

## STRESS GRADES

**200.** Allowable unit working stresses herein are for lumber of species and groups of species manufactured by mills located in the West Coast region. The West Coast region is covered by these rules. Species covered include both Western US Domestic soft wood species and species imported into the US. Design values for visually graded lumber are shown in Tables 5a through 11. Design values for Machine Stress Rated lumber are shown in Table 13.

Machine Stress Rated lumber is lumber which has been non-destructively evaluated and sorted by determining a physical or mechanical property. The design strength values are determined from known correlations between a physical or mechanical property, stiffness and strength and from certification and quality control testing programs.

The design values for visually graded lumber are divided into two categories, (1) Dimension Grades (Structural Light Framing, Light Framing, Structural Joist and Plank, and Stud) and (2) all other visual grades.

Design values for  $F_b$ ,  $F_t$ ,  $F_c$ , and MOE for the Dimension Grades are based on the analysis of test data of full size lumber specimens. The test data were sampled in accordance with ASTM D2915 (Standard Practice for Evaluating Allowable Properties for Grades of Structural Lumber), tested in accordance with ASTM D4761 (Standard Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material), and allowable properties derived from the test data in accordance with ASTM D1990 (Standard Practice for Establishing Allowable Properties for Visually Graded Dimension Lumber from In-Grade Tests of Full Size Specimens). Design values for  $F_v$  and  $F_{c\perp}$  for the dimension grades are developed as for the other visual grades, and are described below.

The design values for the other visual grades listed in Tables 7 to 11 are based upon the latest studies of Western species and are calculated in accordance with ASTM Standard D2555 (Standard Methods for Establishing Clear Wood Strength Values), and ASTM Standard D245 (Standard Methods for Establishing Structural Grades for Visually Graded Lumber).

**200-a. SPECIES COMBINATIONS.** Administrative and marketing considerations often make it desirable to combine species into a single marketing group. In determining clear wood properties for combinations of species, equitable treatment for each species in the combination is assured by using a weighting factor based on the standing timber volume. The clear wood properties for the combination of species are the weighted averages of the included species with an additional limit to ensure that the properties for the group do not deviate significantly from the lowest species in the group. The following combinations of species and regions have been made for West Coast woods. Clear wood values for these combinations are determined in accordance with ASTM D2555.

- Group 1. Coast Douglas fir, Interior West Douglas fir, Interior North Douglas fir and Western larch.
- Group 2. Pacific silver fir, Noble fir, Grand fir, California red fir and White fir.
- Group 3. Balsam fir, Eastern spruces, Engelmann spruce, Sitka spruce, Jack pine, Lodgepole pine and Red pine.
- Group 4. Western red cedar, Incense cedar, Alaska cedar and Port Orford cedar.
- Group 5. Subalpine fir, Idaho white pine, Sugar pine and Ponderosa pine.

For Fb, Ft, Fc and MOE, groups 3 and 5 were grouped according to the procedures for grouping in ASTM D1990. In addition to the above groups clear wood values have been determined for individual species of Western hemlock, Sitka spruce and Mountain hemlock.

**200-b. VARIABILITY.** The various species of wood used structurally differ in their strength and stiffness properties. There is also a variability in the strength and stiffness of clear wood within each species, resulting from natural and normal differences in the growth of individual trees.

### 200-c. DESIGN VALUES.

#### DIMENSION GRADES

Tables 5 (a, b, c & d) and 6 (a, b, c, d & e) show the base design values for Dimension Grades of West Coast lumber. Base values must be multiplied by appropriate Table 4 factors for width. Design values for F<sub>b</sub>, F<sub>t</sub>, and F<sub>c</sub> are derived from tests of full size dimension lumber. The nonparametric fifth percentile tolerance limit values (75% confidence) have been adjusted for condition of seasoning, size, and grade. The values are further reduced by a factor of safety and duration of load. Modulus of elasticity values are mean values. The MOE values shown in the tables have been adjusted for condition of seasoning, grade, and span to depth ratio. Property adjustments are in accordance with ASTM D1990. For F<sub>v</sub> and F<sub>c</sub>⊥ allowable properties are derived using the clear wood approach of D2555 and D245 as for the non-dimension grades.

#### OTHER GRADES

Tables 7 through 11 show the design values for Structural grades other than Dimension Grades of West Coast lumber. Design values for strength properties such as fiber stress in bending are derived from basic clear wood values reduced to reflect the 5% exclusion limit value. They are further reduced by a safety factor and a duration of load factor and then adjusted for condition of seasoning, density, depth effect and strength ratio. Modulus of elasticity values are average values for species or groups of species. Recommended modulus of elasticity "E" values shown in the tables are computed from unadjusted clear wood values shown in ASTM D2555. The values are adjusted 6.4% for span-depth ratio and where appropriate, for seasoning and for density. Also in accordance with ASTM D245, species average E values have been reduced for grade effect.

#### MSR GRADES

The E value for machine rated lumber is determined by nondestructively testing each piece. Stress rating machines segregate material into ranges of E. The MOE design values for MSR lumber are the average values for these ranges. Tests show the coefficient of variation in MOE of this material to be approximately 0.11.

**200-d. ENGINEERING DESIGN VALUES.** The design values shown in the tables assume that any piece may contain the maximum strength reducing characteristics allowed in the grade. The values are premised on the assumption of the individual member carrying its own design load.

**200-e. REPETITIVE MEMBER DESIGN VALUES.** Generally relatively few pieces in a grade contain the maximum strength reducing characteristics permitted in the grade. Therefore most of the pieces will have actual values higher than the assigned engineering value. When these pieces are used together an increase of 15% may be taken in design values for fiber stress in bending ( $F_b$ ). A repetitive member system is defined as framing or supporting members such as joists, studs, planks or decking that are continuous or spaced not more than 24 inches on center and are joined by floor, roof, or other load-distributing elements.

**200-f. WIDTH EFFECT ON DESIGN VALUES** The tabulated values herein are based on a nominal width for Light Framing and nominal thickness for Decking of 4". Studs are based on a 6" width. Values for Structural Light Framing, Structural Joist and Plank, beams, stringers and posts are for a 12" width. Table 4 provides factors to adjust the base properties of Structural Light Framing, Structural Joist and Plank, and Studs for width. ASTM D245 provides a method to adjust bending stress values for width in beams, stringers, posts, and timbers.

