AMERICAN WOOD COUNCIL

November 2013

ADDENDUM

to the 2012 *Design Values for Wood Construction*

(a supplement to the *National Design Specification® (NDS®) for Wood Construction*)

Table 4C Reference Design Values for Mechanically Graded Dimension Lumber (2"-4" thick)[1,2,3] (Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4C ADJUSTMENT FACTORS

Commercial grade	Size classification	Design values in pounds per square inch (psi)					Grading Rules Agency
		Bending	Tension parallel to grain	Compression parallel to grain	Modulus of Elasticity		
		F_b	F_t	F_c	E	E_{min}	
MACHINE STRESS RATED (MSR) LUMBER							
750f-1.4E	2" and less in thickness 2" and wider	750	425	925	1,400,000	710,000	SPIB
850f-1.4E		850	475	975	1,400,000	710,000	SPIB
900f-1.0E		900	350	1,050	1,000,000	510,000	WCLIB, WWPA, NELMA, NSLB
975f-1.6E		975	550	1,450	1,600,000	810,000	SPIB
1050f-1.2E		1,050	450	1,225	1,200,000	610,000	SPIB
1050f-1.6E		1,050	575	1,500	1,600,000	810,000	SPIB
1200f-1.2E		1,200	600	1,400	1,200,000	610,000	NLGA, WCLIB, WWPA, NELMA, NSLB
1200f-1.3E		1,200	600	1,400	1,300,000	660,000	SPIB
1200f-1.6E		1,200	650	1,550	1,600,000	810,000	SPIB
1250f-1.4E		1,250	800	1,475	1,400,000	710,000	WCLIB, ~~WWPA~~
1250f-1.6E		1,250	725	1,600	1,600,000	810,000	SPIB
1350f-1.3E		1,350	750	1,600	1,300,000	660,000	NLGA, WCLIB, WWPA, NELMA, NSLB
1350f-1.4E		1,350	750	1,600	1,400,000	710,000	SPIB
1400f-1.2E		1,400	800	1,600	1,200,000	610,000	NLGA, ~~WWPA~~
1450f-1.3E		1,450	800	1,625	1,300,000	660,000	NLGA, WCLIB, WWPA, NELMA, NSLB
1450f-1.3E		1,450	825	1,600	1,300,000	660,000	SPIB
1450f-1.5E		1,450	875	1,625	1,500,000	760,000	WCLIB, ~~WWPA~~
1500f-1.4E		1,500	900	1,650	1,400,000	710,000	NLGA, WCLIB, WWPA, NELMA, NSLB
1500f-1.5E		1,500	900	1,650	1,500,000	760,000	SPIB
1500f-1.6E		1,500	900	1,650	1,600,000	810,000	SPIB
1500f-1.7E		1,500	900	1,650	1,700,000	860,000	SPIB
1600f-1.4E		1,600	950	1,675	1,400,000	710,000	NLGA, ~~WWPA~~
1650f-1.3E		1,650	1,020	1,700	1,300,000	660,000	NLGA, ~~WWPA~~
1650f-1.5E		1,650	1,020	1,700	1,500,000	760,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
~~1650f-1.6E-1075f~~		~~1,650~~	~~1,075~~	~~1,700~~	~~1,600,000~~	~~810,000~~	~~WCLIB, WWPA~~
1650f-1.6E		1,650	1,175	1,700	1,600,000	810,000	WCLIB, ~~WWPA~~
1650f-1.7E		1,650	1,020	1,750	1,700,000	860,000	SPIB
~~1650f-1.8E~~		~~1,650~~	~~1,020~~	~~1,750~~	~~1,800,000~~	~~910,000~~	~~WCLIB, WWPA~~
1700f-1.6E		1,700	1,175	1,725	1,600,000	810,000	WCLIB, ~~WWPA~~
~~1750f-2.0E~~		~~1,750~~	~~1,125~~	~~1,725~~	~~2,000,000~~	~~1,020,000~~	~~WCLIB, WWPA~~

