

LUMBER DESIGN VALUES AND FRAMING SPANS

FOR DOUGLAS FIR-LARCH, HEM-FIR, SOUTHERN PINE AND SPRUCE-PINE-FIR



Lumber Design Values and Framing Spans

Wood framing is the material of choice for residential construction and is increasing its market share in non-residential construction. Wood frame construction design often relies on the lumber design values and allowable span tables published in building codes and standards, as well as in industry technical publications. The most commonly used lumber species groups are Douglas Fir-Larch, Hem-Fir, and Southern Pine, grown in the U.S. and Canadian Spruce-Pine-Fir.

Selected lumber design values and span tables for these species groups are provided in this publication. Comprehensive information for Western species lumber products (Douglas Fir-Larch, Douglas Fir South, Hem-Fir, Spruce-Pine-Fir South, Western Cedars and Western Woods) can be found at www.wwpa.org.

Lumber Design Values

Structural lumber design values are assigned by Western Wood Products Association and other lumber rules-writing agencies according to ASTM Standards. Each agency develops and maintains the design values for the species in its region. Full-size lumber samples collected from lumber mills representative of the products going to the marketplace are tested. The design values are published by the lumber rules-writing agencies after the test results and the derived design values are reviewed by the USDA Forest Products Laboratory and approved by the Board of Review of the American Lumber Standard Committee.

Western Species Lumber Testing

The testing of Western species lumber is conducted periodically to monitor the reliability of the published design values, and to allow for timely actions to be taken, if needed, to support Western lumber products.

WWPA Resource Library

The publications can be downloaded from the WWPA Online Resource Library. The Resource Library is a comprehensive digital repository designed to support the design, specification, and application of Western Lumber. It offers a wide variety of materials, including product and technical support literature, grade rules, and design tools. Users, such as architects, engineers, builders, and retailers, can locate resources by filtering categories such as Resource Usage (Design, Specifying, Installation, Lumber Grading), Topic, Product and Species.

Much of the technical information, such as Design Load Tables for Solid-Sawn Lumber Beams and Headers, is available as free PDF downloads, providing essential data for structural and nonstructural uses of Western softwood lumber. Visit www.wwpa.org/resources.



