

DESIGN VALUE TABLES

8

BASE VALUE EQUATIONS*

BASE VALUE EQUATIONS

Apply to Dimension Lumber Base Values in Table 1

Base Value	x	Size Adjustment Factor	x	Routine Adjustment Factors	x	Special Use Factors	=	Design Value
F_b	x	C_F	x	$C_D \times C_r$	x	$C_M \times C_R \times C_t \times C_{Fu}$	=	F_b
F_t	x	C_F	x	C_D	x	$C_M \times C_R \times C_t$	=	F_t
F_v			x	$C_D \times C_v$	x	$C_M \times C_R \times C_t$	=	F_v
$F_{c\perp}$					x	$C_M \times C_R \times C_t$	=	$F_{c\perp}$
$F_{c//}$	x	C_F	x	C_D	x	$C_M \times C_R \times C_t$	=	$F_{c//}$
E					x	$C_M \times C_R \times C_t$	=	E

For $F_{c\perp}$ value of 0.02* deformation basis, see Table F.

Note: C_F = Size Factor
 C_r = Repetitive Member Factor
 C_v = Horizontal Shear
 C_D = Duration of Load
 C_{Fu} = Flat Use Factor
 C_M = Wet Use Factor
 C_R = Fire Retardant Factor
 C_t = Temperature Factor, refer to the National Design Specification

* These equations are for the use of the Adjustment Factors A through G. Adjustment Factor Tables A through G are for use with the Base Values in Tables 1 and 2.

DIMENSION LUMBER ADJUSTMENT FACTORS

SIZE FACTORS (C_F)

TABLE A

Apply to Dimension Lumber Base Values

Grades	Nominal Width (depth)	Fb		Ft	Fc//	Other Properties
		2"x3" thick nominal	4" thick nominal			
Select Structural, No. 1, No. 2 & No. 3	4" & less	1.5	1.5	1.5	1.15	1.0
	5"	1.4	1.4	1.4	1.1	1.0
	6"	1.3	1.3	1.3	1.1	1.0
	8"	1.2	1.3	1.2	1.05	1.0
	10"	1.1	1.2	1.1	1.0	1.0
	12"	1.0	1.1	1.0	1.0	1.0
Construction & Standard	4" & less	1.0	1.0	1.0	1.0	1.0
	Utility	2" & 3" 4"	0.4 1.0	— 1.0	0.4 1.0	0.6 1.0
Stud	4" & less	1.1	1.1	1.1	1.05	1.0
	5" & 6"	1.0	1.0	1.0	1.0	1.0
	8" & wider	1.0	1.0	1.0	1.0	1.0

REPETITIVE MEMBER FACTOR (C_r) TABLE B	
Apply to Size-adjusted F _b	
Where 2" to 4" thick lumber is used repetitively, such as for joists, studs, rafters and decking, the pieces side by side share the load and the strength of the entire assembly is enhanced. Therefore, where three or more members are adjacent or are not more than 24" apart and are joined by floor, roof or other load distributing elements, the F _b value can be increased 1.15 for repetitive member use.	REPETITIVE MEMBER USE
	F_b X 1.15

DURATION OF LOAD ADJUSTMENT (C_D) TABLE C	
Apply to Size-adjusted Values	
Wood has the property of carrying substantially greater maximum loads for short durations than for long durations of loading. Tabulated design values apply to normal load duration. (Factors do not apply to MOE or F _{c⊥}).	
LOAD DURATION	FACTOR
Permanent	0.9
Ten Years (Normal Load)	1.0
Two Months (Snow Load)	1.15
Seven Day	1.25
One Day	1.33
Ten Minutes	
(Wind and Earthquake Loads)	1.6
Impact	2.0
Conform load requirements with local codes. Refer to Model Building Codes or the National Design Specification for high-temperature or fire-retardant treated adjustment factors.	

