ANTHONY FOREST PRODUCTS CO.
295 COOPER DRIVE
EL DORADO, ARKANSAS 71730

WFP ENGINEERED PRODUCTS, LLC
POST OFFICE BOX 11122
800-1055 WEST GEORGIA STREET
VANCOUVER, BRITISH COLUMBIA V6E 3P3
CANADA

TABLE 1 – REFERENCE DESIGN VALUES FOR STRUCTURAL GLUED LAMINATED SOFTWOOD TIMBER COMBINATIONS[A]
(MEMBERS STRESSED PRIMARILY IN BENDING) (TABULATED DESIGN VALUES ARE FOR NORMAL LOAD DURATION AND DRY SERVICE CONDITIONS.)

Combination Symbol	Species[b] Outer/Core	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[c]		Compression Perpendicular to Grain		Shear Parallel to Grain	Modulus of Elasticity[f]			Extreme Fiber in Bending[g]	Compression Perpendicular to Grain	Shear Parallel to Grain	Modulus of Elasticity[f]			Tension Parallel to Grain	Compression Parallel to Grain	Specific Gravity for Fastener Design	
		Bottom of Beam Stressed in tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Tension Face	Compression Face													Top or Bottom Face	Side Face
		F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} [d] (psi)	$E_{x\,true}$ (10^6 psi)	$E_{x\,app}$ (10^6 psi)	$E_{x\,min}$ (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} [d,e] (psi)	$E_{y\,true}$ (10^6 psi)	$E_{y\,app}$ (10^6 psi)	$E_{y\,min}$ (10^6 psi)	F_t (psi)	F_c (psi)	G	
16F-V3	DF/DF	1600	1250	560	560	265	1.6	1.5	0.79	1450	560	230	1.6	1.5	0.79	975	1500	0.50	0.50
20F-E/ES1[h]	ES/ES	2000	2000	560	560	200	1.9	1.8	0.95	1100	300	175	1.6	1.5	0.79	1050	1150	0.41	0.41
20F-E/SPF1[i]	SPF/SPF	2000	2000	425	425	215	1.6	1.5	0.79	875	425	190	1.5	1.4	0.74	425	1100	0.42	0.42
20F-E8	ES/ES	2000	1300	450	450	200	1.6	1.5	0.79	1000	315	175	1.5	1.4	0.74	825	1100	0.41	0.41
20F-E8M1	ES/ES	2000	2000	450	450	200	1.6	1.5	0.79	1400	315	175	1.5	1.4	0.74	825	1100	0.41	0.41
20F-V4	DF/DF	2000	1450	590	560	265	1.7	1.6	0.85	1450	560	230	1.7	1.6	0.85	975	1550	0.50	0.50
20F-V8	DF/DF	2000	2000	590	590	265	1.7	1.6	0.85	1450	560	230	1.7	1.6	0.85	975	1600	0.50	0.50
20F-V12	AC/AC	2000	1400	560	560	265	1.6	1.5	0.79	1250	470	230	1.5	1.4	0.74	925	1500	0.46	0.46
20F-V13	AC/AC	2000	2000	560	560	265	1.6	1.5	0.79	1250	470	230	1.5	1.4	0.74	950	1550	0.46	0.46
22F-V/POC1	POC/POC	2200	2200	560	560	265	1.9	1.8	0.95	1500	375	230	1.7	1.6	0.79	1150	1950	0.45	0.45
22F-V/POC2	POC/POC	2200	1600	560	560	265	1.9	1.8	0.95	1500	375	230	1.7	1.6	0.79	1150	1900	0.45	0.45
24F-E/CSP1	CSP/CSP	2400	2400	560	560	215	1.7	1.6	0.85	1150	470	190	1.7	1.6	0.85	1150	2000	0.42	0.42
24F-E/CSP2	CSP/CSP	2400	2400	560	560	215	1.9	1.8	0.95	1500	470	190	1.7	1.6	0.85	1150	2000	0.42	0.42
24F-E/CSP3	CSP/CSP	2400	1550	560	650	215	1.7	1.6	0.85	1200	470	195	1.6	1.5	0.79	900	1750	0.42	0.42
24F-E/CSP4	CSP/CSP	2400	1700	560	650	215	1.9	1.8	0.95	1400	470	200	1.7	1.6	0.85	1150	1900	0.42	0.42
24F-E/SPF1	SPF/SPF	2400	2400	560	560	215	1.7	1.6	0.85	1150	470	190	1.7	1.6	0.85	1150	2000	0.42	0.42
24F-E/SPF2	SPF/SPF	2400	2400	560	560	215	1.9	1.8	0.95	1500	470	190	1.7	1.6	0.85	1150	2000	0.42	0.42
24F-E/SPF3	SPF/SPF	2400	1550	560	650	215	1.7	1.6	0.85	1200	470	195	1.6	1.5	0.79	900	1750	0.42	0.42
