CARPENTRY AND FRAMING

INSPECTION NOTES

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UP TO CODE

Carpentry and Framing
Inspection Notes

INSPECTING COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL CONSTRUCTION

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The IBC Building Code's Purpose

"101.3 Intent. The purpose of this code is to provide minimum requirements to safeguard the public health, safety and general welfare. . . ."

INTERNATIONAL CODE COUNCIL

CONTENTS

CHAPTER 1
INTRODUCTION

Up to Code Inspectors Guides comprise a series of manuals covering different CSI construction procedures and standards for commercial and industrial projects. Although based on the IBC 2003 and IRC 2003 codes, these guides are not intended to replace these codes or any of the other model codes and/or specifications in the contract documents. The goal is for the Inspector and/or project site managers to use these guides as a basis for establishing his or her inspection guidelines, and for providing the client with a well-built project meeting the specifications. The convenient sizing of these guides allows the Inspector to carry them around in a pocket, making code and standards information readily accessible. Furthermore, our intent is for this reference tool to be instrumental in the construction of better buildings and to be a valuable training guide for those just entering the construction field. These guides are valuable tools for architects, engineers, project managers, tradespeople, and contractors, as well as inspectors.

THINK SAFETY AT ALL TIMES

CHAPTER 2
GENERAL CARPENTRY

SHOP DRAWINGS AND SAMPLES

- ❑ Check each contract for items requiring submission and approval of shop drawings. Items requiring shop drawings will vary with the contract. Items commonly requiring shop drawings include the following:
  - Exterior doors and frames
  - Window frames and nonstock windows
  - Completely assembled windows
  - Interior wood finish, when so specified
  - Finish stair work
  - All cabinet work
  - Roof trusses
  - Prefabricated items
- ❑ Remind the contractor that shop drawings must be submitted and approved prior to fabrication or delivery of materials.
- ❑ Remember that only certain shop drawings require owner approval and the others are submitted by the contractor for information only. The action required will be given on the submittal register. See that the appropriate action has been taken.

- ❑ Check that all shop drawings have been submitted prior to installation or use of the item.
- ❑ Check all work for conformance with the approved shop drawings.
- ❑ Remind contractor that all specified samples are required to be submitted and approved prior to delivery of materials to the site.
- ❑ Ensure that all approved samples received by the inspection forces are tagged as to type of use and location and stored in a readily accessible area of the field office.
- ❑ Check materials delivered to site against the approved samples.

LUMBER

Species and Grade

- ❑ Check the species and grade against that specified for each use. This information should be in the "Species and grade table" in the specifications.
- ❑ Verify that the species and grade meet the code requirements.

Grade Stamp

- ❑ Check both finish and structural lumber for grade stamp. The stamp or mark should

agree with the rule or standard under which the material is produced.

Defects

- ❑ Check defects against the appropriate grading rules found in the appropriate inspection agency publication. Obtain copies of the grading rules.
- ❑ Check lumber for tolerance of dimensions.
- ❑ Check lumber for imperfections in excess of those allowable, as regards the following:
  - Checks, splits, shake, pockets
  - Decay
  - Grain structure
  - Knots
  - Percentage of hardwood or sapwood
  - Wane (presence of bark or lack of wood)
  - Warp, crook, bow, cup

Full definitions of the above properties or defects and other grading considerations are included in most of the grading rules handbooks.

Moisture Content

- ❑ Check the specifications for the allowable moisture content of lumber at time of delivery and when installed.

- ❑ Check the moisture content of the lumber:
  (a) Moisture content can be readily checked in the field with a moisture meter.
  (b) Moisture content can be checked in a laboratory by the oven drying process.
- ❑ Ensure that lumber treated with a water-borne preservative has a moisture content not to exceed 19%.
- ❑ Ensure that exterior and interior finish lumber and flooring do not have more than 12% moisture at time of delivery and when installed.

STORAGE

Boards and Dimension Lumber

- ❑ Check that lumber is stored off of the ground in properly drained area.
- ❑ Ensure that the lumber is adequately covered and ventilated to prevent an increase in moisture content.
- ❑ Make sure the lumber is stacked to prevent warp.

Finish Lumber, Flooring, and Millwork

- ❑ Ensure materials are stored at the site only in weathertight sheds and at the risk of the contractor.

- ❑ Make sure materials are not brought into the building until the plaster is dry and the windows and doors are installed or temporary enclosures are provided.
- ❑ During the heating season, ensure permanent or temporary heating is provided.
- ❑ Make sure materials are not stored in areas of high humidity.

PRESERVATIVE TREATMENT

An affidavit may be required on preservative treatment wood, stating retention, paintability, drying time, surface deposit and moisture content. A proper grade-marking identification in accordance with AWPB standards is required for all pressure treated lumber.

- ❑ Check for "Approved Grading Agency" and grade on treated lumber. Lumber with waterborne treatment will also be marked "Dry" indicating a moisture content of 19%.
- ❑ Ensure that when bottoms of the floor joist are 18 in. or less from the earth, they are pressure treated.
- ❑ Ensure that when bottoms of girders are 12 in. or less from the earth, they are pressure treated.

- ❑ Check that exterior wood steps, platforms, and railings are pressure treated.
- ❑ Check that wood members set in concrete are pressure treated.
- ❑ Check that wood is pressure treated when used for the following:
  - Wood sleepers
  - Furring strips attached to interior face of exterior walls
  - All furring used below grade
- ❑ Make sure that creosote pressure-treated wood is limited in use for material in contact with soil or water.
- ❑ Use only water-borne pressure-treated wood in contact with built-up roofing materials.
- ❑ Check specifications for requirement of pressure preservative treatment on exterior millwork.
- ❑ Check to be sure that cut surfaces are brush coated with the same preservative treatment.

GENERAL FRAMING

- ❑ Check framing for accuracy of line, level, fabrication, and fitting. Exterior wall studs should be checked for plumb and alignment before exterior masonry work is begun.

- ❏ Check connection and method of rigidly securing all members. Use NFPA's "Manual for House Nailing" for recommended nailing schedule. Do not allow overnailing.
- ❏ Ensure that all joist hanger, beam hangers, and connectors are properly installed with all holes nailed. Verify manufacturers mounting instructions.
- ❏ Carefully check for first class workmanship as compared with applicable requirements of the American Institute of Timber Construction Publication.
- ❏ Do not permit the arbitrary cutting or notching of framing members.
- ❏ Check the framing of all openings with appropriate schedules.
- ❏ Check to see that a 2-in. space is maintained between chimney and lumber.
- ❏ Combustionable sheathing can only butt up to masonry if it is a minimum of 12" from the firebox.
- ❏ Check for the leveling of girders or joist on masonry and concrete with steel shims and do not allow the use of wood shims on wood or metal bearings.
- ❏ For framing details, check with specifications and with contract and/or shop drawings.