8

**HORIZONTAL SHEAR
ADJUSTMENT (C_v)**

TABLE D

Apply to F_v Values

Horizontal shear values published in Table 1 are based upon the maximum degree of shake, check or split that might develop in a piece. When the actual size of these characteristics is known, the following adjustments may be taken.

2" THICK LUMBER	3" and THICKER LUMBER
For convenience, the tables below may be used to determine horizontal shear values for any grade of 2" thick lumber in any species when the length of split or check is known:	Horizontal shear values for 3" and thicker lumber also are established as if a piece were split full length. When specific lengths of splits are known and any increase in them is not anticipated, the following adjustments may be applied:

When length of split on wide face is:	Multiply Tabulated F_v value by:	When length of split on wide face is:	Multiply Tabulated F_v value by:
No split	2.00	No split	2.00
1/2 x wide face	1.67	1/2 x narrow face	1.67
3/4 x wide face	1.50	1 x narrow face	1.33
1 x wide face or more	1.00	1 1/2 x narrow or more	1.00

FLAT USE FACTORS (C_{fu})

TABLE E

Apply to Size-adjusted F_b

NOMINAL WIDTH	NOMINAL THICKNESS	
	2" & 3"	4"
2" & 3"	1.00	—
4"	1.10	1.00
5"	1.10	1.05
6"	1.15	1.05
8"	1.15	1.05
10" & wider	1.20	1.10

ADJUSTMENTS FOR COMPRESSION PERPENDICULAR TO GRAIN (C_{c⊥}) **TABLE F**

for Deformation Basis of 0.02"
Apply to F_{c⊥} Values

Design values for compression perpendicular to grain (F_{c⊥}) are established in accordance with the procedures set forth in ASTM Standards D 2555 and D 245. ASTM procedures consider deformation under bearing loads as a serviceability limit state comparable to bending deflection because bearing loads rarely cause structural failures. Therefore, ASTM procedures for determining compression perpendicular to grain values are based on a deformation of 0.04" and are considered adequate for most classes of structures. Where most stringent measures need to be taken in design, the following formula permits the designer to adjust design values to a more conservative deformation basis of 0.02".

$$Y_{02} = 0.73 Y_{04} + 5.60$$

EXAMPLE: SPFs Y₀₄ = 335

$$Y_{02} = 0.73 (335) + 5.60 = 250 \text{ Psi}$$

WET USE FACTORS (C_M) **TABLE G**

Apply to Size-adjusted Values

The recommended design values shown in the accompanying tables are for applications where the moisture content of the wood does not exceed 19%. For use conditions where the moisture content of dimension lumber will exceed 19%, the Wet Use Adjustment Factors below are recommended:

PROPERTY	ADJUSTMENT FACTOR
Fb Extreme Fiber Stress in Bending	0.85*
Ft Tension Parallel to Grain	1.0*
Fc// Compression Parallel to Grain	0.8**
Fv Horizontal Shear	0.97
Fc⊥ Compression Perpendicular to Grain	0.67
E Modulus of Elasticity	0.9

* Fiber Stress in Bending Wet Use Factor 1.0 for size-adjusted Fb not exceeding 1150 psi.

** Compression Parallel to Grain in Wet Use Factor 1.0 for size-adjusted Fc not exceeding 750 psi.



TABLE 1 **DIMENSION LUMBER BASE VALUES — SOFTWOODS**

2" to 4" THICK by 2" and WIDER
USE WITH ADJUSTMENT TABLES A THROUGH G

Design Values in Pounds Per Square Inch

Grades Described in para. 10.0-12.4

Also Stress Rated Boards, See para. 17.0

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Members	Tension Parallel to Grain "Ft"	Hori- zontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpen- dicular "Fc⊥"	Parallel to Grain "Fc//"	
SPF(s)** (<i>Eastern Spruce</i> <i>Red Pine</i> <i>Jack Pine</i> <i>Balsam Fir</i>)	Sel. Str.	1300	575	135	335	1200	1,300,000
	No. 1	875	400	135	335	1050	1,200,000
	No. 2	775	350	135	335	1000	1,100,000
	No. 3	450	200	135	335	575	1,000,000
	Construction Standard	875	400	135	335	1200	1,000,000
	Utility	500	225	135	335	1000	900,000
	Stud	225	100	135	335	675	900,000
		600	275	135	335	625	1,000,000