**200-g. FLAT USE FACTORS.** Table 1 provides adjustment factors which may be used to adjust the fiber stress in bending ( $F_b$ ) values of the Dimension Grades when pieces of these grades are used flatwise rather than on edge. The adjustment factors should be used on the base value after adjusting for width (Table 4).

## STRESS GRADES

**Table 1. Adjustment Factors for Flatwise Use of Dimension Lumber.**

Width (nominal)	Less than 4"	4"	5"	6"	8"	10" & Wider
Factor for:						
<b>2" and 3" Thickness</b>	1.0	1.10	1.10	1.15	1.15	1.20
<b>4" Thickness</b>		1.00	1.05	1.05	1.05	1.10

To determine allowable design stresses for structural loads applied to the wide face of Beams & Stringers graded per paragraph 130, multiply the assigned design values (Table 10, Para. 200) by the following factors:

### ADJUSTMENT FACTORS FOR FLATWISE USE OF BEAMS & STRINGERS

Beam & Stringer Grade	Factors		
	Extreme fiber in Bending, Fb	Modulus of Elasticity, E	Other Properties
<b>Select Structural</b>	0.86	1.0	1.0
<b>No. 1</b>	0.74	0.9	1.0
<b>No. 2</b>	1.0	1.0	1.0

**200-h. EFFECT OF MOISTURE CONTENT ON DESIGN VALUES.** The design values shown in the tables are applicable to lumber surfaced either unseasoned or dry as long as it is used under dry conditions such as in most covered structures. The section properties of lumber for design use should be those applicable to the "dry" surfaced sizes shown in these rules. In calculating design values, the change 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.

## STRESS GRADES

---

There are two situations where the tabulated design values should be adjusted:

1. When 4" and thinner lumber is used where the moisture content will exceed 19%, the design values should be multiplied by the adjustment factors shown in Table 2.
2. When lumber 5" and thicker is used where the moisture content will exceed 19% for an extended period of time, the design values should be multiplied by the adjustment factors shown in Table 3.

Design values for scaffold plank are based on exposed conditions of use.

### ADJUSTMENT FACTORS FOR SEASONING

**Table 2. Adjustment Factors for Nominal 4" and Thinner Lumber.**

Extreme Fiber in Bending	Tension Parallel to Grain	Compression Parallel to Grain	Horizontal Shear	Compression Perp. To Grain	Modulus of Elasticity
F <sub>b</sub>	F <sub>t</sub>	F <sub>c</sub>	F <sub>v</sub>	F <sub>c</sub> ⊥	E
.85*	1.0	.80**	0.97	0.67	0.9

*Use these factors only when moisture content will exceed 19% in use.*

*\* When size adjusted bending values do not exceed 1150 psi a factor of 1.0 may be used.*

*\*\* When size adjusted compression values do not exceed 750 psi a factor of 1.0 may be used.*

**Table 3. Adjustment Factors for 5" and Thicker Lumber.**

Extreme Fiber in Bending	Tension Parallel to Grain	Compression Parallel to Grain	Horizontal Shear	Compression Perp. To Grain	Modulus of Elasticity
F <sub>b</sub>	F <sub>t</sub>	F <sub>c</sub>	F <sub>v</sub>	F <sub>c</sub> ⊥	E
1.0	1.0	0.91	1.0	0.67	1.0

*Use these factors only when moisture content will exceed 19% in use.*

**200-i. ADJUSTMENT FACTORS FOR HORIZONTAL SHEAR.** The tabulated horizontal shear values shown herein are based on the conservative assumption that the most severe checks, shakes or splits possible are present. Since shear stress in most joists and beams is greatest near the ends the restrictions are applied only for a distance from each end equal to three times the width of the wide face of the piece. Since shear stress is greatest near the neutral axis the restrictions also are applied only in the middle one-half of the height of the piece and only the shakes, checks and splits in this section are measured.

**200-j. COMPRESSION PERPENDICULAR TO GRAIN.** Compression perpendicular to grain design values are calculated according to the latest editions of ASTM Standard D2555 and D245. These design values are based on an allowable deformation limit of .04 inches and are for standard design of most structures. Values at .02 inch deformation can be obtained by using the formula:

$$F_{c\perp}(.02) = 0.73F_{c\perp}(.04) + 5.60$$

**200-k.** Design values listed in this rule book are for use with Allowable Stress Design (ASD) procedures. Load Resistance Factor Design (LRFD) is an alternative engineering design procedure. Reference resistance values for use with LRFD design procedures can be computed from the ASD design values listed in this book by multiplying the design values by the factors listed below:

### CONVERSION FACTORS FOR USE WITH LRFD DESIGN\*\*

<b>Extreme Fiber in Bending</b>	<b>Tension Parallel to Grain</b>	<b>Horizontal Shear</b>
<b>F<sub>b</sub></b>	<b>F<sub>t</sub></b>	<b>F<sub>v</sub></b>
2.54	2.70	2.88
<b>Compression Perp. To Grain</b>	<b>Compression Parallel To Grain</b>	<b>Modulus of Elasticity</b>
<b>F<sub>c⊥</sub></b>	<b>F<sub>c//</sub></b>	<b>E</b>
1.67	2.40	1.0

*\*\*Factors established in accordance with ASTM D5457.*

## STRESS GRADES

---

The table of conversion factors to convert Allowable Design Values for use with ASD design procedures to reference resistance values for use with LRFD design procedures converts the values in pounds per square inch (psi) units to ksi units. Recent publications utilizing LRFD design procedures have standardized on listing reference resistance values in thousands pounds per square inch (ksi) units to avoid confusion with ASD allowable design values. To convert allowable design values in psi units to reference resistance values in ksi units, the factors given in paragraph 200k must be divided by 1000.