CHAPTER 3
CRAWL SPACE AND BASEMENT FRAMING

- ❑ Check that pressure-treated wood is used for the following:
  - Sills <8 in. from ground
  - Girders <12 in. from ground
  - Joists <18 in. from ground
- ❑ Ensure that all sills, sleepers, and furring strips are on concrete.
- ❑ Ensure that ends of girders are in concrete and masonry having less than ½-in. clearance on ends, sides and top.
- ❑ Ensure that pressure-treated wood is retreated in the field when cut!
- ❑ Check that treated lumber conforms to Doc Ps 20-70.

FOUNDATION ANCHORS

Refer to Figure 3-1 for details on foundation anchor bolts in block or concrete. If straps are used in lieu of bolts the spacing (which is usually 3–3½ ft) needs to be adjusted as per the manufacturer's directions.

When checking anchorage, ensure affirmative responses to the following:

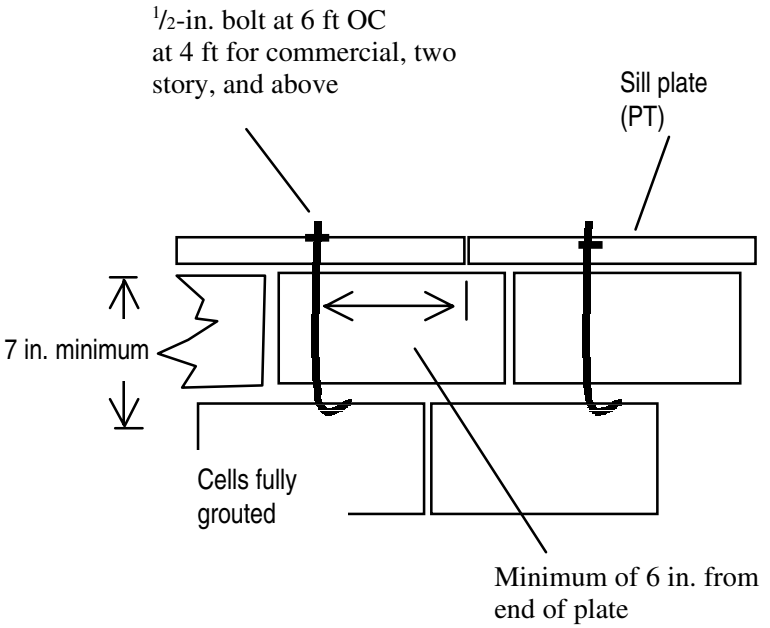


Figure 3-1 FOUNDATION ANCHOR BOLTS IN BLOCK OR CONCRETE

- ❑ Is anchorage provided near the end of each section of sill or nailer as well as at the specified spacing?
- ❑ Are anchors the correct size? Spacing?
- ❑ If anchor straps are used are they the correct size and spaced according to the manufacturer's instructions? Most anchor straps must be bent before being placed in the concrete or mortar.
- ❑ Are ends of every sill plate anchored as specified (12 in.)?
- ❑ Are anchors provided for window frames and door bucks?

- ❑ Are anchors provided for wood sleepers?
- ❑ Are anchors provided for plates on concrete floors?
- ❑ Are anchors provided for end studs of partitions abutting masonry?
- ❑ Are anchors embedded far enough in concrete or block?

COLUMNS AND POSTS

Refer to Figure 3-2 for anchoring requirements. See Tables 3-1 and 3-2 for calculating loads on steel columns and wood posts.

- ❑ Ensure that wood columns are at least 4 in. by 4 in. nominal.
- ❑ Ensure that steel columns are at least 3 in. in diameter.
- ❑ Ensure that steel columns are primed or painted both inside and outside.
- ❑ Check that metal post poles and columns in contact with concrete are primed.
- ❑ Check that wood columns, posts, and poles supporting structures and embedded in concrete are pressure treated.
- ❑ Check that cripple walls above 4 ft meet size requirements for an additional story.

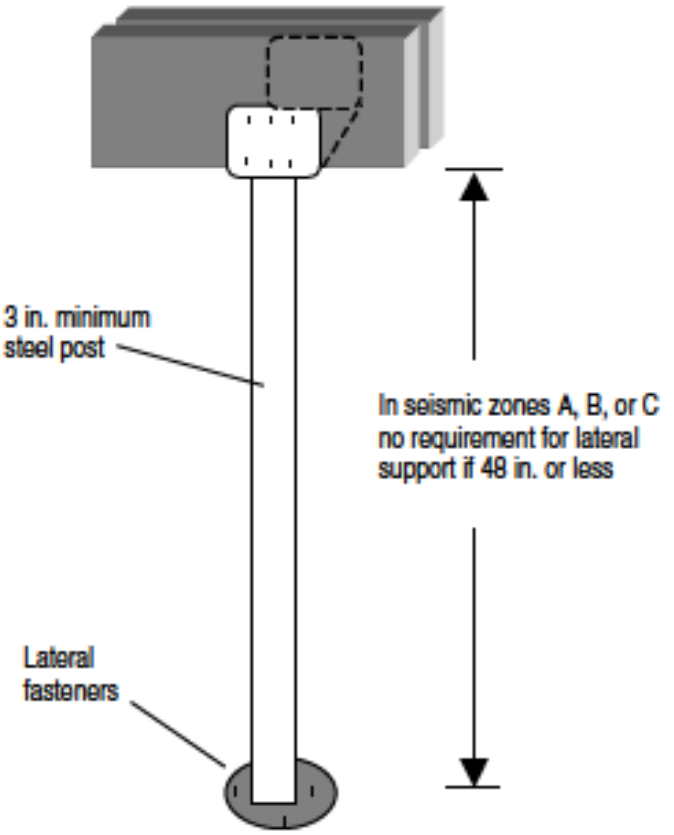


Figure 3-2 GIRDER POST ANCHORING REQUIREMENTS

TABLE 3-1 PIPE POST LOADS

	A 36 standard pipe		
Nominal (in.)	**4**	**3½**	**3**
Wall thickness (in.)	0.237	0.226	0.216
Weight per foot (lb)	10.79	9.11	7.58
Length (ft)	**A 36 standard pipe (load in kips)**		
6	59	48	38
7	57	46	36
8	54	44	34
9	52	41	31
10	49	38	28
11	46	35	25
12	43	32	22
13	40	29	19
14	36	25	16
15	33	22	14
16	29	19	12
17	26	17	11
18	23	15	10
19	21	14	
20	19	12	
22	15	10	
24	13		
25	12		
26			