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Table 4C (Cont.) **Reference Design Values for Mechanically Graded Dimension Lumber (2"-4" thick)[1,2,3]** (Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4C ADJUSTMENT FACTORS

Commercial grade	Size classification	Design values in pounds per square inch (psi)					Grading Rules Agency
		Bending	Tension parallel to grain	Compression parallel to grain	Modulus of Elasticity		
		F_b	F_t	F_c	E	E_{min}	
MACHINE STRESS RATED (MSR) LUMBER (Cont.)							
1800f-1.5E		1,800	1,300	1,750	1,500,000	760,000	NLGA~~, WWPA~~
1800f-1.6E		1,800	1,175	1,750	1,600,000	810,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
1800f-1.8E		1,800	1,200	1,750	1,800,000	910,000	WCLIB~~, WWPA~~
~~1800f-2.0E~~		~~1,800~~	~~1,175~~	~~1,750~~	~~2,000,000~~	~~1,020,000~~	~~WCLIB~~
~~1850f-1.7E~~		~~1,850~~	~~1,175~~	~~1,850~~	~~1,700,000~~	~~860,000~~	~~SPIB~~
1950f-1.5E		1,950	1,375	1,800	1,500,000	760,000	SPIB~~, WWPA~~
1950f-1.7E		1,950	1,375	1,800	1,700,000	860,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
2000f-1.6E		2,000	1,300	1,825	1,600,000	810,000	NLGA~~, WWPA~~
2100f-1.8E		2,100	1,575	1,875	1,800,000	910,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
2250f-1.7E	2" and less	2,250	1,750	1,925	1,700,000	860,000	NLGA~~, WWPA~~
2250f-1.8E	in thickness	2,250	1,750	1,925	1,800,000	910,000	NLGA, WCLIB~~, WWPA~~
2250f-1.9E		2,250	1,750	1,925	1,900,000	970,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
~~2250f-2.0E-1600f~~	2" and wider	~~2,250~~	~~1,600~~	~~1,925~~	~~2,000,000~~	~~1,020,000~~	~~WCLIB, WWPA~~
~~2250f-2.0E~~		~~2,250~~	~~1,750~~	~~1,925~~	~~2,000,000~~	~~1,020,000~~	~~WCLIB, WWPA~~
2400f-1.8E		2,400	1,925	1,975	1,800,000	910,000	NLGA~~, WWPA~~
2400f-2.0E		2,400	1,925	1,975	2,000,000	1,020,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
2500f-2.2E		2,500	1,750	2,000	2,200,000	1,120,000	WCLIB~~, WWPA~~
~~2500f-2.2E-1925f~~		~~2,500~~	~~1,925~~	~~2,000~~	~~2,200,000~~	~~1,120,000~~	~~WCLIB, WWPA~~
~~2550f-1.8E~~		~~2,550~~	~~1,400~~	~~2,000~~	~~1,800,000~~	~~910,000~~	~~SPIB~~
2550f-2.1E		2,550	2,050	2,025	2,100,000	1,070,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
2700f-2.0E		2,700	1,800	2,100	2,000,000	1,020,000	WCLIB~~, WWPA~~
2700f-2.2E		2,700	2,150	2,100	2,200,000	1,120,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
~~2850f-1.8E~~		~~2,850~~	~~1,600~~	~~2,100~~	~~1,800,000~~	~~910,000~~	~~SPIB~~
2850f-2.3E		2,850	2,300	2,150	2,300,000	1,170,000	NLGA, SPIB, WCLIB, WWPA, NELMA, NSLB
3000f-2.4E		3,000	2,400	2,200	2,400,000	1,220,000	NLGA, SPIB

(Continued on following page)

Table 4C (Cont.) **Reference Design Values for Mechanically Graded Dimension Lumber (2"-4" thick)[1,2,3]** (Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4C ADJUSTMENT FACTORS