### 200-I. ASSIGNED SPECIES AVERAGE SPECIFIC GRAVITY

Species or Species Group	Specific Gravity (OD WT/OD VOL)
<b>Domestic</b>	
Douglas Fir & Douglas Fir/Larch	0.50
Hem-Fir	0.43
Spruce-Pine-Fir South	0.36
Mountain Hemlock	0.47
Sitka Spruce	0.43
Western Cedars	0.36
Western Hemlock	0.47
Western Woods	0.36
Port Orford Cedar	0.44
Alaska Cedar	0.47



## STRESS GRADES

---

Species or Species Group	County of Origin	Specific Gravity (OD W/ OD VOL)
<b>Imported</b>		
Austrian Spruce	Austria/Czech Rep.	0.43
Douglas Fir/EU Larch	Austria/Czech Rep.	0.48
Douglas Fir	Germany/France	0.48
Montane Pine	Rep. South Africa	0.45
Norway Spruce	Baltic States	0.43
Norway Spruce	Finland	0.42
Norway Spruce	Germany/NE France/ Switzerland	0.42
Norway Spruce	Romania/Ukraine	0.38
Norway Spruce	Sweden	0.42
Scots Pine	Austria/Czech Rep.	0.50
Scots Pine	Finland	0.48
Scots Pine	Germany	0.53
Scots Pine	Baltic States (Estonia/ Latvia/Lithuania)	0.45
Silver Fir	Germany/NE France/ Switzerland	0.43

*Calculated in accordance with American Wood Council Standards,*

## STRESS GRADES

**TABLE 4. WIDTH ADJUSTMENT FACTORS FOR USE WITH VALUES IN TABLES 5 AND 6.**

Grade	Width (depth)	Fb		Ft	Fc	Other Properties
		Less than 4" thick	4" thick			
<b>Select Struct., No. 1, No. 2, No. 3</b>	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" 12" 14" & Wider	1.1 1.0 0.9	1.2 1.1 1.0	1.1 1.0 0.9	1.0 1.0 0.9	1.0 1.0 1.0
<b>Const., Stand.</b>	2" & 3" 4"	1.0 1.0	1.0 1.0	1.0 1.0	1.0 1.0	1.0 1.0
	<b>Utility</b>	2" & 3" 4"	0.4 1.0	— 1.0	0.4 1.0	0.6 1.0
<b>Studs*</b>		4" & less 5" 6"	1.1 1.0 1.0	1.1 1.0 1.0	1.1 1.0 1.0	1.05 1.0 1.0

\* Factors are for Stud widths 6" and less. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade.

# STRESS GRADES

**TABLE 5a. Domestic Species Base Values For: STRUCTURAL LIGHT FRAMING and STRUCTURAL JOISTS AND PLANKS**  
 Design Values, PSI, Normal Loading

2" to 4" thick; 2 to 4" wide Grade Descriptions - Para 124  
 2" to 4" thick; 5" and wider Grade Descriptions - Para 123

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
<b>DOUGLAS FIR</b>	Sel. Struct.	1,500	1,000	1,700	180	625	1,900,000
	No. 1 & Btr.	1,200	800	1,550	180	625	1,800,000
	No. 1	1,000	675	1,500	180	625	1,700,000
	No. 2	900	575	1,350	180	625	1,600,000
	No. 3	525	325	775	180	625	1,400,000
<b>HEM-FIR</b>	Sel. Struct.	1,400	925	1,500	150	405	1,600,000
	No. 1 & Btr.	1,100	725	1,350	150	405	1,500,000
	No. 1	975	625	1,350	150	405	1,500,000
	No. 2	850	525	1,300	150	405	1,300,000
	No. 3	500	300	725	150	405	1,200,000
<b>SPRUCE-PINE-FIR SOUTH</b>	Sel. Struct.	1,300	575	1,200	135	335	1,300,000
	No. 1	875	400	1,050	135	335	1,200,000
	No. 2	775	350	1,000	135	335	1,100,000
	No. 3	450	200	575	135	335	1,000,000
<b>WESTERN WOODS</b>	Sel. Struct.	900	400	1,050	135	335	1,200,000
	No. 1	675	300	950	135	335	1,100,000
	No. 2	675	300	900	135	335	1,000,000
	No. 3	375	175	525	135	335	900,000
<b>WESTERN JUNIPER</b>	Sel. Struct.	925	525	225	125	770	600,000
	No. 1	800	425	200	125	770	600,000
	No. 2	650	350	175	125	770	500,000
	No. 3	375	200	100	125	770	500,000

*All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.*

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 124  
2" to 4" thick; 5" and wider Grade Descriptions - Para 123

**TABLE 5b. Domestic Cedars Base Values For:  
STRUCTURAL LIGHT FRAMING and STRUCTURAL JOISTS AND PLANKS**  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
<b>ALASKA CEDAR</b>	Sel. Struct.	1,150	625	1,000	165	525	1,400,000
	No. 1	975	525	900	165	525	1,300,000
	No. 2	800	425	750	165	525	1,200,000
	No. 3	450	250	425	165	525	1,100,000
<b>PORT ORFORD CEDAR*</b>	Sel. Struct.	1,250	700	1,150	165	470	1,600,000
	No. 1	1,050	575	1,050	165	470	1,500,000
	No. 2	875	475	875	165	470	1,400,000
	No. 3	500	275	500	165	470	1,300,000
<b>WESTERN CEDAR</b>	Sel. Struct.	1,000	600	1,000	155	425	1,100,000
	No. 1	725	425	825	155	425	1,000,000
	No. 2	700	425	650	155	425	1,000,000
	No. 3	400	250	375	155	425	900,000

*All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.*

**TABLE 5c. Imported Norway and Austrian Spruce Base Values For: STRUCTURAL LIGHT FRAMING and STRUCTURAL JOIST AND PLANKS Design Values, PSI, Normal Loading**