Lumber Design Values

LUMBER DESIGN VALUES IN POUNDS PER SQUARE INCH – 2X4 AND 2X10 SIZES ONLY

SIZE	SPECIES	GRADE	Extreme Fiber Stress in Bending	Tension Parallel to Grain	Horizontal Shear	Compression		Modulus of Elasticity
			F_b	F_t	F_v	Perpendicular to Grain	Parallel to Grain	
						$F_{c\perp}$	$F_{c\parallel}$	E
2x4	Douglas Fir-Larch	Select Structural	2250	1500	180	625	1955	1,900,000
		No. 1 & Btr.	1800	1200	180	625	1785	1,800,000
		No. 1	1500	1015	180	625	1725	1,700,000
		No. 2	1350	865	180	625	1555	1,600,000
		No. 3	790	490	180	625	890	1,400,000
		Construction	1000	650	180	625	1650	1,500,000
		Standard	575	375	180	625	1400	1,400,000
		Utility	275	175	180	625	900	1,300,000
	Stud	770	495	180	625	895	1,400,000	
	Hem-Fir	Select Structural	2100	1390	150	405	1725	1,600,000
		No. 1 & Btr.	1650	1090	150	405	1555	1,500,000
		No. 1	1465	940	150	405	1555	1,500,000
		No. 2	1275	790	150	405	1495	1,300,000
		No. 3	750	450	150	405	835	1,200,000
		Construction	975	600	150	405	1550	1,300,000
		Standard	550	325	150	405	1300	1,200,000
		Utility	250	150	150	405	850	1,100,000
	Stud	745	440	150	405	840	1,200,000	
	Southern Pine	Dense Select Structural	2700	1900	175	660	2050	1,900,000
		Select Structural	2350	1650	175	565	1900	1,800,000
		Non-Dense Select Structural	2050	1450	175	480	1800	1,600,000
		No. 1 Dense	1650	1100	175	660	1750	1,800,000
		No. 1	1500	1000	175	565	1650	1,600,000
		No. 1 Non-Dense	1300	875	175	480	1550	1,400,000
		No. 2 Dense	1200	750	175	660	1500	1,600,000
		No. 2	1100	675	175	565	1450	1,400,000
		No. 2 Non-Dense	1050	600	175	480	1450	1,300,000
		No. 3/Stud	650	400	175	565	850	1,300,000
		Construction	875	500	175	565	1600	1,400,000
		Standard	475	275	175	565	1300	1,200,000
Utility	225	125	175	565	850	1,200,000		
Spruce-Pine-Fir	Select Structural	1875	1050	135	425	1610	1,500,000	
	No. 1/No. 2	1310	675	135	425	1320	1,400,000	
	No. 3	750	375	135	425	745	1,200,000	
	Construction	1000	500	135	425	1400	1,300,000	
	Standard	550	275	135	425	1150	1,200,000	
	Utility	275	125	135	425	750	1,100,000	
Stud	740	385	135	425	760	1,200,000		
2x10	Douglas Fir-Larch	Select Structural	1650	1100	180	625	1700	1,900,000
		No. 1 & Btr.	1320	880	180	625	1550	1,800,000
		No. 1	1100	745	180	625	1500	1,700,000
		No. 2	990	635	180	625	1350	1,600,000
		No. 3/Stud	580	360	180	625	775	1,400,000
	Hem-Fir	Select Structural	1540	1020	150	405	1500	1,600,000
		No. 1 & Btr.	1210	800	150	405	1350	1,500,000
		No. 1	1075	690	150	405	1350	1,500,000
		No. 2	935	580	150	405	1300	1,300,000
		No. 3/Stud	550	330	150	405	725	1,200,000
	Southern Pine	Dense Select Structural	1950	1300	175	660	1800	1,900,000
		Select Structural	1700	1150	175	565	1650	1,800,000
		Non-Dense Select Structural	1500	1050	175	480	1600	1,600,000
		No. 1 Dense	1200	800	175	660	1550	1,800,000
		No. 1	1050	700	175	565	1450	1,600,000
		No. 1 Non-Dense	950	625	175	480	1400	1,400,000
		No. 2 Dense	850	525	175	660	1350	1,600,000
		No. 2	800	475	175	565	1300	1,400,000
		No. 2 Non-Dense	750	425	175	480	1250	1,300,000
	No. 3/Stud	475	275	175	565	750	1,300,000	
	Spruce-Pine-Fir	Select Structural	1375	770	135	425	1400	1,500,000
		No. 1/No. 2	960	495	135	425	1150	1,400,000
		No. 3/Stud	550	275	135	425	650	1,200,000

Lumber Framing Spans

MAXIMUM ALLOWABLE LUMBER FRAMING SPANS

FLOOR JOISTS

40# LIVE LOAD 10# DEAD LOAD L/360

Design Criteria: Strength - 40 lbs. per sq. ft. live load, plus 10 lbs. per sq. ft. dead load. Deflection - Limited in span in inches divided by 360 for live load only.