TABLE 1
(Continued)
DIMENSION LUMBER BASE VALUES — SOFTWOODS
2" to 4" THICK by 2" and WIDER
USE WITH ADJUSTMENT TABLES A THROUGH G

Design Values in Pounds Per Square Inch

Grades Described in para. 10.0-12.4

Also Stress Rated Boards, See para. 17.0

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Hori- zontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpen- dicular "Fc⊥"	Parallel to Grain "Fc//"	
EASTERN HEMLOCK- TAMARACK**	Sel. Str.	1250	575	170	555	1200	1,200,000
	No. 1	775	350	170	555	1000	1,100,000
	No. 2	575	275	170	555	825	1,100,000
	No. 3	350	150	170	555	475	900,000
	Construction Standard	675	300	170	555	1050	1,000,000
	Utility	375	175	170	555	850	900,000
	Stud	175	75	170	555	550	800,000
			450	200	170	555	525

E. HEMLOCK - BALSAM FIR - TAMARACK	Sel. Str.	1250	140	335	1200	1,200,000
	No. 1	775	140	335	1000	1,100,000
	No. 2	575	140	335	825	1,100,000
	No. 3	350	140	335	475	900,000
	Construction	675	140	335	1050	1,000,000
	Standard	375	140	335	850	900,000
	Utility	175	140	335	550	800,000
Stud	450	140	335	525	900,000	
EASTERN*** SOFTWOODS	Sel. Str.	1250	140	335	1200	1,200,000
	No. 1	775	140	335	1000	1,100,000
	No. 2	575	140	335	825	1,100,000
	No. 3	350	140	335	475	900,000
	Construction	675	140	335	1050	1,000,000
	Standard	375	140	335	850	900,000
	Utility	175	140	335	550	800,000
Stud	450	140	335	525	900,000	

* See para. 31.0 through 37.0 for additional information on these values.

** The same values apply to each species if stamped individually.

*** Eastern Softwoods species grouping = Any combination of the above species, excluding Northern White Cedar and Aspen.





TABLE 2 DIMENSION LUMBER BASE VALUES — HARDWOODS
 2" to 4" THICK by 2" and WIDER
 USE WITH ADJUSTMENT TABLES A THROUGH G
 Design Values in Pounds Per Square Inch

Grades Described in para. 10.0-12.4

Also Stress Rated Boards, See para. 17.0

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "Fc _L "	Parallel to Grain "Fc _T "	
RED MAPLE	Sel. Str.	1300	750	210	615	1100	1,700,000
	No. 1	925	550	210	615	900	1,600,000
	No. 2	900	525	210	615	700	1,500,000
	No. 3	525	300	210	615	400	1,300,000
	Construction Standard	1050	600	210	615	925	1,400,000
	Utility	575	325	210	615	725	1,300,000
	Stud	275	150	210	615	475	1,200,000
		700	425	210	615	450	1,300,000

MIXED MAPLE	Sel. Str.	1000	600	195	620	875	1,300,000
	No. 1	725	425	195	620	700	1,200,000
	No. 2	700	425	195	620	550	1,100,000
	No. 3	400	250	195	620	325	1,000,000
	Construction	800	475	195	620	725	1,100,000
	Standard	450	275	195	620	575	1,000,000
	Utility	225	125	195	620	375	900,000
	Stud	550	325	195	620	350	1,000,000
BEECH-BIRCH- HICKORY	Sel. Str.	1450	850	195	715	1200	1,700,000
	No. 1	1050	600	195	715	950	1,600,000
	No. 2	1000	600	195	715	750	1,500,000
	No. 3	575	350	195	715	425	1,300,000
	Construction	1150	675	195	715	1000	1,400,000
	Standard	650	375	195	715	775	1,300,000
	Utility	300	175	195	715	500	1,200,000
	Stud	775	450	195	715	475	1,300,000