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
AUSTRIAN SPRUCE	Sel. Struct.	1,500	675	1,250	175	260	1,700,000
	No. 1	1,000	450	1,100	175	260	1,600,000
	No. 2	925	400	1,050	175	260	1,500,000
	No. 3	525	225	675	175	260	1,300,000
NORWAY SPRUCE BAL TIC STATES (ESTONIA / LATVIA / LITHUANIA)	Sel. Struct.	1,200	550	1,200	150	430	1,600,000
	No. 1	850	375	1,050	150	430	1,400,000
	No. 2	800	350	1,000	150	430	1,300,000
	No. 3	450	200	575	150	430	1,100,000
NORWAY SPRUCE FINLAND	Sel. Struct.	1,350	600	1,200	125	220	1,500,000
	No. 1	850	375	1,000	125	220	1,400,000
	No. 2	625	275	875	125	220	1,200,000
	No. 3	375	175	500	125	220	1,100,000
NORWAY SPRUCE GERMANY/ NE FRANCE / SWITZERLAND	Sel. Struct.	1,200	550	1,200	170	355	1,600,000
	No. 1	825	375	1,050	170	355	1,400,000
	No. 2	725	325	950	170	355	1,200,000
	No. 3	425	200	550	170	355	1,100,000
NORWAY SPRUCE NORWAY	Sel. Struct.	1,550	700	1,250	115	360	1,800,000
	No. 1	1,000	450	1,100	115	360	1,500,000
	No. 2	800	375	1,000	115	360	1,300,000
	No. 3	475	200	575	115	360	1,200,000
NORWAY SPRUCE SWEDEN	Sel. Struct.	1,250	550	1,200	170	285	1,600,000
	No. 1	825	375	1,050	170	285	1,400,000
	No. 2	675	300	925	170	285	1,200,000
	No. 3	400	175	525	170	285	1,100,000

*All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.*

**TABLE 5c. (cont.) Imported Norway and Austrian Spruce Base Values For: STRUCTURAL LIGHT FRAMING and STRUCTURAL JOIST AND PLANKS**  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
NORWAY SPRUCE ROMANIA /UKRAINE	Sel. Struct.	1,250	575	1,200	275	100	1,500,000
	No. 1	850	375	1,050	275	100	1,400,000
	No. 2	750	325	950	275	100	1,200,000
	No. 3	425	200	550	275	100	1,100,000
DOUGLAS FIR FRANCE / GERMANY	Sel. Struct.	1,500	675	1,250	205	540	1,900,000
	No. 1	975	450	1,100	205	540	1,700,000
	No. 2	825	375	1,000	205	540	1,500,000
	No. 3	475	225	600	205	540	1,300,000

**TABLE 5d. Imported Scots Pine Base Values For: STRUCTURAL LIGHT FRAMING and STRUCTURAL JOISTS AND PLANKS**  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
SCOTS PINE AUSTRIA / CZECH REPUBLIC / ROMANIA /UKRAINE	Sel. Struct.	1,300	600	1,200	135	270	1,700,000
	No. 1	900	400	1,050	135	270	1,600,000
	No. 2	775	350	1,000	135	270	1,400,000
	No. 3	450	200	575	135	270	1,300,000
SCOTS PINE BALTIC COUNTRIES ESTONIA / LATVIA / LITHUANIA	Sel. Struct.	1,150	525	1,150	130	430	1,500,000
	No. 1	800	350	1,050	130	430	1,400,000
	No. 2	750	325	975	130	430	1,200,000
	No. 3	425	200	550	130	430	1,100,000

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 124  
2" to 4" thick; 5" and wider Grade Descriptions - Para 123

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

TABLE 5d. (cont.) Imported Scots Pine Base Values For:  
STRUCTURAL LIGHT FRAMING and STRUCTURAL JOISTS AND PLANKS  
Design Values, PSI, Normal Loading

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 124  
2" to 4" thick; 5" and wider Grade Descriptions - Para 123

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
SCOTS PINE FINLAND	Sel. Struct.	1,300	600	1,200	150	210	1,500,000
	No. 1	950	425	1,100	150	210	1,400,000
	No. 2	925	425	1,100	150	210	1,300,000
	No. 3	525	250	625	150	210	1,200,000
SCOTS PINE GERMANY <sup>1</sup>	Sel. Struct.	1,200	550	1,200	160	395	1,600,000
	No. 1	800	375	1,050	160	395	1,400,000
	No. 2	700	325	950	160	395	1,100,000
	No. 3	400	175	550	160	395	1,000,000
SCOTS PINE SWEDEN	Sel. Struct.	1,350	600	1,200	120	410	1,700,000
	No. 1	850	375	1,000	120	410	1,500,000
	No. 2	625	275	875	120	410	1,300,000
	No. 3	375	175	500	120	410	1,200,000
MONTANE PINE REPUBLIC OF SOUTH AFRICA	Sel. Struct.	975	425	1,100	135	325	1,300,000
	No. 1	650	300	950	135	325	1,100,000
	No. 2	600	275	850	135	325	1,000,000
	No. 3	350	150	475	135	325	900,000
SILVER FIR GERMANY / NE FRANCE / SWITZERLAND	Sel. Struct.	950	425	1,100	130	400	1,500,000
	No. 1	725	325	975	130	400	1,400,000
	No. 2	725	325	950	130	400	1,300,000
	No. 3	425	200	550	130	400	1,100,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

<sup>1</sup> Does not include states of Baden-Wuerttemberg nor Saarland.

## STRESS GRADES

**TABLE 6a. Domestic Species Base Values For:  
LIGHT FRAMING and STUD**  
Design Values, PSI, Normal Loading

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 122  
2" to 4" thick; 2" to 6" wide Grade Descriptions - Para 121

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc⊥	Modulus of Elasticity E
DOUGLAS FIR	Construction Standard	1,000	650	1,650	180	625	1,500,000
	Utility	575	375	1,400	180	625	1,400,000
	* Studs	275	175	900	180	625	1,300,000
HEM-FIR	Construction Standard	700	450	850	180	625	1,400,000
	Utility	975	600	1,550	150	405	1,300,000
	* Studs	550	325	1,300	150	405	1,200,000
SPRUCE-PINE-FIR SOUTH	Construction Standard	250	150	850	150	405	1,100,000
	Utility	675	400	800	150	405	1,200,000
	* Studs	875	400	1,200	135	335	1,000,000
WESTERN WOODS	Construction Standard	500	225	1,000	135	335	900,000
	Utility	225	100	675	135	335	900,000
	* Studs	600	275	625	135	335	1,000,000
WESTERN JUNIPER	Construction Standard	775	350	1,100	135	335	1,000,000
	Utility	425	200	925	135	335	900,000
	* Stud	200	100	600	135	335	800,000
WESTERN JUNIPER	Construction Standard	525	225	575	135	335	900,000
	Utility	750	400	200	125	770	500,000
	* Stud	425	225	175	125	770	500,000
WESTERN JUNIPER	Construction Standard	200	100	100	125	770	400,000
	Utility	500	275	100	125	770	500,000
	* Stud	750	400	200	125	770	500,000

\* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade. Note: All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.