Species or Group		Grade		Span (feet and inches)															
				2 x 6				2 x 8				2 x 10				2 x 12			
				spacing on center															
		12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"		
Douglas Fir-Larch	Sel. Struc.	11-4	10-4	9-8	9-0	15-0	13-7	12-10	11-11	19-1	17-4	16-4	15-2	23-3	21-1	19-10	18-5		
	No.1 & Btr.	11-2	10-2	9-6	8-10	14-8	13-4	12-7	11-8	18-9	17-0	16-0	14-9	22-10	20-9	19-1	17-1		
	No.1	10-11	9-11	9-4	8-8	14-5	13-1	12-4	11-0	18-5	16-5	15-0	13-5	22-0	19-1	17-5	15-7		
	No.2	10-9	9-9	9-2	8-3	14-2	12-9	11-8	10-5	18-0	15-7	14-3	12-9	20-11	18-1	16-6	14-9		
Hem-Fir	Sel. Struc.	10-9	9-9	9-2	8-6	14-2	12-10	12-1	11-3	18-0	16-5	15-5	14-4	21-11	19-11	18-9	17-5		
	No.1 & Btr.	10-6	9-6	9-0	8-4	13-10	12-7	11-10	11-0	17-8	16-0	15-1	14-0	21-6	19-6	18-3	16-4		
	No.1	10-6	9-6	9-0	8-4	13-10	12-7	11-10	10-10	17-8	16-0	14-10	13-3	21-6	18-10	17-2	15-5		
	No.2	10-0	9-1	8-7	7-11	13-2	12-0	11-3	10-2	16-10	15-2	13-10	12-5	20-4	17-7	16-1	14-4		
Southern Pine	Sel. Struc.	11-4	10-4	9-8	9-0	15-0	13-7	12-10	11-11	19-1	17-4	16-4	15-2	23-3	21-1	19-10	18-5		
	ND Sel. Struc.	11-2	10-2	9-6	8-10	14-8	13-4	12-7	11-8	18-9	17-0	16-0	14-11	22-10	20-9	19-6	18-1		
	No.1 D	10-9	9-9	9-2	8-6	14-2	12-10	12-1	11-3	18-0	16-5	15-5	14-4	21-11	19-11	18-9	17-5		
	No.1	11-2	10-2	9-6	8-10	14-8	13-4	12-7	11-8	18-9	17-0	15-8	14-0	22-10	20-0	18-3	16-4		
	No.1 ND	10-9	9-9	9-2	8-6	14-2	12-10	12-1	11-3	18-0	16-1	14-8	13-1	21-11	19-1	17-5	15-7		
	No.2 D	10-3	9-4	8-9	8-2	13-6	12-3	11-7	10-6	17-3	15-3	13-11	12-6	20-11	18-1	16-6	14-9		
	No.2	10-9	9-7	8-9	7-10	14-0	12-2	11-1	9-11	16-8	14-6	13-2	11-10	19-8	17-1	15-7	13-11		
	No.2 ND	10-3	9-4	8-6	7-7	13-6	11-10	10-10	9-8	16-2	14-0	12-10	11-5	19-1	16-6	15-1	13-6		
	No.3	10-0	9-1	8-4	7-5	13-2	11-6	10-6	9-5	15-8	13-7	12-5	11-1	18-5	16-0	14-7	13-0		
	Spruce-Pine-Fir	Sel. Struc.	10-6	9-6	9-0	8-4	13-10	12-7	11-10	11-0	17-8	16-0	15-1	14-0	21-6	19-6	18-4	17-0	
No.1/No.2	10-3	9-4	8-9	8-1	13-6	12-3	11-6	10-3	17-3	15-5	14-1	12-7	20-7	17-10	16-3	14-7			
No.3	8-8	7-6	6-10	6-2	11-0	9-6	8-8	7-9	13-5	11-8	10-7	9-6	15-7	13-6	12-4	11-0			

FLOOR JOISTS

30# LIVE LOAD 10# DEAD LOAD L/360

Design Criteria: Strength - 30 lbs. per sq. ft. live load, plus 10 lbs. per sq. ft. dead load. Deflection - Limited in span in inches divided by 360 for live load only.