24F-E/SPF4	SPF/SPF	2400	1700	560	650	215	1.9	1.8	0.95	1400	470	200	1.7	1.6	0.85	1150	1900	0.42	0.42
24F-E/ES1	ES/ES	2400	1700	560	560	200	1.8	1.7	0.90	1100	300	175	1.6	1.5	0.79	1050	1150	0.41	0.41
24F-E/ES1M1	ES/ES	2400	2400	560	560	200	1.9	1.8	0.95	1100	300	175	1.6	1.5	0.79	1050	1150	0.41	0.41
24F-E15M1	HF/HF	2400	1600	500	500	215	1.9	1.8	0.95	1200	375	190	1.6	1.5	0.79	975	1500	0.43	0.43
24F-V4	DF/DF	2400	1850	650	650	265	1.9	1.8	0.95	1450	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V4M1[j]	DF/DF	2400	1850	650	650	265	1.9	1.8	0.95	1450	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V4M2[j]	DF/DF	2400	1850	650	650	220	1.9	1.8	0.95	1450	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V5	DF/HF	2400	1600	650	650	215	1.8	1.7	0.90	1350	375	200	1.6	1.5	0.79	1100	1450	0.50	0.43
24F-V5M1	DF/SPF	2400	1600	650	650	215	1.9	1.8	0.95	1200	375	200	1.6	1.5	0.79	1050	1450	0.50	0.42
24F-V5M2[h]	DF/HF	2400	1600	650	650	215	1.9	1.8	0.95	1200	375	200	1.6	1.5	0.79	1150	1450	0.50	0.43
24F-V5M3[h]	DF/HF	2400	1600	650	650	215	1.9	1.8	0.95	1200	375	200	1.6	1.5	0.79	1150	1450	0.50	0.43
24F-V8	DF/DF	2400	2400	650	650	265	1.9	1.8	0.95	1550	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V8M1[j]	DF/DF	2400	2400	650	650	265	1.9	1.8	0.95	1550	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V8M2[j]	DF/DF	2400	2400	650	650	220	1.9	1.8	0.95	1550	560	230	1.7	1.6	0.85	1100	1650	0.50	0.50
24F-V10	DF/HF	2400	2400	650	650	215	1.9	1.8	0.95	1450	375	200	1.6	1.5	0.79	1150	1550	0.50	0.43
24F-V/DF1[h]	DF/SW	2400	1600	650	650	195	1.9	1.8	0.95	900[k]	255	205	1.5	1.4	0.74	1000	1250	0.50	0.42
26F-E/DF1[h]	DF/DF	2600	1950[k]	650	650	265	2.1	2.0	1.06	1850	560	230	1.9	1.8	0.95	1400	1800	0.50	0.50
26F-E/DF1M1[h]	DF/DF	2600	2600	650	650	265	2.1	2.0	1.06	1850	560	230	1.9	1.8	0.95	1400	1800	0.50	0.50
24F-1.8E Glulam Header[l]	WS,SP/WS, SP	2400	1600	500	500	215	1.9	1.8	0.95	1300	375	200	1.6	1.5	0.79	950	1200	0.42	0.42
16F-V5M1[j]	SP/SP	1600	1600	650	650	300	1.5	1.4	0.74	1750	650	260	1.5	1.4	0.74	1000	1500	0.55	0.55
24F-E/SP1[i]	SP/SP	2400	2400	740	740	300	1.9	1.8	0.95	1650	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
24F-V1	SP/SP	2400	1750	740	650	300	1.8	1.7	0.90	1450	650	260	1.6	1.5	0.79	1100	1500	0.55	0.55
24F-V3	SP/SP	2400	2000	740	740	300	1.9	1.8	0.95	1700	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
24F-V3M1[j]	SP/SP	2400	2000	740	740	300	1.9	1.8	0.95	1750	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
24F-V3M2[j]	SP/SP	2400	2000	740	740	250	1.9	1.8	0.95	1750	650	260	1.7	1.6	0.85	1150	1650	0.55	0.55
24F-V4[r]	SP/SP	2400	1650	740	650	210	1.8	1.7	0.90	1350	470	230	1.6	1.5	0.79	975	1350	0.55	0.55
24F-V5	SP/SP	2400	2400	740	740	300	1.8	1.7	0.90	1700	650	265	1.6	1.5	0.79	1150	1600	0.55	0.55
24F-V5M1	SP/SP	2400	2400	740	740	300	1.9	1.8	0.95	1700	650	260	1.6	1.5	0.79	1150	1600	0.55	0.55
24F-V5M2	SP/SP	2400	2400	740	740	300	1.9	1.8	0.95	1700	650	260	1.6	1.5	0.79	1150	1600	0.55	0.55
24F-V5M3	SP/SP	2400	2400	740	740	250	1.9	1.8	0.95	1700	650	260	1.6	1.5	0.79	1150	1600	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	See NDS	