TABLE 3-2 AXIAL COMPRESSION CAPACITY OF SOLID WOOD POSTS (KIPS)					
Size designation	*Unbraced length (ft)*				
	6	8	10	12	14
2×4	1.3				
3×4	6.0	3.4	2.2		
3×6	9.4	5.3	3.4		
4×4	14.7	9.3	5.9	4.1	3.0
4×6	23.1	14.6	9.3	6.5	4.8
4×8	30.4	19.2	12.3	8.5	6.3
6×6	35.4	33.5	29.6	22.5	16.6
6×8	48.3	45.7	40.3	30.6	22.6
6×10	61.2	57.9	51.1	38.8	28.6
6×12	74.1	70.1	61.8	47.0	34.7
8×8	67.5	66.0	63.9	60.0	53.6
8×10	85.5	83.6	80.9	75.9	67.9
8×12	103.5	101.2	98.0	91.9	82.2
8×14	121.5	118.9	115.0	107.9	96.5
10×10	108.3	108.3	106.0	103.6	99.6
10×12	131.1	131.1	128.4	125.4	120.6
10×14	153.9	153.9	150.7	147.2	141.6
10×16	176.7	176.7	173.0	169.0	162.5
12×12	158.7	158.7	158.7	155.5	152.7

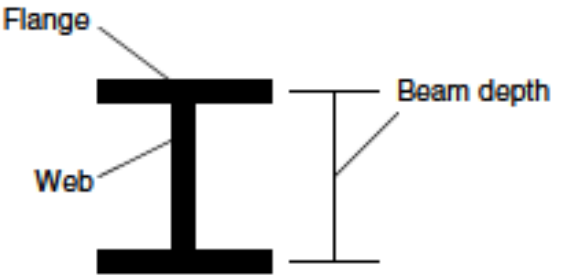


Figure 3-3 TYPICAL I BEAM SECTION

STEEL GIRDERS

The most common of the steel beams is the I-shaped beam thus called an I beam (Figure 3-3). In actuality the I beam is referred to as a w-shaped beam. Beams come in different sizes, shapes, and strengths (see Figure 3-4). It is critical that the correct beams or columns are used exactly as per plans.

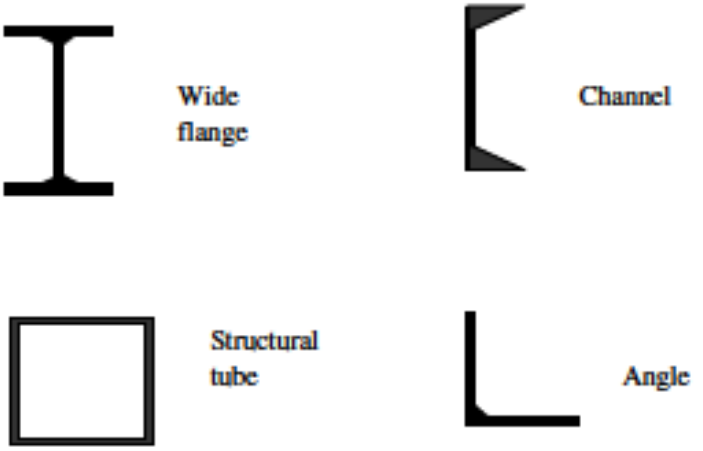


Figure 3-4 STEEL SHAPES

A typical beam would be denoted as:

$$W16 \times 36$$

Here, W refers to the type of beam, 16 is the nominal depth of the beam in inches, and 36 is the weight of the beam per foot. The heavier the weight the stronger the beam.

Beams used as girders are called "simple" beams because the ends are usually not fixed to the pockets in which they rest (Figure 3-5). Thus in theory the beam ends are free to rotate and or flex.

- Do not allow field adjustments to any steel member without proper approval.
- Most specifications require a certified welder.

Figure 3-6 shows load reactions on beams. Refer to Table 3-3 for maximum loads on steel girders.

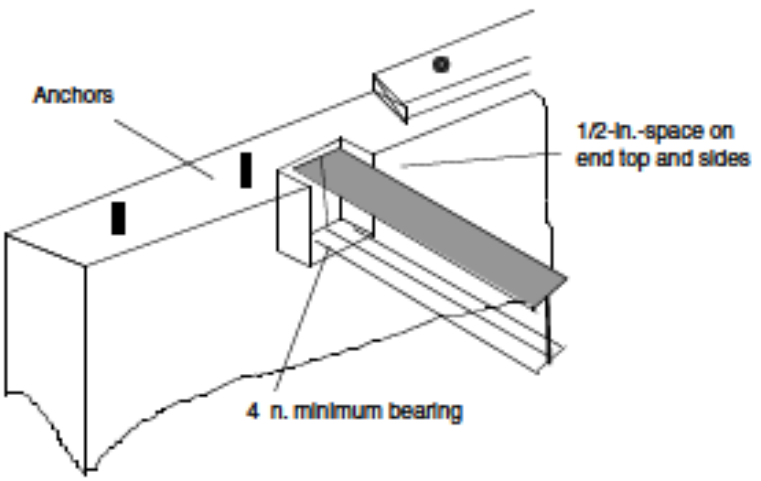


Figure 3-5 BEAM POCKETS

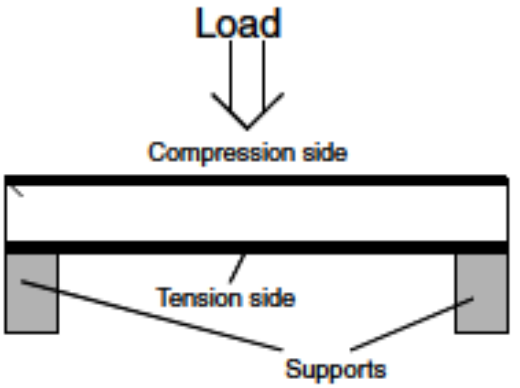


Figure 3-6 LOADS ON STEEL OR WOOD BEAM

TABLE 3-3 MAXIMUM LOADS ON STEEL GIRDERS

	Beam size and weight (kips)				
Span (ft)	W10 × 21	W12 × 27	W14 × 30	W16 × 36	W18 × 50
10	29	45	56	75	119
12	24	38	46	63	99
14	21	32	40	54	85
16	17.9	28	35	47	74
18	15.9	25	31	42	66
20	14.3	23	28	38	59
22		21	25	34	54
24		19	24	31	49
26			21	29	46
28			19.6	27	42
30			18.6	25	40

Note: All loads are in kips (1000 pounds).