Species or Group		Grade		Span (feet and inches)															
				2 x 6				2 x 8				2 x 10				2 x 12			
				spacing on center															
		12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"		
Douglas Fir-Larch	Sel. Struc.	12-6	11-4	10-8	9-11	16-6	15-0	14-1	13-1	21-0	19-1	18-0	16-8	25-7	23-3	21-10	20-3		
	No.1 & Btr.	12-3	11-2	10-6	9-9	16-2	14-8	13-10	12-10	20-8	18-9	17-8	16-5	25-1	22-10	21-4	19-1		
	No.1	12-0	10-11	10-4	9-7	15-10	14-5	13-7	12-4	20-3	18-5	16-9	15-0	24-8	21-4	19-6	17-5		
	No.2	11-10	10-9	10-1	9-3	15-7	14-2	13-0	11-8	19-10	17-5	15-11	14-3	23-4	20-3	18-6	16-6		
Hem-Fir	Sel. Struc.	11-10	10-9	10-1	9-4	15-7	14-2	13-4	12-4	19-10	18-0	17-0	15-9	24-2	21-11	20-8	19-2		
	No.1 & Btr.	11-7	10-6	9-10	9-2	15-3	13-10	13-0	12-1	19-5	17-8	16-7	15-5	23-7	21-6	20-2	18-3		
	No.1	11-7	10-6	9-10	9-2	15-3	13-10	13-0	12-1	19-5	17-8	16-7	14-10	23-7	21-1	19-3	17-2		
	No.2	11-0	10-0	9-5	8-9	14-6	13-2	12-5	11-4	18-6	16-10	15-6	13-10	22-6	19-8	17-11	16-1		
Southern Pine	Sel. Struc.	12-6	11-4	10-8	9-11	16-6	15-0	14-1	13-1	21-0	19-1	18-0	16-8	25-7	23-3	21-10	20-3		
	ND Sel. Struc.	12-3	11-2	10-6	9-9	16-2	14-8	13-10	12-10	20-8	18-9	17-8	16-5	25-1	22-10	21-6	19-11		
	No.1 D	11-10	10-9	10-1	9-4	15-7	14-2	13-4	12-4	19-10	18-0	17-0	15-9	24-2	21-11	20-8	19-2		
	No.1	12-3	11-2	10-6	9-9	16-2	14-8	13-10	12-10	20-8	18-9	17-6	15-8	25-1	22-4	20-5	18-3		
	No.1 ND	11-10	10-9	10-1	9-4	15-7	14-2	13-4	12-4	19-10	18-0	16-5	14-8	24-2	21-4	19-6	17-5		
	No.2 D	11-3	10-3	9-8	8-11	14-11	13-6	12-9	11-9	19-0	17-1	15-7	13-11	23-1	20-3	18-6	16-6		
	No.2	11-10	10-8	9-9	8-9	15-7	13-7	12-5	11-1	18-8	16-2	14-9	13-2	22-0	19-1	17-5	15-7		
	No.2 ND	11-3	10-3	9-6	8-6	14-11	13-3	12-1	10-10	18-1	15-8	14-4	12-10	21-4	18-6	16-10	15-1		
	No.3	11-0	10-0	9-3	8-4	14-6	12-10	11-9	10-6	17-6	15-2	13-10	12-5	20-7	17-10	16-3	14-7		
	Spruce-Pine-Fir	Sel. Struc.	11-7	10-6	9-10	9-2	15-3	13-10	13-0	12-1	19-5	17-8	16-7	15-5	23-7	21-6	20-2	18-9	
No.1/No.2	11-3	10-3	9-8	8-11	14-11	13-6	12-9	11-6	19-0	17-2	15-8	14-1	23-0	19-11	18-3	16-3			
No.3	9-8	8-5	7-8	6-10	12-4	10-8	9-9	8-8	15-0	13-0	11-10	10-7	17-5	15-1	13-9	12-4			

Lumber Framing Spans

MAXIMUM ALLOWABLE LUMBER FRAMING SPANS

CEILING JOISTS

20# LIVE LOAD 10# DEAD LOAD L/240

Design Criteria: Strength - 20 lbs. per sq. ft. live load, plus 10 lbs. per sq. ft. dead load. Deflection - Limited in span in inches divided by 240 for live load only.