TABLE 1 (CONTINUED) – REFERENCE DESIGN VALUES FOR STRUCTURAL GLUED LAMINATED SOFTWOOD TIMBER COMBINATIONS[A]
(MEMBERS STRESSED PRIMARILY IN BENDING) (TABULATED DESIGN VALUES ARE FOR NORMAL LOAD DURATION AND DRY SERVICE CONDITIONS.)

Combination Symbol	Species[b] Outer/Core	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[c]		Compression Perpendicular to Grain		Shear Parallel to Grain	Modulus of Elasticity[f]			Extreme Fiber in Bending[g]	Compression Perpendicular to Grain	Shear Parallel to Grain	Modulus of Elasticity[f]			Tension Parallel to Grain	Compression Parallel to Grain	Specific Gravity for Fastener Design	
		Bottom of Beam Stressed in tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Tension Face	Compression Face													Top or Bottom Face	Side Face
		F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} [d] (psi)	$E_{x\ true}$ (10^6 psi)	$E_{x\ app}$ (10^6 psi)	$E_{x\ min}$ (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} [d,e] (psi)	$E_{y\ true}$ (10^6 psi)	$E_{y\ app}$ (10^6 psi)	$E_{y\ min}$ (10^6 psi)	F_t (psi)	F_c (psi)	G	
26F-V1	SP/SP	2600	2000	740	740	300	1.9	1.8	0.95	1700	650	260	1.7	1.6	0.85	1150	1600	0.55	0.55
26F-V2	SP/SP	2600	2100	740	740	300	2.0	1.9	1.00	1950	740	260	1.9	1.8	0.95	1300	1850	0.55	0.55
26F-V3	SP/SP	2600	2100	740	740	300	2.0	1.9	1.00	1950	650	260	1.9	1.8	0.95	1250	1800	0.55	0.55
26F-V3M1[j]	SP/SP	2600	2100	740	740	300	2.0	1.9	1.00	1950	650	260	1.9	1.8	0.95	1250	1800	0.55	0.55
26F-V3M2[j]	SP/SP	2600	2100	740	740	250	2.0	1.9	1.00	1950	650	260	1.9	1.8	0.95	1250	1800	0.55	0.55
26F-V4	SP/SP	2600	2600	740	740	300	2.0	1.9	1.00	1700	650	260	1.9	1.8	0.95	1200	1600	0.55	0.55
26F-V4M1[j]	SP/SP	2600	2600	740	740	300	2.0	1.9	1.00	1700	650	260	1.9	1.8	0.95	1200	1600	0.55	0.55
26F-V4M2[j]	SP/SP	2600	2600	740	740	250	2.0	1.9	1.00	1700	650	260	1.9	1.8	0.95	1200	1600	0.55	0.55
28F-E1	SP/SP	2800	2300	805	805	300	2.2[q]	2.1[q]	1.11[q]	1600	650	260	1.8	1.7	0.90	1300	1850	0.55	0.55
28F-E1M1	SP/SP	2800	2300	805	805	300	2.2	2.1	1.11	1600	650	260	1.8	1.7	0.90	1300	1850	0.55	0.55
28F-E2	SP/SP	2800	2800	805	805	300	2.2[q]	2.1[q]	1.11[q]	2000	650	260	1.8	1.7	0.90	1300	1850	0.55	0.55
28F-E2M1	SP/SP	2800	2800	805	805	300	2.2	2.1	1.11	2000	650	260	1.8	1.7	0.90	1300	1850	0.55	0.55
30F-E1[m]	SP/SP	3000	2400	805	805	300	2.2[q]	2.1[q]	1.11[q]	1750	650	260	1.8	1.7	0.90	1250	1750	0.55	0.55
30F-E1M1[m]	SP/SP	3000	2400	805	805	300	2.2	2.1	1.11	1750	650	260	1.8	1.7	0.90	1250	1750	0.55	0.55
30F-E1M2[n]	LVL/SP	3000[o]	2400	650[p]	740	300	2.2	2.1	1.11	1750	650	260	1.8	1.7	0.90	1250	1750	0.50	0.50
30F-E2[m]	SP/SP	3000	3000	805	805	300	2.2[q]	2.1[q]	1.11[q]	1750	650	260	1.8	1.7	0.90	1350	1750	0.55	0.55