EXTERIOR WALL WOOD GIRDERS AND HEADERS

Refer to Tables 3-4 through 3-11 for span specifications.

Headers in Joists or Rafters

- ❑ Ensure that, with openings larger than 4 ft, the header is doubled.
- ❑ Ensure that, with openings of 6 ft or larger, metal hangers are used.

TABLE 3-4 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, AND CEILING (GROUND SNOW LOAD 30 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2×6	5-5	1	4-8	1	4-2	1
2-2×8	6-10	1	5-11	2	5-4	2
2-2×10	8-5	2	7-3	2	6-6	2
2-2×12	9-9	2	8-5	2	7-6	2
3-2×8	8-4	1	7-5	1	6-8	1
3-2×10	10-6	1	9-1	2	8-2	2
3-2×12	12-2	2	10-7	2	9-5	2
4-2×8	7-0	1	6-1	2	5-5	2
4-2×10	11-8	1	10-6	1	9-5	2
4-2×12	14-1	1	12-2	2	10-11	2

TABLE 3-5 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND ONE CENTER-BEARING FLOOR (GROUND SNOW LOAD 30 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-6	1	4-0	1	3-7	2
2-2 × 8	5-9	2	5-0	2	4-6	2
2-2 × 10	7-0	2	6-2	2	5-6	2
2-2 × 12	8-1	2	7-1	2	6-5	2
3-2 × 8	7-2	1	6-3	2	5-8	2
3-2 × 12	10-2	2	8-11	2	8-0	2
4-2 × 8	5-10	2	5-2	2	4-8	2
4-2 × 10	10-1	1	8-10	2	8-0	2
4-2 × 12	11-9	2	10-3	2	9-3	2

TABLE 3-6 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND ONE CLEAR SPAN FLOOR (GROUND SNOW LOAD 30 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-11	1	3-5	2	3-0	2
2-2 × 8	5-0	2	4-4	2	3-10	2
2-2 × 10	6-1	2	5-3	2	4-8	2
2-2 × 12	7-1	2	6-1	3	5-5	3
3-2 × 8	6-3	2	5-5	2	4-10	2
3-2 × 10	7-7	2	6-7	2	5-11	2
3-2 × 12	8-10	2	7-8	2	6-10	2
4-2 × 8	5-1	2	4-5	2	3-11	2
4-2 × 10	8-9	2	7-7	2	6-10	2
4-2 × 12	10-2	2	8-10	2	7-11	2

TABLE 3-7 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND TWO CENTER-BEARING FLOORS (GROUND SNOW LOAD 30 PSF)

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-9	2	3-3	2	2-11	2
2-2 × 8	4-9	2	4-2	2	3-9	2
2-2 × 10	5-9	2	5-1	2	4-7	3
2-2 × 12	6-8	2	5-10	3	5-3	3
3-2 × 8	5-11	2	5-2	2	4-8	2
3-2 × 12	8-5	2	7-4	2	6-7	2
4-2 × 8	4-10	2	4-3	2	3-10	2
4-2 × 10	8-4	2	7-4	2	6-7	2
4-2 × 12	9-8	2	8-6	2	7-8	2

TABLE 3-8 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, AND CEILING (GROUND SNOW LOAD 50 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-8	1	4-1	1	3-8	2
2-2 × 8	5-11	2	5-2	2	4-7	2
2-2 × 10	7-3	2	6-3	2	5-7	2
2-2 × 12	8-5	2	7-3	2	6-6	2
3-2 × 8	7-5	1	6-5	2	5-9	2
3-2 × 10	9-1	2	7-10	2	7-0	2
3-2 × 12	10-7	2	9-2	2	8-2	2
4-2 × 8	6-1	2	5-3	2	4-8	2
4-2 × 10	10-6	1	9-1	2	8-2	2
4-2 × 12	12-2	2	10-7	2	9-5	2

TABLE 3-9 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND ONE CENTER-BEARING FLOOR (GROUND SNOW LOAD 50 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-1	1	3-7	2	3-3	2
2-2 × 8	5-2	2	4-6	2	4-1	2
2-2 × 10	6-4	2	5-6	2	5-0	2
2-2 × 12	7-4	2	6-5	2	5-9	3
3-2 × 8	6-5	2	5-8	2	5-1	2
3-2 × 10	7-11	2	6-11	2	6-3	2
3-2 × 12	9-2	2	8-0	2	7-3	2
4-2 × 8	5-3	2	4-7	2	4-2	2
4-2 × 10	9-1	2	8-0	2	7-2	2
4-2 × 12	10-7	2	9-3	2	8-4	2

TABLE 3-10 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND ONE CLEAR SPAN FLOOR (GROUND SNOW LOAD 50 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-10	2	3-4	2	3-0	2
2-2 × 8	4-10	2	4-2	2	3-9	2
2-2 × 10	5-11	2	5-1	2	4-7	3
2-2 × 12	6-10	2	5-11	3	5-4	3
3-2 × 8	6-1	2	5-3	2	4-8	2
3-2 × 10	7-5	2	6-5	2	5-9	2
3-2 × 12	8-7	2	7-5	2	6-8	2
4-2 × 8	4-11	2	4-3	2	3-10	2
4-2 × 10	8-7	2	7-5	2	6-7	2
4-2 × 12	9-11	2	8-7	2	7-8	2

TABLE 3-11 EXTERIOR WALL HEADERS OR GIRDERS, SUPPORTING ROOF, CEILING, AND TWO CENTER-BEARING FLOORS (GROUND SNOW LOAD 50 PSF)

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2×6	3-8	2	3-2	2	2-10	2
2-2×8	4-7	2	4-0	2	3-8	2
2-2×10	5-8	2	4-11	2	4-5	3
2-2×12	6-6	2	5-9	3	5-2	3
3-2×8	5-9	2	5-1	2	4-7	2
3-2×10	7-1	2	6-2	2	5-7	2
3-2×12	8-2	2	7-2	2	6-5	3
4-2×8	4-9	2	4-2	2	3-9	2
4-2×10	8-2	2	7-2	2	6-5	2
4-2×12	9-5	2	8-3	2	7-5	2

INTERIOR GIRDERS

Refer to Tables 3-12 and 3-13 for span specifications for interior wood girders.