Species or Group		Grade		Span (feet and inches)															
				2 x 4				2 x 6				2 x 8				2 x 10			
				spacing on center															
12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"				
Douglas Fir-Larch	Sel. Struc.	10-5	9-6	8-11	8-3	16-4	14-11	14-0	13-0	21-7	19-7	18-5	17-2	27-6	25-0	23-7	21-3		
	No.1 & Btr.	10-3	9-4	8-9	8-1	16-1	14-7	13-9	12-3	21-2	19-1	17-5	15-7	26-10	23-3	21-3	19-0		
	No.1	10-0	9-1	8-7	7-8	15-9	13-9	12-6	11-2	20-1	17-5	15-10	14-2	24-6	21-3	19-5	17-4		
	No.2	9-10	8-11	8-2	7-3	15-0	13-0	11-11	10-8	19-1	16-6	15-1	13-6	23-3	20-2	18-5	16-5		
Hem-Fir	No.3	7-10	6-10	6-2	5-7	11-6	9-11	9-1	8-1	14-7	12-7	11-6	10-3	17-9	15-5	14-1	12-7		
	Sel. Struc.	9-10	8-11	8-5	7-10	15-6	14-1	13-3	12-3	20-5	18-6	17-5	16-2	26-0	23-8	22-3	20-6		
	No.1 & Btr.	9-8	8-9	8-3	7-8	15-2	13-9	12-11	11-9	19-11	18-2	16-8	14-11	25-5	22-3	20-4	18-2		
	No.1	9-8	8-9	8-3	7-7	15-2	13-7	12-4	11-1	19-10	17-2	15-8	14-0	24-3	21-0	19-2	17-1		
Southern Pine	No.2	9-2	8-4	7-10	7-1	14-5	12-8	11-7	10-4	18-6	16-0	14-8	13-1	22-7	19-7	17-10	16-0		
	No.3	7-8	6-8	6-1	5-5	11-2	9-8	8-10	7-11	14-2	12-4	11-3	10-0	17-4	15-0	13-8	12-3		
	D Sel. Struc.	10-5	9-6	8-11	8-3	16-4	14-11	14-0	13-0	21-7	19-7	18-5	17-2	27-6	25-0	23-7	21-10		
	Sel. Struc.	10-3	9-4	8-9	8-1	16-1	14-7	13-9	12-9	21-2	19-3	18-2	16-10	27-1	24-7	23-1	21-6		
	ND Sel. Struc.	9-10	8-11	8-5	7-10	15-6	14-1	13-3	12-3	20-5	18-6	17-5	16-2	26-0	23-8	22-3	20-3		
	No.1 D	10-3	9-4	8-9	8-0	16-1	14-7	13-6	12-0	21-2	18-5	16-10	15-1	25-7	22-2	20-3	18-1		
	No.1	9-10	8-11	8-5	7-8	15-6	14-0	12-9	11-5	20-5	17-9	16-2	14-6	23-11	20-9	18-11	16-11		
	No.1 ND	9-5	8-7	8-0	7-2	14-9	13-2	12-0	10-9	19-3	16-8	15-2	13-7	22-9	19-9	18-0	16-1		
	No.2 D	9-8	8-5	7-8	6-10	14-3	12-4	11-3	10-1	18-1	15-8	14-4	12-10	21-7	18-8	17-0	15-3		
	No.2	9-3	8-0	7-4	6-7	13-11	12-0	11-0	9-10	17-7	15-3	13-11	12-6	20-11	18-1	16-6	14-9		
Spruce-Pine-Fir	No.2 ND	9-1	7-10	7-2	6-5	13-7	11-9	10-9	9-7	17-2	14-10	13-7	12-1	20-3	17-6	16-0	14-4		
	No.3	7-2	6-2	5-8	5-1	10-7	9-2	8-4	7-5	13-3	11-6	10-6	9-5	16-1	13-11	12-9	11-5		
	Sel. Struc.	9-8	8-9	8-3	7-8	15-2	13-9	12-11	12-0	19-11	18-2	17-1	15-10	25-5	23-2	21-8	19-5		
	No.1/No.2	9-5	8-7	8-0	7-2	14-9	12-10	11-9	10-6	18-9	16-3	14-10	13-3	22-11	19-10	18-2	16-3		
No.3	7-8	6-8	6-1	5-5	11-2	9-8	8-10	7-11	14-2	12-4	11-3	10-0	17-4	15-0	13-8	12-3			

ROOF RAFTERS

30# SNOW LOAD 10# DEAD LOAD L/240

Design Criteria: Strength - 30 lbs. per sq. ft. snow load, plus 10 lbs. per sq. ft. dead load. Deflection - Limited in span in inches divided by 240 for live load only.

