

Table 4C Adjustment Factors

Flat Use Factor, C_{fu}

Bending design values adjusted by size factors are based on edgewise use (load applied to narrow face). When dimension lumber is used flatwise (load applied to wide face), the bending design value, F_b , shall also be multiplied by the following flat use factors:

Flat Use Factors, C_{fu}

Width (depth)	Thickness (breadth)
	2"
2" & 3"	1.0
4"	1.1
5"	1.1
6"	1.15
8"	1.15
10" & wider	1.2

Repetitive Member Factor, C_r

Bending design values, F_b , for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor, $C_r = 1.15$, when such members are used as joists, truss chords, rafters, studs, planks, decking, or similar members which are in contact or spaced not more than 24" on center, are not less than 3 in number and are joined by floor, roof, or other load distributing elements adequate to support the design load.

Wet Service Factor, C_M

When dimension lumber is used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table:

Wet Service Factors, C_M

F_b	F_t	F_v	$F_{c\perp}$	F_c	E and E_{min}
0.85*	1.0	0.97	0.67	0.8**	0.9

* when $F_b \leq 1,150$ psi, $C_M = 1.0$

** when $F_c \leq 750$ psi, $C_M = 1.0$

Table 4C Reference Design Values for Mechanically Graded Dimension Lumber^{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

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)					Grading Rules Agency
		Bending F _b	Tension parallel to grain F _t	Compression parallel to grain F _c	Modulus of Elasticity		
					E	E _{min}	
MACHINE STRESS RATED (MSR) LUMBER							
900f-1.0E	2" and less in thickness 2" and wider	900	350	1,050	1,000,000	510,000	WCLIB, WWPA, NELMA, NSLB
1200f-1.2E		1,200	600	1,400	1,200,000	610,000	NLGA, WCLIB, WWPA, NELMA, NSLB
1250f-1.4E		1,250	800	1,475	1,400,000	710,000	WCLIB, WWPA
1350f-1.3E		1,350	750	1,600	1,300,000	660,000	NLGA, WCLIB, WWPA, NELMA, NSLB
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-1.5E		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
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 _t		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-1.8E		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
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
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		2,250	1,750	1,925	1,700,000	860,000	NLGA, WWPA
2250f-1.8E		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 _t		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 _t		2,500	1,925	2,000	2,200,000	1,120,000	WCLIB, WWPA
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-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	

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REFERENCE DESIGN VALUES

Table 4C Reference Design Values for Mechanically Graded Dimension Lumber^{1,2,3}
(Cont.) (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

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)					Grading Rules Agency
		Bending F _b	Tension parallel to grain F _t	Compression parallel to grain F _c	Modulus of Elasticity		
					E	E _{min}	
MACHINE EVALUATED LUMBER (MEL)							
M-5	2" and less in thickness 2" and wider	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		2,300	1,400	1,950	1,900,000	890,000	NLGA, SPIB
M-22		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		2,700	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

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⊥}.** Values for specific gravity, G, shear parallel to grain, F_v, and compression perpendicular to grain, F_{c⊥}, are provided below for MSR and MEL lumber. For species or species groups not shown below, the G, F_v, and F_{c⊥} 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⊥} design values may be calculated in accordance with the grading rule requirements.

Species	Modulus of Elasticity E (x10 ⁶), psi	Design Values			Grading Rules Agency
		Specific Gravity G	Shear Parallel to Grain F _v , psi	Compression Perpendicular to Grain F _{c⊥} , psi	
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 (N)	1.2 to 1.9	0.49	180	625	NLGA
	2.0 to 2.2	0.53	180	715	
	2.3 and higher	0.57	190	715	
Douglas Fir-South	1.0 and higher	0.46	180	520	WWPA
Englemann Spruce-	1.0 and higher	0.38	135	335	WWPA
Lodgepole Pine	1.5 and higher	0.46	160	555	WWPA
Hem-Fir	1.0 and higher	0.43	150	405	WCLIB, WWPA
	1.6	0.44	155	510	
	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	670	
2.4	0.52	190	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 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 (South)	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

- 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.