

USING THESE TABLES

The primary purpose of this publication is to provide a convenient reference of joist and rafter spans for specific grades of Southern Pine lumber. The maximum spans provided in these tables were determined on the same basis as those given in the code-recognized *Span Tables for Joists and Rafters, 1993 Edition*, published by the American Forest & Paper Association (AFPA), formerly National Forest Products Association (NFPA). Southern Pine design values used in the calculations are based on the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition*, published by the Southern Pine Inspection Bureau (SPIB).

There are three general categories of span tables:

Floor Joists

Conventional loads	Tables 1-7	pages 8-11
Wet-service conditions	Tables 40-41	page 28
Heavy live loads	Tables 42-47	pages 29-31

Ceiling Joists

Conventional loads	Tables 8-9	page 12
--------------------	------------	---------

Rafters

Snow loads ($C_D = 1.15$)	Tables 10-33	pages 13-24
Construction loads ($C_D = 1.25$)	Tables 34-39	pages 25-27

General Requirements

The quality of wood products and fasteners and the design of load-supporting wood members and connections shall conform to the *National Design Specification® (NDS®)* published by AFPA (NFPA). All members shall be so framed, anchored, tied, and braced to have the necessary strength and rigidity. Adequate bracing and bridging to resist wind and other lateral forces shall be provided.

Design Loads

Assumed loading conditions are stated in the heading for each table. Live and dead loads are shown in psf (pounds per square foot). The provided range of loads accommodates the most common design loads used. Structures in heavy snow load areas should be analyzed thoroughly using accepted engineering practice. For rafters with roof live loads less than 20 psf, see AFPA's *Span Tables for Joists and Rafters* for adjustments.

The estimated dead loads for rafters are based on the type or amount of roof covering material. Tables are included for three common coverings:

Light roofing (10 psf dead load)

Up to 2 courses of asphalt shingles, or wood shakes/shingles

Medium roofing (15 psf dead load)

2" clay book tile

Heavy roofing (20 psf dead load)

3" clay book tile

All listed dead loads include the weight of the framing members.

Lumber Sizes

Computations for these span tables are based on net lumber dimensions (actual sizes), provided by the *American Softwood Lumber Standard PS 20-70*:

Nominal Size, inches	Actual Dry Size, inches
2 x 4	1-1/2 x 3-1/2
2 x 6	1-1/2 x 5-1/2
2 x 8	1-1/2 x 7-1/4
2 x 10	1-1/2 x 9-1/4
2 x 12	1-1/2 x 11-1/4

Spans

The maximum spans in these tables were computed using standard engineering design formulas for simple span beams with uniform loads. They assume installation of at least three joists or rafters spaced not more than 24" on center. The calculated spans assume fully supported members, properly sheathed and nailed on the top edge of the joist or rafter. They do not, however, include composite action of adhesive and sheathing.

Tabulated maximum spans are the distance from face to face of supports, and are given in feet and inches of horizontal projection of the member. This represents the actual length of horizontal members such as floor and ceiling joists. For sloping rafters, the span is also measured along the horizontal projection, with the chart on page 32 providing a convenient tool for calculating the corresponding sloping rafter length.

These span tables were calculated considering three design conditions:

Bending (flexure)

Deflection

Compression perpendicular-to-grain.

For live loads greater than 60 psf, an additional check for **shear parallel-to-grain** (horizontal shear) was included. Only the controlling length rounded to the nearest inch is shown in the tables. Listed spans in this publication have been limited to 26'-0" based on material availability. Southern Pine is commonly available in lengths up to 20'. Check sources of supply for longer lengths.

Almost all of the spans in these tables are intended for use in covered structures or where the moisture content in use does not exceed 19% for an extended period of time. Two wet-service floor joist tables, tables 40 and 41, are included for structures where the moisture content exceeds 19%.

Load Duration

Wood has the ability to carry substantially greater maximum loads for short durations than for long durations. Tabulated design values apply to normal loading conditions, and may be multiplied by a load duration factor, C_D , permitted by established engineering design criteria and building code regulations. This factor is covered in detail in the *NDS*, and summarized in the *Southern Pine Use Guide* available from the Southern Pine Marketing Council.

Floor and ceiling joists are based on the normal ten-year load duration which implies a load duration factor, C_D , of 1.0. For rafters, the load duration factor, C_D , is typically either 1.15 for two-month snow loads, or 1.25 for 7-day construction loads. Snow loads are presented in rafter tables 10-33, while construction loads are presented in rafter tables 34-39. All of these rafter tables are labeled to indicate the load duration factor used.

Deflection

Deflection may be the controlling factor in determining the member size required when appearance or rigidity is important. Control of floor vibration is another important reason to limit deflection.

Deflection limits are expressed as a fraction of the span length in inches, and consider only the live load in accordance with established engineering practice for the design of joists and rafters. The most generally used deflection limits are summarized below:

Application	Deflection Limit
Floor joists	$L/360$
Ceiling joists	$L/240$
Rafters: Drywall ceiling	$L/240$
Rafters: No finished ceiling	$L/180$

In cases where a stricter deflection limit is desired, and the length is controlled by the $L/360$ deflection limit, the tabulated span lengths may be multiplied by the factors shown below.

Deflection Limit	Adjustment Factor
$L/480$	0.91
$L/600$	0.84

Bending

Bending design values used assume a fully supported member, properly sheathed and nailed on one edge of the joist or rafter. The repetitive member use factor, C_r , of 1.15 was included, as allowed in the *NDS*. The load duration factor, C_D , was also applied as appropriate.

Compression Perpendicular-to-Grain

The compression perpendicular-to-grain check assumed a 2.0" bearing length and rarely controlled the maximum spans. An additional check should be made for shorter bearing lengths, such as for 1.5" ledgers.

Shear Parallel-to-Grain

For live loads greater than 60 psf, an additional check for shear parallel-to-grain was included. All loads within a distance from supports equal to the depth of the members were neglected when calculating the shear force, as allowed in the *NDS*.

Design Values

Spans in this publication are based on Southern Pine design values published in the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition*. The stress values and modulus of elasticity values assigned to dimension lumber in those rules are based on tests of full-size lumber conducted by SPIB in cooperation with the U.S. Forest Products Laboratory. The procedures set forth in the listed ASTM standards were followed in assigning these design values:

Standard Practice for Establishing Properties for Visually Graded Dimension Lumber from In-Grade Tests of Full Size Specimens, ASTM D1990-91.

Standard Test Methods for Establishing Clear Wood Strength Values, ASTM D2555-88.

Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber, ASTM D245-88.

Adjustment Factors

Tabulated SPIB design values were multiplied by appropriate adjustment factors to determine allowable design values. Adjustment factors used for these tables are:

Repetitive Member Factor, C_r : The bending design value, 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 centers, are not less than 3 in number and are joined by floor, roof or other load distributing element adequate to support the design load.

Load Duration Factor, C_D : Tabulated design values apply to normal load duration. Normal load duration contemplates a load that fully stresses a member to its allowable design value by the application of the full design load for a cumulative duration of approximately ten years. When the cumulative duration of the full maximum load does not exceed the specified time period, all tabulated design values except modulus of elasticity, E , and compression perpendicular-to-grain, $F_{c\perp}$, based on a deformation limit shall be multiplied by the appropriate load duration factor.

Wet Service Factor, C_M : When dimension lumber is used where moisture content will exceed 19 percent for an extended time period, design values shall be multiplied by the appropriate wet service factors.

The resulting allowable design values used to determine these Southern Pine maximum spans are listed in the table on page 7.