Species or Group		Grade		Span (feet and inches)															
				2 x 6				2 x 8				2 x 10				2 x 12			
				spacing on center															
12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"				
Douglas Fir-Larch	Sel. Struc.	14-4	13-0	12-3	11-4	18-10	17-2	16-1	15-0	24-1	21-10	20-7	19-1	29-3	26-7	25-0	22-10		
	No.1 & Btr.	14-1	12-9	12-0	11-2	18-6	16-10	15-10	14-5	23-8	21-6	19-9	17-8	28-9	25-1	22-10	20-5		
	No.1	13-9	12-6	11-8	10-5	18-2	16-2	14-9	13-2	22-9	19-9	18-0	16-1	26-5	22-10	20-11	18-8		
	No.2	13-6	12-1	11-0	9-10	17-8	15-4	14-0	12-6	21-7	18-9	17-1	15-3	25-1	21-8	19-10	17-9		
Hem-Fir	No.3	10-8	9-3	8-5	7-7	13-6	11-8	10-8	9-7	16-6	14-3	13-1	11-8	19-2	16-7	15-2	13-6		
	Sel. Struc.	13-6	12-3	11-7	10-9	17-10	16-2	15-3	14-2	22-9	20-8	19-5	18-0	27-8	25-1	23-7	21-11		
	No.1 & Btr.	13-3	12-0	11-4	10-6	17-5	15-10	14-11	13-10	22-3	20-2	18-11	16-11	27-1	24-0	21-11	19-7		
	No.1	13-3	12-0	11-4	10-3	17-5	15-10	14-7	13-0	22-3	19-6	17-9	15-11	26-1	22-7	20-7	18-5		
Southern Pine	No.2	12-7	11-5	10-9	9-7	16-7	14-11	13-7	12-2	21-0	18-2	16-7	14-10	24-4	21-1	19-3	17-3		
	No.3	10-5	9-0	8-3	7-4	13-2	11-5	10-5	9-4	16-1	13-11	12-9	11-5	18-8	16-2	14-9	13-2		
	D Sel. Struc.	14-4	13-0	12-3	11-4	18-10	17-2	16-1	15-0	24-1	21-10	20-7	19-1	29-3	26-7	25-0	23-3		
	Sel. Struc.	14-1	12-9	12-0	11-2	18-6	16-10	15-10	14-8	23-8	21-6	20-2	18-9	28-9	26-1	24-7	22-10		
	ND Sel. Struc.	13-6	12-3	11-7	10-9	17-10	16-2	15-3	14-2	22-9	20-8	19-5	18-0	27-8	25-1	23-7	21-11		
	No.1 D	14-1	12-9	12-0	11-2	18-6	16-10	15-8	14-0	23-8	20-7	18-10	16-10	27-8	24-0	21-11	19-7		
	No.1	13-6	12-3	11-7	10-7	17-10	16-2	15-1	13-5	22-3	19-3	17-7	15-9	26-5	22-10	20-11	18-8		
	No.1 ND	12-11	11-9	11-1	10-0	17-0	15-5	14-1	12-7	21-2	18-4	16-9	15-0	25-1	21-8	19-10	17-9		
	No.2 D	13-3	11-5	10-6	9-4	16-10	14-7	13-3	11-11	20-0	17-4	15-10	14-2	23-7	20-5	18-8	16-8		
	No.2	12-11	11-2	10-2	9-2	16-4	14-2	12-11	11-7	19-5	16-10	15-4	13-9	22-10	19-10	18-1	16-2		
Spruce-Pine-Fir	No.2 ND	12-7	10-11	9-11	8-11	15-11	13-9	12-7	11-3	18-10	16-3	14-10	13-4	22-1	19-2	17-6	15-7		
	No.3	9-9	8-6	7-9	6-11	12-4	10-8	9-9	8-9	15-0	13-0	11-10	10-7	17-9	15-4	14-0	12-6		
	Sel. Struc.	13-3	12-0	11-4	10-6	17-5	15-10	14-11	13-10	22-3	20-2	19-0	17-8	27-1	24-7	23-1	20-11		
	No.1/No.2	12-11	11-9	10-11	9-9	17-0	15-1	13-9	12-4	21-4	18-5	16-10	15-1	24-8	21-5	19-6	17-6		
No.3	10-5	9-0	8-3	7-4	13-2	11-5	10-5	9-4	16-1	13-11	12-9	11-5	18-8	16-2	14-9	13-2			