30F-E2M1[m]	SP/SP	3000	3000	805	805	300	2.2	2.1	1.11	1750	650	260	1.8	1.7	0.90	1350	1750	0.55	0.55
30F-E2M2[n]	LVL/SP	3000[o]	3000[o]	650[p]	650[p]	300	2.2	2.1	1.11	1750	650	260	1.8	1.7	0.90	1350	1750	0.50	0.50
30F-E2M3[n]	LVL/SP	3000[o]	3000[o]	650[p]	650[p]	300	2.2	2.1	1.11	1750	650	260	1.8	1.7	0.90	1350	1750	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	See NDS	

For SI: 1 psi = 6.895 Pa

(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. However, design values are tabulated for loading both perpendicular and parallel to the wide faces of the laminations. For combinations and design values applicable to members loaded primarily axially or parallel to the wide faces of the laminations, see Table 2. For members of 2 or 3 laminations, see Table 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. The tabulated design values are for normal duration of loading. For other durations of loading, see applicable building code.

(b) 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.

(c) 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. 20F-E/ES1 does not require special tension laminations.

(d) The design values for shear, F_{vx} and F_{vy} shall be decreased by multiplying by a factor of 0.72 for non-prismatic members, notched members, and for all members subject to impact or cyclic loading. The reduced design value shall be used for design of members at connections that transfer shear by mechanical fasteners. The reduced design value shall also be used for determination of design values for radial tension and torsion. F_{vx} and F_{vy} values do not include adjustments for checking.

(e) 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 shall be multiplied by 0.4 for members with 5, 7, or 9 laminations or by 0.5 for all other members. This reduction shall be cumulative with the adjustment in footnote (d).

(f) See Section 2.5 of ANSI 117 (www.apawood.org) for the E_{true}, E_{app}, and E_{min}.

(g) 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.

(h) 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.

(i) 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.

(j) 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.

(k) 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.

(l) This combination must be manufactured from either 24F-V4/WS, 24F-V5M1/WS, 24F-V5M2/WS, 24F-V5M3/WS, 24F-E15M1/WS, 24F-E/SPF4, or 24F-V3/SP, and is intended primarily for use in header applications.

(m) 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.

(n) 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.

(o) 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.

(p) 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.