TABLE 2
(Continued)
DIMENSION LUMBER BASE VALUES — HARDWOODS
 2" to 4" THICK by 2" and WIDER
 USE WITH ADJUSTMENT TABLES A THROUGH G

Design Values in Pounds Per Square Inch

Grades Described in para. 10.0-12.4

Also Stress Rated Boards, See para. 17.0

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Hori- zontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpen- dicular "Fc⊥"	Parallel to Grain "Fc//"	
MIXED OAK	Sel. Str.	1150	675	170	800	1000	1,100,000
	No. 1	825	500	170	800	825	1,000,000
	No. 2	800	475	170	800	625	900,000
	No. 3	475	275	170	800	375	800,000
	Construction Standard	925	550	170	800	850	900,000
	Utility	525	300	170	800	650	800,000
	Stud	250	150	170	800	425	800,000
		625	375	170	800	400	800,000

RED OAK	Sel. Str.	1150	675	170	820	1000	1,400,000
	No. 1	825	500	170	820	825	1,300,000
	No. 2	800	475	170	820	625	1,200,000
	No. 3	475	275	170	820	375	1,100,000
	Construction	925	550	170	820	850	1,200,000
	Standard	525	300	170	820	650	1,100,000
	Utility	250	150	170	820	425	1,000,000
	Stud	625	375	170	820	400	1,100,000
NORTHERN RED OAK	Sel. Str.	1400	800	220	885	1150	1,400,000
	No. 1	1000	575	220	885	925	1,400,000
	No. 2	975	575	220	885	725	1,300,000
	No. 3	550	325	220	885	425	1,200,000
	Construction	1100	650	220	885	975	1,200,000
	Standard	625	350	220	885	750	1,100,000
	Utility	300	175	220	885	500	1,000,000
	Stud	750	450	220	885	450	1,200,000



TABLE 2
(Continued)
DIMENSION LUMBER BASE VALUES — HARDWOODS
2" to 4" THICK by 2" and WIDER

USE WITH ADJUSTMENT TABLES A THROUGH G
Design Values in Pounds Per Square Inch

Grades Described in para. 10.0-12.4

Also Stress Rated Boards, See para. 17.0

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Hori- zontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpen- dicular "Fc _L "	Parallel to Grain "Fc _T "	
WHITE OAK	Sel. Str.	1200	700	220	800	1100	1,100,000
	No. 1	875	500	220	800	900	1,000,000
	No. 2	850	500	220	800	700	900,000
	No. 3	475	275	220	800	400	800,000
	Construction Standard	950	550	220	800	925	900,000
	Utility	525	325	220	800	725	800,000
	Stud	250	150	220	800	475	800,000
		650	375	220	800	450	800,000

ASPEN	Sel. Str.	875	500	120	265	725	1,100,000	
	No. 1	625	375	120	265	600	1,100,000	
	No. 2	600	350	120	265	450	1,000,000	
	No. 3	350	200	120	265	275	900,000	
	Construction	700	400	120	265	625	900,000	
	Standard	375	225	120	265	475	900,000	
	Utility	175	100	120	265	300	800,000	
	Stud	475	275	120	265	300	900,000	
	YELLOW POPLAR	Sel. Str.	1000	575	145	420	900	1,500,000
		No. 1	725	425	145	420	725	1,400,000
No. 2		700	400	145	420	575	1,300,000	
No. 3		400	225	145	420	325	1,200,000	
Construction		800	475	145	420	750	1,300,000	
Standard		450	250	145	420	575	1,100,000	
Utility		200	125	145	420	375	1,100,000	
Stud		550	325	145	420	350	1,200,000	

See para. 31.0 through 37.0 for additional information on these values.