TABLE 6b. Domestic Cedars Base Values For:  
LIGHT FRAMING and STUD  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
ALASKA CEDAR	Construction	900	500	950	165	525	1,200,000
	Standard	500	275	775	165	525	1,100,000
	Utility	250	125	500	165	525	1,000,000
	* Stud	625	350	475	165	525	1,100,000
PORT ORFORD CEDAR	Construction	975	550	1,100	165	470	1,300,000
	Standard	550	300	900	165	470	1,200,000
	Utility	250	150	600	165	470	1,100,000
	* Stud	675	375	550	165	470	1,300,000
WESTERN CEDAR	Construction	800	475	850	155	425	900,000
	Standard	450	275	650	155	425	800,000
	Utility	225	125	425	155	425	800,000
	* Stud	550	325	400	155	425	900,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.  
\* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade. All values are in psi.

## STRESS GRADES

**TABLE 6c. Imported Norway and Austrian Spruce Base Values For:  
LIGHT FRAMING and STUD Design Values, PSI, Normal Loading**

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 122  
2" to 4" thick; 2" to 6" wide Grade Descriptions - Para 12

SPECIES	GRADE	Ex. Fib. Bending Fb	Tension Par. To Grain Ft	Comp. Par. To Grain Fc	Horizontal Shear Fv	Comp. Perp. To Grain Fc <sub>⊥</sub>	Modulus of Elasticity E
AUSTRIAN SPRUCE	Construction	1,050	475	1,300	175	260	1,400,000
	Standard	575	250	1,100	175	260	1,300,000
	Utility	275	125	725	175	260	1,200,000
	* Stud	725	325	675	175	260	1,300,000
NORWAY SPRUCE BALTIC STATES (ESTONIA / LATVIA / LITHUANIA)	Construction	900	400	1,200	150	430	1,200,000
	Standard	500	225	1,050	150	430	1,100,000
	Utility	250	100	675	150	430	1,000,000
	* Stud	625	275	625	150	430	1,100,000
NORWAY SPRUCE FINLAND	Construction	725	325	1,100	125	220	1,100,000
	Standard	400	175	900	125	220	1,000,000
	Utility	200	75	600	125	220	1,000,000
	* Stud	500	225	550	125	220	1,100,000
NORWAY SPRUCE GERMANY/ NE FRANCE / SWITZERLAND	Construction	825	375	1,200	170	355	1,100,000
	Standard	475	200	975	170	355	1,000,000
	Utility	225	100	650	170	355	900,000
	* Stud	575	250	600	170	355	1,100,000
NORWAY SPRUCE NORWAY	Construction	925	425	1,250	115	360	1,200,000
	Standard	525	225	1,050	115	360	1,100,000
	Utility	250	100	675	115	360	1,000,000
	* Stud	625	275	650	115	360	1,200,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h. \* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade.

TABLE 6c. (cont.) Imported Norway and Austrian Spruce Base Values For:  
LIGHT FRAMING and STUD Design Values, PSI, Normal Loading

2" to 4" thick; 2" to 4" wide Grade Descriptions - Para 122  
2" to 4" thick; 2" to 6" wide Grade Descriptions - Para 121

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
NORWAY SPRUCE SWEDEN	Construction	775	350	1,150	170	285	1,200,000
	Standard	425	200	950	170	285	1,100,000
	Utility	200	100	625	170	285	1,000,000
	* Stud	550	250	575	170	285	1,100,000
NORWAY SPRUCE ROMANIA / UKRAINE	Construction	850	375	1,200	100	275	1,100,000
	Standard	475	200	1,000	100	275	1,000,000
	Utility	225	100	650	100	275	1,000,000
	* Stud	575	250	600	100	275	1,100,000
DOUGLAS FIR FRANCE / GERMANY	Construction	925	425	1,250	205	540	1,400,000
	Standard	525	225	1,050	205	540	1,300,000
	Utility	250	100	675	205	540	1,200,000
	* Stud	650	300	650	205	540	1,300,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h. \* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade.

# STRESS GRADES

**TABLE 6d. Imported Scots Pine Base Values For:  
LIGHT FRAMING and STUDS**  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
SCOTS PINE AUSTRIA / CZECH REPUBLIC / ROMANIA / UKRAINE	Construction	875	400	1,200	135	270	1,300,000
	Standard	500	225	1,000	135	270	1,200,000
	Utility	225	100	675	135	270	1,100,000
	* Stud	600	275	625	135	270	1,300,000
SCOTS PINE BALTIC STATES (ESTONIA / LATVIA / LITHUANIA)	Construction	850	375	1,200	130	430	1,100,000
	Standard	475	225	1,000	130	430	1,000,000
	Utility	225	100	650	130	430	1,000,000
	* Stud	575	275	625	130	430	1,100,000
SCOTS PINE FINLAND	Construction	1,050	475	1,300	150	210	1,200,000
	Standard	600	275	1,100	150	210	1,100,000
	Utility	275	125	725	150	210	1,000,000
	* Stud	725	325	675	150	210	1,200,000
SCOTS PINE GERMANY <sup>1</sup>	Construction	800	375	1,150	160	395	1,100,000
	Standard	450	200	975	160	395	1,000,000
	Utility	225	100	625	160	395	900,000
	* Stud	550	250	600	160	395	1,000,000
SCOTS PINE SWEDEN	Construction	725	325	1,100	120	410	1,200,000
	Standard	400	175	900	120	410	1,100,000
	Utility	200	75	600	120	410	1,000,000
	* Stud	500	225	550	120	410	1,200,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

\* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade.