(q) For 28F and 30F members with more than 15 laminations, $E_{x\ true}$ = 2.1 x 10^6 psi, $\mathbf{E_{x\ app}}$ = 2.0 x 10^6 psi, and $E_{x\ min}$ = 1.06 x 10^6 psi.

(r) This combination may contain lumber with wane. If lumber with wane is used, the design value for shear parallel to grain, $\mathbf{F_{VX}}$, shall be multiplied by 0.67 if wane is allowed on both sides. If wane is limited to one side, $\mathbf{F_{vx}}$ shall be multiplied by 0.83. This reduction shall be cumulative with the adjustment in footnote (d).

TABLE 2 – REFERENCE DESIGN VALUES FOR STRUCTURAL GLUED LAMINATED SOFTWOOD TIMBER (MEMBERS STRESSED PRIMARILY IN AXIAL TENSION OR COMPRESSION) (TABULATED DESIGN VALUES ARE FOR NORMAL LOAD DURATION AND DRY SERVICE CONDITIONS.)

Combination Symbol	Species	Grade	All Loading: Modulus of Elasticity			Axially Loaded: Compression Perpendicular to Grain	Axially Loaded: Tension Parallel to Grain	Axially Loaded: Compression Parallel to Grain		Bending about Y-Y Axis (Loaded Parallel to Wide Faces of Laminations): Bending			Bending about Y-Y Axis: Shear Parallel to Grain[a,b]	Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations): Bending	Bending About X-X Axis: Shear Parallel to Grain[c]	Fasteners: Specific Gravity for Fastener Design
			E_{axial} (10^6 psi)	0.95 E_{axial} (10^6 psi)	$E_{axial\ min}$ (10^6 psi)	$F_{c\perp}$ (psi)	2 or More Laminations F_t (psi)	4 or More Laminations F_c (psi)	2 or 3 Laminations F_c (psi)	4 or More Laminations F_{by} (psi)	3 Laminations F_{by} (psi)	2 Laminations F_{by} (psi)	F_{vy} (psi)	2 Laminations to 15 in. Deep[d] F_{bx} (psi)	F_{vx} (psi)	G
Visually Graded Western Species																
1	DF	L3	1.6	1.5	0.79	560	950	1550	1250	1450	1250	1000	230	1250	265	0.50
2	DF	L2	1.7	1.6	0.85	560	1250	1950	1600	1800	1600	1300	230	1700	265	0.50
3	DF	L2D	2.0	1.9	1.00	650	1450	2300	1900	2100	1850	1550	230	2000	265	0.50
5	DF	L1	2.1	2.0	1.06	650	1650	2400	2100	2400	2100	1800	230	2200	265	0.50
22[e]	SW	L3	1.1	1.0	0.53	315	525	850	725	800	700	575	170	725	195	0.35
70	AC	L2	1.4	1.3	0.69	470	975	1450	1450	1400	1250	1000	230	1350	265	0.46
Visually Graded Southern Pine																
47	SP	N2M12	1.5	1.4	0.74	650	1200	1900	1150	1750	1550	1300	260	1400	300	0.55
48	SP	N2D12	1.8	1.7	0.90	740	1400	2200	1350	2000	1800	1500	260	1600	300	0.55
49	SP	N1M16	1.8	1.7	0.90	650	1350	2100	1450	1950	1750	1500	260	1800	300	0.55
50	SP	N1D14	2.0	1.9	1.00	740	1550	2300	1700	2300	2100	1750	260	2100	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

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

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

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

(d) 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.

(e) When Western Cedars, Western Cedars (North), Western Woods, and Redwood (open grain) are used in combinations for Softwood Species (SW), the design value for modulus of elasticity shall 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) tabulated design values for shear parallel to grain, F_{vx} and F_{vy}, shall be reduced by 10 psi, before applying any other adjustments.

TABLE 3 – MANUFACTURING LOCATIONS

Manufacturer	Location
Anthony Forest Products Co.	295 Cooper Drive, El Dorado, AR 71730
Anthony Forest Products Co.	256 Edison Road, Washington, GA 30676
WFP Engineered Products, LLC	218 V Street, Vancouver, WA 98661
WFP Engineered Products, LLC	3559 Truman Road, Washougal, WA 98671

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