

TECHNICAL NOTE NUMBER 201

FOREST PRODUCTS LABORATORY - U. S. FOREST SERVICE - MADISON, WISCONSIN

WORKING STRESSES FOR STRUCTURAL TIMBERS

The working stresses for structural timbers of various species given here are the result of a long series of tests by the Forest Products Laboratory at Madison, Wisconsin, on small clear specimens and timbers containing defects. They are applicable to beams, joists, girders, and short columns graded in accordance with the Forest Service basic grading rules for structural timbers. (See Forest Products Laboratory Technical Note 200.) Commercial grading rules were found in general to be too indefinite in their limitations of the size, number, and location of defects to make it practical to establish working stresses for them, even if tests could be carried out on every grade found in the local markets.

The stresses given in the table are for timbers of the Forest Service base grade, Select (S2). From them the stresses permissible for the other three basic grades can be easily computed. With Extra Select (S1) timbers of any species a stress $7/6$ as large as the stress given in the table may be used. Standard (S3) timbers should be subjected to only $5/6$ the listed stress. Common (S4) timbers can take only $4/6$ the stress given for Select (S2). The working stresses of the different grades of Douglas fir and southern yellow pine can be increased one-sixth the allowable stress given in the table for the basic or Select (S2) grade, if the material meets the density requirements of the American Society of Testing Materials.

A "factor of safety" adjustment of the test values has been made to take care of the loss in strength from defects, the effect of long continued loads, the variation of individual pieces from the average, and the possibility of slight accidental overloading. It is evident that a large part of this "factor of safety"

is required to correlate laboratory test results with actual conditions of use, and only a small part of it may be considered a true factor of safety. The application of a load which would produce three times the working stress given as allowable would be expected to cause the immediate failure of some of the timbers and the ultimate failure of 75 per cent of them. In fact, the application of loads which would produce stresses only one and one-half times the working stresses recommended would be expected to cause occasional failures if the loads were left on for any great length of time.

WORKING STRESSES PERMISSIBLE FOR STRUCTURAL TIMBERS OF SELECT (S2) GRADE¹

(pounds per square inch)

Species	Bending			Compression				
	Allowable stress in extreme fiber for Select (S2) grade		Allowable stress in horizontal section (S2) grade All locations	Allowable stress parallel to grain		Allowable stress perpendicular to grain for all grades		
	Under stress in dry location (normal and warehouse)	Under stress in wet location (normal and warehouse)		Wet location	Dry outside location	Dry inside location	Wet location	Dry outside location
Ash, black	800	900	90	500	560	560	160	200
Ash, commercial white (green, bluish, white)	1000	1200	135	900	1000	1100	260	376
Aspen and larchtooth aspen	800	800	80	450	560	560	100	150
Balsam poplar	800	800	80	450	560	560	100	150
Beech	1000	1200	135	900	1100	1200	200	275
Birch, paper	600	750	80	450	560	560	100	150
Birch, yellow and aspen	1000	1200	135	900	1000	1100	260	376
Birch, white	800	900	90	450	560	560	100	150
Cedar, western red	750	800	80	450	560	560	100	150
Cedar, northern and southern white	600	650	70	450	560	560	100	150
Cedar, Port Orford	900	1000	100	750	850	900	160	200
Cherry	700	850	80	450	560	560	100	150
Cottonwood	800	900	90	450	560	560	100	150
Cypress, white	1000	1200	135	900	1000	1100	260	376
Douglas fir (western Washington and Oregon)	1000	1200	135	900	1000	1100	260	376
Douglas fir (Rocky Mountain type)	700	800	80	450	560	560	100	150
Elm, coast	1000	1200	135	900	1000	1100	260	376
Elm, white	800	900	90	450	560	560	100	150
Elm, yellow and white	700	800	80	450	560	560	100	150
Elm, white	800	900	90	450	560	560	100	150
Elm, commercial white (white, noble, green)	800	900	90	450	560	560	100	150
Gum, black and cotton	800	900	90	450	560	560	100	150
Gum, red	800	900	90	450	560	560	100	150
Hemlock, western	900	1100	100	650	750	800	160	200
Hemlock, (eastern)	800	900	90	450	560	560	100	150
Ketchikan, (true and false)	1200	1400	140	1000	1200	1300	280	400
Larch, western	900	1100	100	650	750	800	160	200
Larch, sugar and black	1000	1200	135	900	1000	1100	260	376
Larch, white	800	900	90	450	560	560	100	150
Oak, commercial red and white	1000	1200	135	900	1000	1100	260	376
Pine, southern yellow	1000	1200	135	900	1000	1100	260	376
Pine, white, sugar, western white, western yellow	750	800	80	450	560	560	100	150
Pine, white	800	900	90	450	560	560	100	150
Pine, yellow	800	900	90	450	560	560	100	150
Redwood, yellow	800	900	90	450	560	560	100	150
Redwood, red, white, 33lb	800	900	90	450	560	560	100	150
Spruce, Engelmann	500	550	55	350	400	450	80	120
Spruce, white	800	900	90	450	560	560	100	150
Spruce, (eastern)	950	1100	100	650	750	800	160	200

¹ Working stresses for Extra Select (S1), Extra Select (S1), and Common (S4) grades are obtained by multiplying the basic stress by 7/6, 8/6, 9/6, and 4/6 respectively.

² The influence of knots on compressive strength of columns of constant cross section decreases as the length increases. When the length reaches 30 times the least dimension, knots such as are allowable in Select (S2) timbers have no effect on the strength as a column.

³ The working stresses of any grade of timbers of Douglas fir and southern yellow pine which meet the density requirements of the American Society of Testing Materials shall be increased one-fourth the allowable stress given in the table for the basic or Select (S2) grade.