<sup>1</sup> Does not include states of Baden-Württemberg nor Saarland.

TABLE 6d. (cont.) Imported Scots Pine Base Values For:  
LIGHT FRAMING and STUDS  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
MONTANE PINE REPUBLIC OF SOUTH AFRICA	Construction	675	300	1,050	135	325	900,000
	Standard	375	175	875	135	325	800,000
	Utility	175	75	575	135	325	800,000
	* Stud	475	200	525	135	325	900,000
SILVER FIR GERMANY / NE FRANCE / SWITZERLAND	Construction	825	375	1,150	130	400	1,200,000
	Standard	475	200	975	130	400	1,100,000
	Utility	225	100	650	130	400	1,000,000
	* Stud	575	250	600	130	400	1,100,000

All values are in psi. \* Values are for Stud width 6" and less. Multiply the values by the appropriate width adjustment factors Table 4. For Studs wider than 6" use the property values and width adjustment factors for No. 3 grade. Certain foreign species and species groups have assigned design values for nominal 2x4 size only. These species are listed in Table 6e.

# STRESS GRADES

**TABLE 6e. Limited Size Values - 2X4, 2X6 Values For:  
STRUCTURAL LIGHT FRAMING, LIGHT FRAMING, AND STUD**  
Design Values, PSI, Normal Loading

See Para. 122 and Para. 124

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Tension Par. To Grain F <sub>t</sub>	Comp. Par. To Grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
DOUGLAS FIR EUROPEAN LARCH FROM AUSTRIA, CZECH REP. AND BAVARIA 2X4	Select Structural	1,900	850	1,400	195	440	1,800,000
	No. 1	1,400	625	1,250	195	440	1,700,000
	No. 2	1,350	600	1,250	195	440	1,600,000
	No. 3	775	350	700	195	440	1,400,000
	Construction	1,000	450	1,250	195	440	1,500,000
	Standard	575	250	1,100	195	440	1,300,000
	Utility * Stud	275 800	125 350	700 700	195 195	440 440	1,300,000 1,400,000
NORWAY SPRUCE FROM ARCHANGEL RUSSIA <sup>1</sup> 2X4	Select Structural	2,300	1,050	1,400	175	315	1,500,000
	No. 1	1,750	775	1,350	175	315	1,400,000
	No. 2	1,750	775	1,350	175	315	1,400,000
	No. 3	1,000	450	775	175	315	1,200,000
	Construction	1,300	600	1,400	175	315	1,300,000
	Standard	725	325	1,200	175	315	1,200,000
	Utility * Stud	350 975	150 450	775 775	175 175	315 315	1,100,000 1,200,000
NORWAY SPRUCE FROM ARCHANGEL RUSSIA <sup>1</sup> 2X6	Select Structural	2,000	900	1,350	175	315	1,500,000
	No. 1	1,500	675	1,300	175	315	1,400,000
	No. 2	1,500	675	1,300	175	315	1,400,000
	No. 3	850	375	750	175	315	1,200,000
* Stud	900	400	750	175	315	1,200,000	

\* Values are for Stud width indicated only. Factors in Table 4 are not applicable. For repetitive member values, see Para. 200-h.

<sup>1</sup> Assigned Species Specific Gravity is 0.42. Rules writing authority transferred from NeLMA.

2" TO 4" thick, 4" to 8" wide Grade Description - Para. 127

TABLE 7. "DEX" HEAVY WALL AND ROOF PLANK  
Design Values, PSI, Normal Loading

SPECIES	GRADE	Ex. Fib. Bending F <sub>b</sub>	Comp. Perp. To Grain F <sub>c⊥</sub>	Modulus of Elasticity E
DOUGLAS FIR	Select Dex	1,750	625	1,800,000
	Commercial Dex	1,450	625	1,700,000
WESTERN HEMLOCK	Select Dex	1,500	410	1,600,000
	Commercial Dex	1,300	410	1,400,000
HEM-FIR	Select Dex	1,400	405	1,500,000
	Commercial Dex	1,150	405	1,400,000
WESTERN CEDAR	Select Dex	1,250	425	1,100,000
	Commercial Dex	1,050	425	1,000,000
SITKA SPRUCE	Select Dex	1,300	435	1,500,000
	Commercial Dex	1,100	435	1,300,000

Values apply to lumber used at 19% maximum moisture content such as in most covered structures. For other use conditions, see section 200-h. For repetitive member values, see Para. 200-e.

## STRESS GRADES

*ASTM D2395, and WCLIB submission to ALSC 6/15/2000.*

**TABLE 8a. SCAFFOLD PLANK**

(2" scaffold surfaced to standard ALS sizes)

Surfaced Scaffold (Nominal 2" maximum thickness, 8" and wider). Flatwise bending values, psi. Grade description — Para. 171. The values in Table 8-a apply to Scaffold surfaced dry or surfaced green to standard ALS sizes as long as the material is 19% maximum moisture content at time of use. The standard dressed "Dry" sizes shall be used to all span calculations.

For "Wet" conditions of use where the moisture content in service will exceed 19% the values in Table 8-a shall be multiplied by the following adjustment factors:

Extreme fiber in bending, Fb Factor – .86

Modulus of Elasticity, E Factor – .97

SPECIES	GRADE	Ex. Fib. Bending Fb (psi)	Modulus of Elasticity E (psi)
<b>DOUGLAS FIR</b>	Dense Premium	2,450	1,900,000
	Premium	2,250	1,800,000
	Dense Select Struc.	2,400	1,900,000
	Select Structural	2,200	1,800,000
<b>SITKA SPRUCE</b>	Premium	1,600	1,500,000
	Select Structural	1,550	1,500,000
<b>WESTERN HEMLOCK</b>	Premium	1,850	1,600,000
	Select Structural	1,800	1,600,000
<b>HEM-FIR</b>	Premium	1,650	1,500,000
	Select Structural	1,600	1,500,000

7



## STRESS GRADES

---

TABLE 8-b SCAFFOLD PLANK.

(3" and thinner, 8" and wider)

Flatwise bending values, psi Grade description — Para. 171. The values in Table 8-b apply to Scaffold used under wet use conditions. Actual manufactured sizes shall be used in span calculations.