TABLE 3-12 GIRDERS, ONE FLOOR ONLY

Size	Building width (ft)					
	20		28		36	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-6	1	3-11	1	3-6	1
2-2 × 8	5-9	1	5-0	2	4-5	2
2-2 × 10	7-0	2	6-1	2	5-5	2
2-2 × 12	8-1	2	7-0	2	6-3	2
3-2 × 8	7-2	1	6-3	1	5-7	2
3-2 × 10	8-9	1	7-7	2	6-9	2
3-2 × 12	10-2	2	8-10	2	7-10	2
4-2 × 8	5-10	1	5-1	2	4-6	2
4-2 × 10	10-1	1	8-9	1	7-10	2
4-2 × 12	11-9	1	10-2	2	9-1	2

TABLE 3-13 GIRDERS, TWO FLOORS ONLY

Size	Building width (ft)					
	20		28		36	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2×6	3-2	2	2-9	2	2-5	2
2-2×8	4-1	2	3-6	2	3-2	2
2-2×10	4-11	2	4-3	2	3-10	3
2-2×12	5-9	2	5-0	3	4-5	3
3-2×8	5-1	2	4-5	2	3-11	2
3-2×10	6-2	2	5-4	2	4-10	2
3-2×12	7-2	2	6-3	2	5-7	3
4-2×8	4-2	2	3-7	2	3-2	2
4-2×10	7-2	2	6-2	2	5-6	2
4-2×12	8-4	2	7-2	2	6-5	2

MAXIMUM DEFLECTION LIMITS

Refer to Tables 3-14 and 3-15 for maximum deflection limits. Deflections are diagrammed in Figure 3-7.

TABLE 3-14 CODE-REQUIRED MAXIMUM DEFLECTION LIMITS

Construction	Live load	Snow or wind load	Dead plus live load
Roof members			
Supporting plaster ceiling	*L*/360	*L*/360	*L*/240
Supporting nonplaster ceiling	*L*/240	*L*/240	*L*/180
Not supporting ceiling	*L*/180	*L*/180	*L*/120
Floor members	*L*/360	—	*L*/240
Exterior walls and interior partitions			
With brittle finishes	—	*L*/240	—
With flexible finishes	—	*L*/120	—
Farm buildings	—	—	*L*/180
Greenhouses	—	—	*L*/120

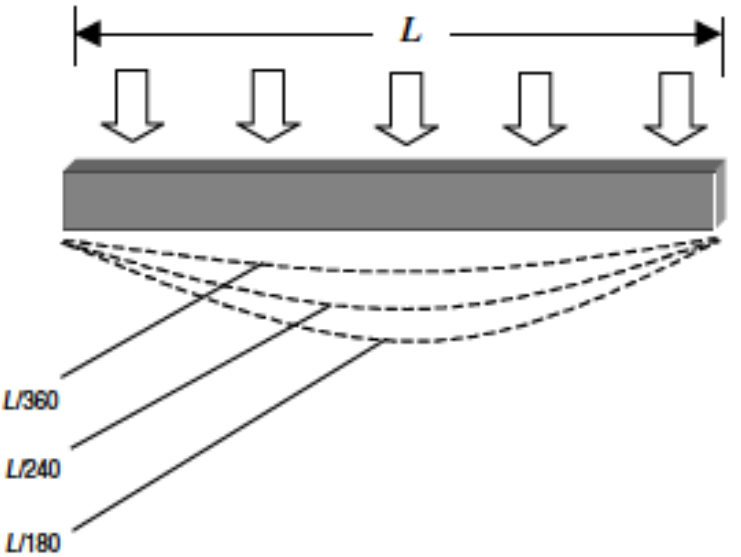


Figure 3-7 DEFLECTIONS

TABLE 3-15 COMPUTED MAXIMUM ALLOWABLE DEFLECTIONS

Span (ft)	*L*/180 (in.)	*L*/240 (in.)	*L*/360 (in.)
15	1	3/4	1/2
16	1 1/16	13/16	17/32
17	1 1/8	27/32	9/16
18	1 3/16	29/32	19/32
19	1 9/32	15/16	5/8
20	1 11/32	1	21/32
21	1 13/32	1 1/16	11/16
22	1 15/32	1 3/32	23/32
23	1 17/32	1 5/32	35/32
24	1 19/32	1 3/16	13/16
25	1 21/32	1 1/4	27/32
26	1 23/32	1 5/16	7/8
27	1 13/16	1 11/32	29/32
28	1 7/8	1 13/32	15/16
29	1 15/16	1 7/16	31/32
30	2	1 1/2	1
31	2 1/16	1 9/16	1 1/32
32	2 1/8	1 19/32	1 1/16

THINK SAFETY AT ALL TIMES

CHAPTER 4
FLOOR FRAMING

FLOOR JOISTS

Refer to Figures 4-1 and 4-2. Span tables are given later in this chapter.

- ❑ Ensure joists are spaced as detailed or specified.
- ❑ Check joists for correct size, grade, and spans.
- ❑ Check that a minimum of 1½ in. bearing on wood (3 in. on masonry) is provided.
- ❑ Check "built-in" joists for fire cuts.
- ❑ Ensure bridging and blocking are installed where shown or specified.
- ❑ Make sure nailing of lower ends of cross bridging (metal) is left until after sheathing or subflooring and partition framing is in place.

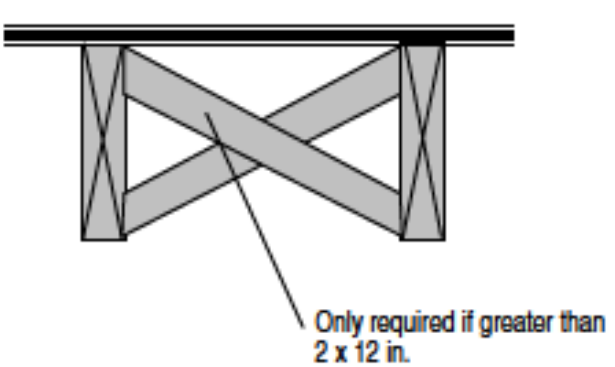


Figure 4-1 FLOOR OR CEILING JOIST BRACING

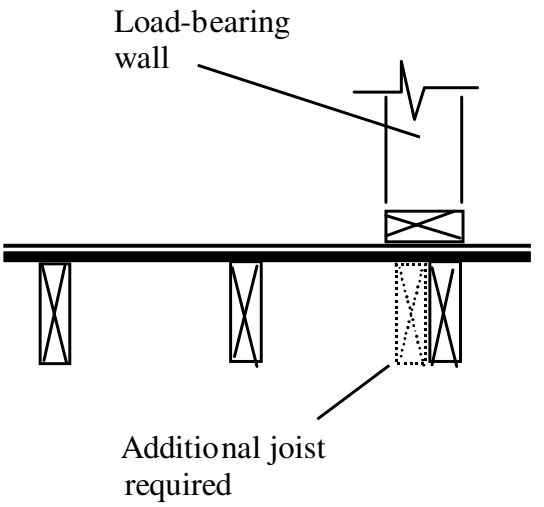


Figure 4-2 JOISTS SUPPORTING LOAD-BEARING WALLS

- ❏ Check sizes of openings through joists. Verify if doubling up of headers and trimmers is required.
- ❏ Check for joist hangers where framed into headers and girders. Ensure that they are correct size and strength.
- ❏ Are joists lapped over bearing and spiked or bolted together?
- ❏ Check for ventilation between sleepers by notching the end blocking.
- ❏ Where joists bear on bottom flange of steel beams, ensure that metal ties are carried across the beam on every fourth joist.
- ❏ Ensure that joists are doubled up under load-bearing partitions that run parallel with the joists.