Commercial grade	Size classification	Design values in pounds per square inch (psi)					Grading Rules Agency
		Bending	Tension parallel to grain	Compression parallel to grain	Modulus of Elasticity		
		F_b	F_t	F_c	E	E_{min}	
MACHINE EVALUATED LUMBER (MEL)							
M-5		900	500	1,050	1,100,000	510,000	SPIB
M-6		1,100	600	1,300	1,000,000	470,000	SPIB
M-7		1,200	650	1,400	1,100,000	510,000	SPIB
M-8		1,300	700	1,500	1,300,000	610,000	SPIB
M-9		1,400	800	1,600	1,400,000	650,000	SPIB
M-10		1,400	800	1,600	1,200,000	560,000	NLGA, SPIB
M-11		1,550	850	1,675	1,500,000	700,000	NLGA, SPIB
M-12		1,600	850	1,675	1,600,000	750,000	NLGA, SPIB
M-13		1,600	950	1,675	1,400,000	650,000	NLGA, SPIB
M-14		1,800	1,000	1,750	1,700,000	790,000	NLGA, SPIB
M-15		1,800	1,100	1,750	1,500,000	700,000	NLGA, SPIB
M-16		1,800	1,300	1,750	1,500,000	700,000	SPIB
M-17[4]		1,950	1,300	2,050	1,700,000	790,000	SPIB
M-18		2,000	1,200	1,825	1,800,000	840,000	NLGA, SPIB
M-19		2,000	1,300	1,825	1,600,000	750,000	NLGA, SPIB
M-20[4]		2,000	1,600	2,100	1,900,000	890,000	SPIB
M-21	2" and less	2,300	1,400	1,950	1,900,000	890,000	NLGA, SPIB
M-22	in thickness	2,350	1,500	1,950	1,700,000	790,000	NLGA, SPIB
M-23		2,400	1,900	1,975	1,800,000	840,000	NLGA, SPIB
M-24	2" and wider	2,700	1,800	2,100	1,900,000	890,000	NLGA, SPIB
M-25		2,750	2,000	2,100	2,200,000	1,030,000	NLGA, SPIB
M-26		2,800	1,800	2,150	2,000,000	930,000	NLGA, SPIB
M-27[4]		3,000	2,000	2,400	2,100,000	980,000	SPIB
M-28		2,200	1,600	1,900	1,700,000	790,000	SPIB
M-29		1,550	850	1,650	1,700,000	790,000	SPIB
M-30		2,050	1,050	1,850	1,700,000	790,000	SPIB
M-31		2,850	1,600	2,150	1,900,000	890,000	SPIB
M-32		750	425	925	1,400,000	650,000	SPIB
M-33		850	475	975	1,400,000	650,000	SPIB
M-34		975	550	1,450	1,600,000	750,000	SPIB
M-35		1,050	575	1,500	1,600,000	750,000	SPIB
M-36		1,200	650	1,550	1,600,000	750,000	SPIB
M-37		1,250	725	1,600	1,600,000	750,000	SPIB
M-38		1,500	900	1,650	1,600,000	750,000	SPIB
M-39		1,650	1,020	1,750	1,700,000	790,000	SPIB
M-40		1,850	1,175	1,850	1,700,000	790,000	SPIB

Table 4C Footnotes

1. **LUMBER DIMENSIONS.** Tabulated design values are applicable to lumber that will be used under dry conditions such as in most covered structures. For 2" to 4" thick lumber the DRY dressed sizes shall be used (see Table 1A) regardless of the moisture content at the time of manufacture or use. In calculating design values, the natural gain in strength and stiffness that occurs as lumber dries has been taken into consideration as well as the reduction in size that occurs when unseasoned lumber shrinks. The gain in load carrying capacity due to increased strength and stiffness resulting from drying more than offsets the design effect of size reductions due to shrinkage.

2. **SPECIFIC GRAVITY, G, SHEAR PARALLEL TO GRAIN, F_v, AND COMPRESSION PERPENDICULAR TO GRAIN, $F_{c\perp}$.** Values for specific gravity, G, shear parallel to grain, F_v, and compression perpendicular to grain, $F_{c\perp}$, are provided below for MSR and MEL lumber. For species or species groups not shown below, the G, F_v and $F_{c\perp}$ values for visually graded lumber may be used. Higher G values may be claimed when (a) specifically assigned by the rules writing agency or (b) when qualified by test, quality controlled for G and provided for on the grade stamp. When a different G value is provided on the grade stamp, higher F_v and $F_{c\perp}$ design values may be calculated in accordance with the grading rule requirements.