SPECIES	GRADE	Ex. Fib. Bending Fb (psi)	Modulus of Elasticity E (psi)
<b>DOUGLAS FIR</b>	Dense Premium	1,850	1,700,000
	Premium	1,700	1,600,000
	Dense Select Str.	1,700	1,700,000
	Select Structural	1,550	1,600,000
<b>SITKA SPRUCE</b>	Premium	1,200	1,300,000
	Select Structural	1,100	1,300,000
<b>WESTERN HEMLOCK</b>	Premium	1,400	1,400,000
	Select Structural	1,250	1,400,000
<b>HEM-FIR</b>	Premium	1,250	1,300,000
	Select Structural	1,100	1,300,000

7

All Scaffold Plank design values are calculated using ASTM Standards D245 and D2555. These values are modified using procedures shown in "Calculating Apparent Reliability of Wood Scaffold Planks," as published by the Journal on Structural Safety, 2 (1984) 47-57.

For modification of design values for Scaffold Plank which has been fire-retardant treated, see the National Design Specification of the American Forest & Paper Association.

## STRESS GRADES

---

TABLE 9. STADIUM PLANK  
(1-1/4" TO 3" thick, 4" and wider.)

Flatwise Bending Values.

PSI Grade Description — Para. 172

SPECIES	Extreme fiber in bending Fb		Modulus of Elasticity E (psi)
	Slope of grain 1:10	Slope of grain 1:14	
DOUGLAS FIR	1,950	2,400	1,800,000
WESTERN HEMLOCK	1,700	2,100	1,600,000
HEM-FIR	1,550	1,900	1,500,000
WESTERN CEDAR	1,400	1,650	1,100,000
SITKA SPRUCE	1,500	1,800	1,500,000
MOUNTAIN HEMLOCK	1,600	1,900	1,300,000

Values apply to lumber used at 19% maximum moisture content such as in most covered structures. For other conditions of use, see section 200-h.

SPECIES	GRADE	Extreme fiber in bending F <sub>b</sub>	Tension parallel to grain F <sub>t</sub>	Comp. parallel to grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. perp. to grain F <sub>c⊥</sub>	Modulus of Elasticity E
DOUGLAS FIR	Dense Select Str.	1,900	1,100	1,300	170	730	1,700,000
	Select Structural	1,600	950	1,100	170	625	1,600,000
	Dense No. 1	1,550	775	1,100	170	730	1,700,000
	No. 1	1,350	675	925	170	625	1,600,000
WESTERN HEMLOCK	No. 2	875	425	600	170	625	1,300,000
	Select Structural	1,400	825	1,000	170	410	1,400,000
HEM-FIR	No. 1	1,150	575	850	170	410	1,400,000
	No. 2	750	375	550	170	410	1,100,000
	Select Structural	1,300	750	925	140	405	1,300,000
	No. 1	1,050	525	750	140	405	1,300,000
PORT ORFORD CEDAR	No. 2	675	350	500	140	405	1,100,000
	Select Structural	1,500	725	1,100	155	470	1,400,000
	No. 1	1,250	525	900	155	470	1,400,000
WESTERN CEDAR	No. 2	825	325	600	155	470	1,100,000
	Select Structural	1,150	675	875	140	425	1,000,000
	No. 1	975	475	725	140	425	1,000,000
	No. 2	625	325	475	140	425	800,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.  
\* Assigned species Specific Gravity is 0.44.

TABLE 10. BEAMS AND STRINGERS (continued)  
Design Values, PSI, Normal Loading

Grade Description - Para. 130

SPECIES	GRADE	Extreme fiber in bending $F_b$	Tension parallel to grain $F_t$	Comp. parallel to grain $F_c$	Horizontal Shear $F_v$	Comp. perp. to grain $F_{c\perp}$	Modulus of Elasticity $E$
SITKA SPRUCE	Select Structural	1,200	675	825	140	435	1,300,000
	No. 1	1,000	500	675	140	435	1,300,000
	No. 2	650	325	450	140	435	1,000,000
MOUNTAIN HEMLOCK	Select Structural	1,350	775	875	170	570	1,100,000
	No. 1	1,100	550	725	170	570	1,100,000
	No. 2	725	375	475	170	570	900,000
SPRUCE-PINE-FIR SOUTH	Select Structural	1,050	625	675	125	335	1,200,000
	No. 1	900	450	550	125	335	1,200,000
	No. 2	575	300	375	125	335	1,000,000
WESTERN JUNIPER	Select Structural	1,300	650	325	115	770	500,000
	No. 1	1,100	450	275	115	770	500,000
	No. 2	725	300	175	115	770	400,000
WESTERN WOODS	Select Structural	1,050	625	750	125	345	1,100,000
	No. 1	900	450	625	125	345	1,100,000
	No. 2	575	300	425	125	345	900,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

TABLE 11. POSTS AND TIMBERS  
Design Values, PSI, Normal Loading

Grade Description - Para. 131

SPECIES	GRADE	Extreme fiber in bending $F_b$	Tension parallel to grain $F_t$	Comp. parallel to grain $F_c$	Horizontal Shear $F_v$	Comp. perp. to grain $F_{c\perp}$	Modulus of Elasticity $E$
DOUGLAS FIR	Dense Select Str.	1,750	1,150	1,350	170	730	1,700,000
	Select Structural	1,500	1,000	1,150	170	625	1,600,000
	Dense No. 1	1,400	950	1,200	170	730	1,700,000
	No. 1	1,200	825	1,000	170	625	1,600,000
WESTERN HEMLOCK	No. 2	750	475	700	170	625	1,300,000
	Select Structural	1,300	875	1,100	170	410	1,400,000
HEM-FIR	No. 1	1,050	700	950	170	410	1,400,000
	No. 2	650	425	650	170	410	1,100,000
	Select Structural	1,200	800	975	140	405	1,300,000
	No. 1	975	650	850	140	405	1,300,000
PORT ORFORD CEDAR	No. 2	575	375	575	140	405	1,100,000
	Select Structural	1,400	775	1,150	155	470	1,400,000
	No. 1	1,150	625	1,000	155	470	1,400,000
WESTERN CEDAR	No. 2	675	375	700	155	470	1,100,000
	Select Structural	1,100	725	925	140	425	1,000,000
	No. 1	875	600	800	140	425	1,000,000
	No. 2	550	350	550	140	425	800,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