- ❏ Ensure that structural members are framed for the passage of pipes or ducts.
- ❏ Ensure that structural members are not cut, notched, or bored more than one-fourth their depth.
- ❏ Check engineered lumber. Engineered lumber has special considerations when drilled and/or cut. Manufacturer's instructions must be strictly followed.
- ❏ Check that the following code requirements are met.
  - Blocking should be of utility-grade minimum.
  - Joists should be doubled under load-bearing walls when running parallel.
  - Joist bearings should be 1½ in. for wood and 3 in. for masonry.
  - Lap joists need to be a minimum of 3 in. (see nailing schedule, Table 5-16).
  - Ledgers must be at least 2 × 2.
  - Hollow concrete masonry units must be grouted full to receive ledger bolts!
  - Brick veneer is not to support any loads other than that of the brick itself.
  - Bridging is needed if the depth-to-thickness ratio exceeds 6 to 1 and intervals are not to exceed 8 ft OC.
  - Drilling and notching must be <⅙ of the joist depth.

- No cuts or notches are allowed in the middle third of the span.
- Cuts or notches on ledgers must be <¼ the depth.
- Holes should not be made within 2 in. of top or bottom and hole diameter must be <⅓ the depth.
- Header joists <4 ft may be a single member. Use a double member if more than 4 ft.
- Hangers must be used if header joists are >6 ft.
- Engineered floor trusses cannot be altered!
- Sawn beams (4 in. and more) cannot be notched, drilled, or cut except at their ends for a ledger (¼ the depth).
- Doubled joists that are separated to allow for piping or vents are to be fully depth blocked by lumber not less than 2 in. and blocking is not to be spaced more than 4 ft OC.

CANTILEVERED JOISTS

Refer to Figure 4-3 and Tables 4-1 to 4-4 for cantilevered joist span specifications. Code requires that cantilevered joists have a 3:1 ratio for uplift. For every foot protruding, there must be 3 ft supported.

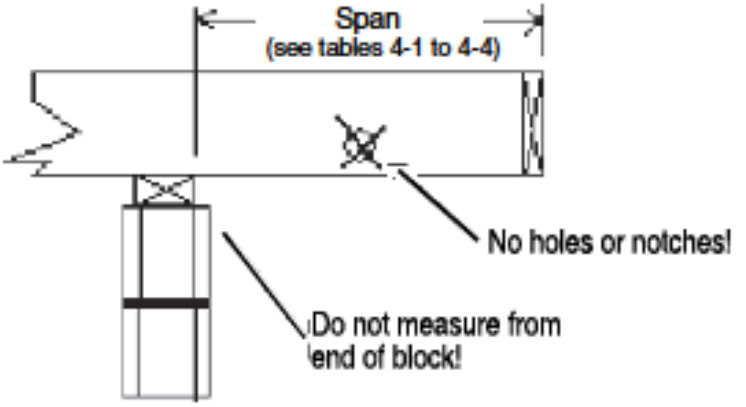


Figure 4-3 MAXIMUM ALLOWED CANTILEVERED JOISTS

TABLE 4-1 CANTILEVERED SPANS FOR FLOOR JOISTS SUPPORTING ONE FLOOR AND ROOF ONLY (FLOOR LIVE LOAD 40 PSF, ROOF LIVE LOAD 20 PSF, SNOW LOAD <20 PSF)

Member and spacing	*Span (in.) for roof width (ft) of*		
	24	32	40
2 × 8 at 12 in.	20	15	
2 × 10 at 16 in.	29	21	16
2 × 10 at 12 in.	36	26	20
2 × 12 at 16 in.		32	25
2 × 12 at 12 in.		42	31
2 × 12 at 8 in.		48	45

TABLE 4-2 CANTILEVERED SPANS FOR FLOOR JOISTS SUPPORTING ONE FLOOR AND ROOF ONLY (FLOOR LIVE LOAD 40 PSF, ROOF LIVE LOAD 20 PSF, SNOW LOAD 30 PSF)

Member and spacing	*Span (in.) for roof width (ft) of*		
	24	32	40
2 × 8 at 12 in.	18		
2 × 10 at 16 in.	26	18	
2 × 10 at 12 in.	34	22	16
2 × 12 at 16 in.	36	29	21
2 × 12 at 12 in.		37	27
2 × 12 at 8 in.		48	38

TABLE 4-3 CANTILEVERED SPANS FOR FLOOR JOISTS SUPPORTING ONE FLOOR AND ROOF ONLY (FLOOR LIVE LOAD 40 PSF, ROOF LIVE LOAD 20 PSF, SNOW LOAD 50 PSF)

Member and spacing	*Span (in.) for roof width (ft) of*		
	24	32	40
2 × 8 at 12 in.			
2 × 10 at 16 in.	20		
2 × 10 at 12 in.	26		
2 × 12 at 16 in.	29	20	
2 × 12 at 12 in.	36	27	17
2 × 12 at 8 in.		40	26

TABLE 4-4 CANTILEVERED SPANS FOR FLOOR JOISTS SUPPORTING ONE FLOOR AND ROOF ONLY (FLOOR LIVE LOAD 40 PSF, ROOF LIVE LOAD 20 PSF, SNOW LOAD 70 PSF)

Member and spacing	*Span (in.) for roof width (ft) of*		
	24	32	40
2 × 8 at 12 in.			
2 × 10 at 16 in.			
2 × 10 at 12 in.	19		
2 × 12 at 16 in.	23		
2 × 12 at 12 in.	31	19	
2 × 12 at 8 in.	36	29	18

JOIST HANGERS

The codes require that joist hangers be installed as per the manufacturer's instructions.