TABLE 3
BEAMS and STRINGERS (5" and THICKER)
 WIDTH MORE THAN 2" GREATER THAN THICKNESS
 Design Values in Pounds Per Square Inch

Grades Described in para. 25.0-25.4

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "Fc⊥"	Parallel to Grain "Fc//"	
EASTERN WHITE PINE	Sel. Str.	1050	625	125	350	675	1,100,000
	No. 1	875	425	125	350	575	1,100,000
	No. 2	575	275	125	350	400	900,000
EASTERN SPRUCE	Sel. Str.	1050	625	125	390	750	1,400,000
	No. 1	900	425	125	390	625	1,400,000
	No. 2	575	275	125	390	375	1,000,000
EASTERN HEMLOCK - TAMARACK	Sel. Str.	1400	925	155	555	950	1,200,000
	No. 1	1150	775	155	555	800	1,200,000
	No. 2	750	375	155	555	500	900,000

EASTERN HEMLOCK	Sel. Str. No. 1	1350	925	155	550	950	1,200,000
	No. 2	1150	775	155	550	800	1,100,000
		750	375	155	550	550	900,000
NORTHERN PINE	Sel. Str.	1250	850	135	435	850	1,300,000
	No. 1	1050	700	135	435	725	1,300,000
	No. 2	675	350	135	435	450	1,000,000
BALSAM FIR	Sel. Str.	1350	900	125	305	950	1,400,000
	No. 1	1100	750	125	305	800	1,400,000
	No. 2	725	350	125	305	500	1,100,000
NORTHERN WHITE CEDAR	Sel. Str.	900	600	115	370	600	700,000
	No. 1	750	500	115	370	500	700,000
	No. 2	500	250	115	370	325	600,000
SPF(s) (<i>Eastern Spruce</i> <i>Red Pine</i> <i>Jack Pine</i> <i>Balsam Fir</i>)	Sel. Str.	1050	625	125	335	675	1,200,000
	No. 1	900	450	125	335	550	1,200,000
	No. 2	575	300	125	335	375	1,000,000



TABLE 3
(Continued)
BEAMS and STRINGERS (5" and THICKER)
 WIDTH MORE THAN 2" GREATER THAN THICKNESS
 Design Values in Pounds Per Square Inch

Grades Described in para. 25.0-25.4

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "Fc⊥"	Parallel to Grain "Fc//"	
RED PINE	Sel. Str.	1150	775	125	410	875	1,400,000
	No. 1	925	625	125	410	775	1,400,000
	No. 2	525	350	125	410	350	1,100,000
RED MAPLE	Sel. Str.	1400	925	195	615	950	1,500,000
	No. 1	1150	750	195	615	825	1,500,000
	No. 2	650	425	195	615	375	1,200,000
MIXED MAPLE	Sel. Str.	1100	725	180	620	750	1,100,000
	No. 1	875	600	180	620	650	1,100,000
	No. 2	500	350	180	620	300	900,000

BEECH-BIRCH- HICKORY	Sel. Str. No. 1	1550	1050	180	715	1050	1,500,000
		1250	850	180	715	900	1,500,000
	No. 2	725	475	180	715	425	1,200,000
MIXED OAK	Sel. Str.	1350	800	155	800	825	1,000,000
	No. 1	1150	550	155	800	700	1,000,000
	No. 2	725	375	155	800	450	800,000
RED OAK	Sel. Str.	1350	800	155	820	825	1,200,000
	No. 1	1150	550	155	820	700	1,200,000
	No. 2	725	375	155	820	450	1,000,000
NORTHERN RED OAK	Sel. Str.	1600	950	205	885	950	1,300,000
	No. 1	1350	675	205	885	800	1,300,000
	No. 2	875	425	205	885	500	1,000,000
WHITE OAK	Sel. Str.	1400	825	205	800	900	1,000,000
	No. 1	1200	575	205	800	775	1,000,000
	No. 2	750	375	205	800	475	800,000