TABLE 11. POSTS AND TIMBERS (continued)  
Design Values, PSI, Normal Loading

Grade Description - Para. 131

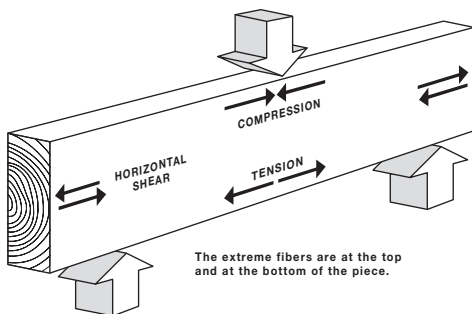
SPECIES	GRADE	Extreme fiber in bending F <sub>b</sub>	Tension parallel to grain F <sub>t</sub>	Comp. parallel to grain F <sub>c</sub>	Horizontal Shear F <sub>v</sub>	Comp. perp. to grain F <sub>c⊥</sub>	Modulus of Elasticity E
SITKA SPRUCE	Select Structural	1,150	750	875	140	435	1,300,000
	No. 1	925	600	750	140	435	1,300,000
	No. 2	550	350	525	140	435	1,000,000
MOUNTAIN HEMLOCK	Select Structural	1,250	825	925	170	570	1,100,000
	No. 1	1,000	675	800	170	570	1,100,000
	No. 2	625	400	550	170	570	900,000
SPRUCE-PINE-FIR SOUTH	Select Structural	1,000	675	700	125	335	1,200,000
	No. 1	800	550	625	125	335	1,200,000
	No. 2	475	325	425	125	335	1,000,000
WESTERN JUNIPER	Select Structural	1,250	675	350	115	770	500,000
	No. 1	1,000	550	300	115	770	500,000
	No. 2	600	325	200	115	770	400,000
WESTERN WOODS	Select Structural	1,000	675	800	125	345	1,100,000
	No. 1	800	525	700	125	345	1,100,000
	No. 2	475	325	475	125	345	900,000

All values are in psi. Values apply to lumber under protected conditions. For other use conditions, see section 200-h.

### STRESSES ILLUSTRATED

#### 200-m. EXTREME FIBER IN BENDING - “F<sub>b</sub>” AND HORIZONTAL SHEAR - “F<sub>v</sub>.”

In structures, the stress grades of lumber used are Light Framing, Joists & Planks and Beams & Stringers. These members may carry loads on spans between supports and the lumber is stressed internally to the extent required to resist the external load. The loads cause pieces to bend, producing tension in the extreme fibers along the face farthest from the applied load and compression in the extreme fibers along the face nearest to the applied load. At the same time, over each support, there is a stress that tends to slide the fibers over each other horizontally. This action is similar to the way the ends of playing cards slide over each other when a deck is sharply bent. The internal force that resists this action is the horizontal shear value of the wood. The shearing stress is maximum at the center of the depth of the piece.

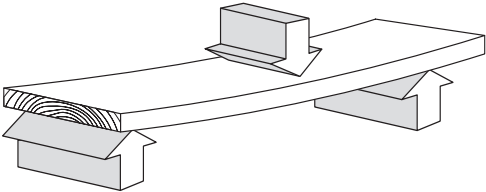


EXTREME FIBERS STRESSED IN BENDING AND HORIZONTAL SHEAR

### MODULUS OF ELASTICITY

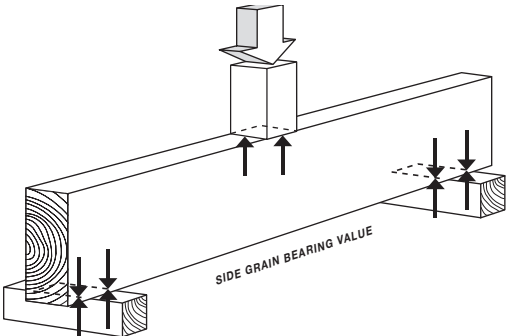
#### MODULUS OF ELASTICITY - "E":

The relationship between the amount a piece deflects and the load causing the deflection determines its stiffness. This is called the modulus of elasticity of the species. A piece may deflect slightly or a lot depending on its size, the span, the load and the modulus of elasticity for the particular species. A large deflection is not necessarily a sign of insufficient strength. For example: the floors of a residence are usually limited to a deflection 1/360th of the span, or less, while a scaffold plank may deflect substantially more.

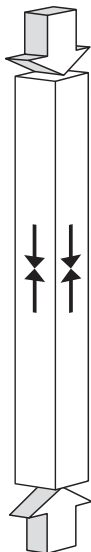


#### COMPRESSION PERPENDICULAR TO GRAIN - " $F_c \perp$ ":

Where a joist, beam or similar piece of lumber bears on supports, the loads tend to compress the fibers. It is therefore necessary that the bearing area is sufficient to prevent side grain crushing.







### COMPRESSION PARALLEL TO GRAIN - "F<sub>c</sub>":

In many parts of a structure, stress-grades are used as POSTS & TIMBERS with the loads supported on the ends of the pieces. Such uses are as studs, posts, columns and struts. LIGHT FRAMING JOISTS & PLANKS and BEAMS & STRINGERS can also be used in this manner.

The internal stress induced by this kind of loading is the same across the whole cross-section and the fibers are uniformly stressed parallel to and along the full length of the piece.

**COMPRESSION  
PARALLEL  
TO GRAIN**

7

## MEASUREMENT OF KNOTS

**201. GENERAL.** The sum of the sizes of all knots in any 6" of length of a piece must not exceed twice the size of the largest knot permitted. More than one knot of maximum permissible size must not be in the same 6" of length and the combination of knots must not be serious.

(Illustrations on the following pages are examples only. Judgment must be used in measuring the many different knots that occur in natural growth for equivalent effect on a piece.)