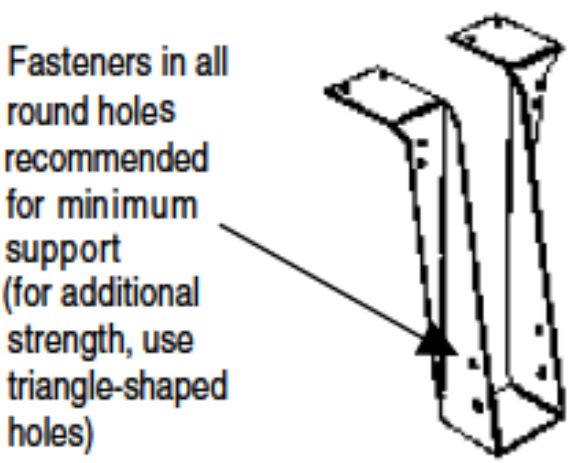


Figure 4-4 JOIST HANGER

All nailing connections must be complete in order to comply with the load capabilities. Refer to Figure 4-4.

ENGINEERED JOISTS

See Figure 4-5 for an example of minimum permissible hole locations in engineered joists and refer to the next section for further guidelines on cutting and drilling engineered joists.

❏ Check joist lateral supports.

- BCI joists must be laterally supported at the ends with hangers, BCI rim joists, rim boards, BCI blocking panels, or x-bracing.
- BCI blocking panels or x-bracing are required at cantilever supports.

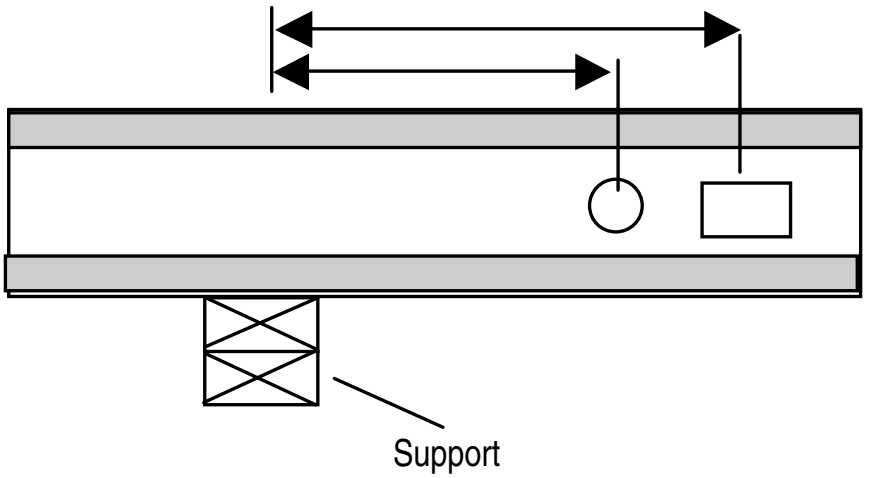


Figure 4-5 MINIMUM PERMISSIBLE HOLE LOCATIONS

- ❑ Ensure a minimum bearing length for BCI joists.
  - A bearing of 1¾ in. is required at end supports.
  - A bearing of 3½ in. is required at cantilever and intermediate supports.
- ❑ Ensure that nailing requirements are met for BCI rim joists, rim boards, or closure panels to BCI joists:
  - BCI 400 and 450: Two 8d box nails, one each in the top and bottom flange.
  - BCI 600 rim joist: Two 16d box nails, one each in the top and bottom flange.
  - BCI 90XL rim joist: Toe-nail top flange to rim joist with two 10d box nails, one each side of flange.
- ❑ Check nailing requirements for BCI rim joists, rim boards, or BCI blocking panels:
  - Use 8d nails at 6 in. OC.
  - When used for shear transfer, follow the building designer's specification.
- ❑ Check nailing of BCI joists to supports:
  - Two 8d nails, one on each side of the web, are required, placed 1½ in. minimum from the end of the BCI joist to avoid splitting.
- ❑ Check nailing of sheathing to BCI joists:
  - If more than one row of nails is used, the rows must be offset at least ½ in.

- BCI 400 and 450 joists: Maximum nail spacing is 18 in. OC.
- BCI 600 and 90XL joists: Maximum nail spacing is 24 in. OC.
- 14 gauge staples may be substituted for 8d nails if the staples penetrate at least 1 in. into the joist.
- Cut backer and filler blocks to a maximum depth equal to the joist depth minus 3¼ in. to avoid a forced fit.

❑ Ensure that BCI joists are protected from the weather. BCI joists are intended only for applications that provide permanent protection from the weather. Bundles of BCI joists should be covered and stored off of the ground on stickers.

❑ Check ventilation needs. The 1½ in., prestamped knock-out holes spaced at 12 in. on center along the BCI joist may all be knocked out and used for cross ventilation. Consult a ventilation expert for specific requirements.

❑ Inspect bird's-mouth cuts.

- BCI joists may be bird's-mouth cut only at the low end support.
- BCI joists with bird's-mouth cuts may cantilever up to 2 ft 6 in. past the low end support. The bottom flange must set fully

on the support and may not overhang the inside face of the support. High end supports and intermediate supports may not be bird's-mouth cut.

CUTTING AND DRILLING OF ENGINEERED JOISTS

Cutting of engineered joists must be done according to the manufacturer's instructions (see Figure 4-6). Siting of cuts should be done according to Tables 4-5 to 4-7. To use these tables, follow these steps:

- ❑ Step 1. Use the joist depth and the diameter of a round hole, or the longest side of a square or rectangular hole, to find the minimum distance allowed in the appropriate table.

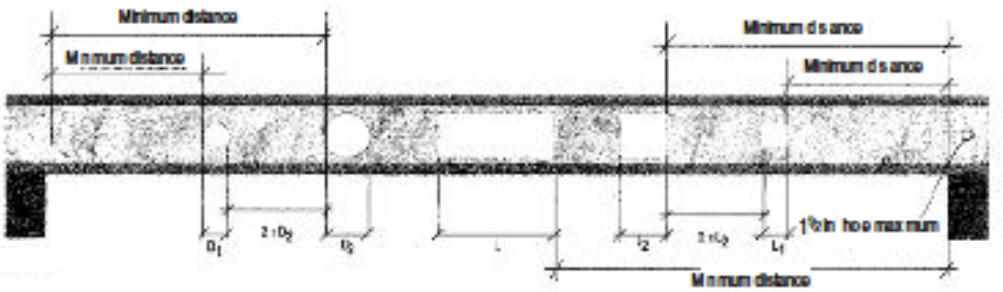


Figure 4-6 HOLE LOCATIONS IN RELATION TO OTHER HOLES AND SUPPORTS (COURTESY OF BOISE CASCADE CORPORATION, FROM ALLJOIST INSTALLATION INSTRUCTIONS)