TABLE 4 **POSTS and TIMBERS (5" X 5" and LARGER)**
WIDTH NOT MORE THAN 2" GREATER THAN THICKNESS
 Design Values in Pounds Per Square Inch

Grades Described in para. 26.0-26.3

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "FcL"	Parallel to Grain "FcP"	
EASTERN WHITE PINE	Sel. Str.	975	650	125	350	725	1,100,000
	No. 1	800	525	125	350	625	1,100,000
	No. 2	450	300	125	350	325	900,000
EASTERN SPRUCE	Sel. Str.	975	675	135	390	775	1,400,000
	No. 1	800	550	135	390	675	1,400,000
	No. 2	450	300	135	390	300	1,000,000
EASTERN HEMLOCK - TAMARACK	Sel. Str.	1300	875	155	555	1000	1,200,000
	No. 1	1050	700	155	555	875	1,200,000
	No. 2	600	400	155	555	400	900,000

EASTERN HEMLOCK	Sel. Str. No. 1	1250	850	155	550	1000	1,200,000
	No. 2	1050	700	155	550	875	1,200,000
		600	400	155	550	400	900,000
NORTHERN PINE	Sel. Str.	1150	800	135	435	900	1,300,000
	No. 1	950	650	135	435	800	1,300,000
		No. 2	550	375	135	435	375
BALSAM FIR	Sel. Str.	1250	825	125	305	1000	1,400,000
	No. 1	1000	675	125	305	875	1,400,000
		No. 2	575	375	125	305	400
NORTHERN WHITE CEDAR	Sel. Str.	850	575	115	370	650	700,000
	No. 1	675	450	115	370	550	700,000
		No. 2	400	250	115	370	250
SPF(s) (<i>Eastern Spruce</i> <i>Red Pine</i> <i>Jack Pine</i> <i>Balsam Fir</i>)	Sel. Str.	1000	675	125	335	700	1,200,000
	No. 1	800	550	125	335	625	1,200,000
		No. 2	475	325	125	335	425



TABLE 4 POSTS and TIMBERS (5" X 5" and LARGER)
(Continued) WIDTH NOT MORE THAN 2" GREATER THAN THICKNESS
 Design Values in Pounds Per Square Inch

Grades Described in para. 26.0-26.3

Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "FcL"	Parallel to Grain "FcP"	
RED PINE	Sel. Str.	1150	775	125	410	875	1,400,000
	No. 1	925	625	125	410	775	1,400,000
	No. 2	525	350	125	410	350	1,100,000
RED MAPLE	Sel. Str.	1400	925	195	615	950	1,500,000
	No. 1	1150	750	195	615	825	1,500,000
	No. 2	650	425	195	615	375	1,200,000
MIXED MAPLE	Sel. Str.	1100	725	180	620	750	1,100,000
	No. 1	875	600	180	620	650	1,100,000
	No. 2	500	350	180	620	300	900,000

BEECH-BIRCH- HICKORY	Sel. Str. No. 1	1550	1050	180	715	1050	1,500,000
		1250	850	180	715	900	1,500,000
	No. 2	725	475	180	715	425	1,200,000
MIXED OAK	Sel. Str.	1250	850	155	800	875	1,000,000
	No. 1	1000	675	155	800	775	1,000,000
	No. 2	575	400	155	800	350	800,000
RED OAK	Sel. Str.	1250	850	155	820	875	1,200,000
	No. 1	1000	675	155	820	775	1,200,000
	No. 2	575	400	155	820	350	1,000,000
NORTHERN RED OAK	Sel. Str.	1500	1000	205	885	1000	1,300,000
	No. 1	1200	800	205	885	875	1,300,000
	No. 2	700	475	205	885	400	1,000,000
WHITE OAK	Sel. Str.	1300	875	205	800	950	1,000,000
	No. 1	1050	700	205	800	825	1,000,000
	No. 2	600	400	205	800	400	800,000