Species	Modulus of Elasticity E (x10^6) psi	Specific Gravity G	Design values in pounds per square inch (psi)		Grading Rules Agency
			Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	
Douglas Fir-Larch	1.0 and higher	0.50	180	625	~~WCLIB,~~ WWPA
	2.0	0.51	180	670	~~WCLIB,~~ WWPA
	2.1	0.52	180	690	
	2.2	0.53	180	715	
	2.3	0.54	185	735	
	2.4	0.55	185	760	
Douglas Fir-Larch	1.0 and higher	0.50	170	625	WCLIB
	2.0	0.51	170	670	WCLIB
	2.1	0.52	170	690	
	2.2	0.53	170	715	
	2.3	0.54	170	735	
	2.4	0.55	170	760	
Douglas Fir-Larch (N)	1.2 to 1.9	0.49	180	625	NLGA
	2.0 to 2.2	0.53	180	715	
	2.3 & higher	0.57	~~180~~ 190	715	NLGA
Douglas Fir-South	1.0 and higher	0.46	180	520	WWPA
Englemann Spruce-Lodgepole Pine	1.0 and higher	0.38	135	335	WWPA
	1.5 and higher	0.46	160	555	WWPA
Hem-Fir	1.0 and higher	0.43	140	405	WCLIB
	1.0 and higher	0.43	150	405	~~WCLIB,~~ WWPA
	1.6	0.44	155	510	WCLIB, WWPA
	1.7	0.45	160	535	
	1.8	0.46	160	555	
	1.9	0.47	165	580	
	2.0	0.48	170	600	
	2.1	0.49	170	625	
	2.2	0.50	175	645	
	2.3	0.51	~~190~~ 175	670	
	2.4	0.52	~~190~~ 180	690	
Hem-Fir (N)	1.0 and higher	0.46	145	405	NLGA
Southern Pine	1.0 and higher	0.55	175	565	SPIB
	1.8*	0.57*	190*	805*	SPIB
	~~1.8~~ 1.9 and higher	0.57	190	805	SPIB
Spruce-Pine-Fir	1.2 and higher	0.42	135	425	NLGA
	1.8 to 1.9	0.46	160	525	NLGA
	2.0 and higher	0.50	170	615	NLGA
Spruce-Pine-Fir (S)	1.0 and higher	0.36	135	335	NELMA, NSLB, WCLIB, WWPA
	1.2 to 1.9	0.42	150	465	NELMA, NSLB
	1.2 to 1.7	0.42	150	465	WWPA
	1.8 to 1.9	0.46	160	555	
	2.0 and higher	0.50	175	645	NELMA, NSLB, WWPA
Western Cedars	1.0 and higher	0.36	155	425	WCLIB, WWPA
Western Woods	1.0 and higher	0.36	135	335	WCLIB, WWPA

* 1.8E southern pine marked with a specific gravity of 0.55 on the grade stamp has a shear parallel to grain, F_v, of 175 psi and compression perpendicular to grain, $F_{c\perp}$, of 565 psi.

3. **MODULUS OF ELASTICITY, E, AND TENSION PARALLEL TO GRAIN, F_t.** For any given bending design value, F_b, the modulus of elasticity, E, and tension parallel to grain, F_t, design value may vary depending upon species, timber source or other variables. The "E" and "F_t" values included in the "F_b-E" grade designations in Table 4C are those usually associated with each "F_b" level. Grade stamps may show higher or lower values if machine rating indicates the assignment is appropriate. Where the "E" or "F_t" values shown on a grade stamp differ from Table 4C values associated with the "F_b" on the grade stamp, the values on the stamp shall be used in design, and the "F_c" value associated with the "F_b" value in Table 4C shall be used.

4. **COMPRESSION PARALLEL TO GRAIN, F_c.** This grade requires "F_c" qualification and quality control.