TABLE 4-5 MINIMUM DISTANCE OF ROUND HOLES FROM INSIDE FACE OF ANY SUPPORT TO NEAREST EDGE OF HOLE FOR BCI ALLJOIST (LIVE LOAD 40 PSF, DEAD LOAD 15 PSF)

Span (ft)	Joist depth (in.)															
	9½				11⅞				14				16			
	Hole size (diameter in in.)															
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
8	1′-0″	2′-0″	—	—	1′-0″	1′-0″	—	—	1′-0″	1′-0″	1′-0″	—	1′-0″	1′-0″	1′-0″	1′-0″
10	1′-0″	3′-0″	—	—	1′-0″	1′-0″	—	—	1′-0″	1′-0″	1′-0″	—	1′-0″	1′-0″	1′-0″	1′-0″
12	1′-0″	4′-0″	—	—	1′-0″	1′-0″	—	—	1′-0″	1′-0″	1′-0″	—	1′-0″	1′-0″	1′-0″	2′-0″
14	1′-6″	5′-6″	—	—	1′-0″	1′-6″	—	—	1′-0″	1′-0″	2′-0″	—	1′-0″	1′-0″	1′-0″	3′-0″
16	2′-6″	6′-6″	—	—	1′-0″	3′-0″	—	—	1′-0″	1′-0″	3′-6″	—	1′-0″	1′-0″	1′-0″	4′-0″
18	3′-6″	8′-0″	—	—	1′-0″	4′-0″	—	—	1′-0″	1′-0″	4′-6″	—	1′-0″	1′-0″	1′-6″	5′-0″
20	4′-6″	9′-0″	—	—	1′-6″	5′-0″	—	—	1′-0″	2′-0″	5′-6″	—	1′-0″	1′-0″	3′-0″	6′-6″
22	6′-0″	10′-6″	—	—	2′-6″	6′-0″	—	—	1′-0″	3′-0″	7′-0″	—	1′-0″	1′-0″	4′-0″	7′-6″
24	7′-0″	11′-6″	—	—	3′-6″	7′-6″	—	—	1′-0″	4′-6″	8′-0″	—	1′-0″	1′-6″	5′-0″	9′-0″
26	—	—	—	—	5′-0″	8′-6″	—	—	2′-0″	5′-6″	9′-0″	—	1′-0″	3′-0″	6′-0″	10′-0″
28	—	—	—	—	6′-0″	10′-0″	—	—	3′-0″	6′-6″	10′-6″	—	1′-0″	4′-0″	7′-6″	11′-6″
30	—	—	—	—	—	—	—	—	4′-0″	7′-6″	11′-6″	—	1′-6″	5′-0″	8′-6″	12′-6″
32	—	—	—	—	—	—	—	—	5′-6″	9′-0″	13′-0″	—	3′-0″	6′-0″	9′-6″	14′-0″
34	—	—	—	—	—	—	—	—	—	—	—	—	4′-0″	7′-0″	11′-0″	15′-0″

TABLE 4-6 MINIMUM DISTANCE OF SQUARE HOLES FROM INSIDE FACE OF ANY SUPPORT TO NEAREST EDGE OF HOLE FOR BCI ALLJOIST (LIVE LOAD 40 PSF, DEAD LOAD 15 PSF)

Span (ft)	Joist depth (in.)															
	9½				11⅞				14				16			
	Hole size (diameter in in.)															
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
10	1′-0″	3′-0″	—	—	1′-0″	1′-0″	—	—	1′-0″	1′-0″	1′-6″	—	1′-0″	1′-0″	1′-0″	2′-6″
12	2′-0″	4′-0″	—	—	1′-0″	2′-0″	—	—	1′-0″	1′-0″	3′-0″	—	1′-0″	1′-0″	1′-6″	4′-0″
14	3′-0″	5′-6″	—	—	1′-0″	3′-0″	—	—	1′-0″	1′-6″	4′-0″	—	1′-0″	1′-0″	2′-6″	5′-0″
16	4′-0″	6′-6″	—	—	2′-0″	4′-6″	—	—	1′-0″	2′-6″	5′-0″	—	1′-0″	1′-6″	3′-6″	6′-6″
18	5′-6″	8′-0″	—	—	3′-0″	5′-6″	—	—	1′-6″	4′-0″	6′-6″	—	1′-0″	2′-6″	5′-0″	7′-6″
20	6′-6″	9′-0″	—	—	4′-6″	7′-0″	—	—	2′-6″	5′-0″	7′-6″	—	1′-0″	3′-6″	6′-0″	9′-0″
22	7′-6″	10′-6″	—	—	5′-6″	8′-0″	—	—	3′-6″	6′-0″	9′-0″	—	2′-0″	4′-6″	7′-0″	10′-0″
24	9′-0″	11′-6″	—	—	6′-6″	9′-0″	—	—	5′-0″	7′-6″	10′-0″	—	3′-0″	5′-6″	8′-6″	11′-6″
26	—	—	—	—	8′-0″	10′-6″	—	—	6′-0″	8′-6″	11′-6″	—	4′-6″	7′-0″	9′-6″	12′-6″
28	—	—	—	—	9′-0″	11′-6″	—	—	7′-0″	9′-6″	12′-6″	—	5′-6″	8′-0″	11′-0″	—
30	—	—	—	—	—	—	—	—	8′-6″	11″-0″	14′-0″	—	6′-6″	9′-0″	12′-0″	—
32	—	—	—	—	—	—	—	—	9′-6″	12′-0″	15-0″	—	7′-6″	10′-6″	13′-6″	—

TABLE 4-7 MINIMUM DISTANCE OF RECTANGULAR HOLES FROM INSIDE FACE OF ANY SUPPORT TO NEAREST EDGE OF HOLE FOR BCI ALLJOIST (LIVE LOAD 40 PSF, DEAD LOAD 15 PSF)

Span (ft)	Joist depth (in.)															
	9½				11⅞				14				16			
	Size of rectangle (in.)															
	5 × 8	5 × 10	5 × 12	5 × 14	7 × 10	7 × 12	7 × 14	7 × 16	10 × 12	10 × 14	10 × 16	10 × 18	12 × 14	12 × 16	12 × 18	12 × 20
8	1′-6″	2′-0″	2′-6″	3′-0″	1′-6″	2′-0″	2′-6″	3′-0″	2′-0″	2′-6″	3′-0″	—	2′-6″	3′-0″	—	—
10	3′-0″	3′-0″	3′-6″	4′-0″	2′-6″	3′-0″	3′-6″	4′-0″	3′-0″	3′-6″	4′-6″	—	3′-6″	4′-6″	—	—
12	4′-0″	4′-6″	5′-0″	5′-6″	3′-6″	4′-0″	5′-0″	5′-6″	4′-6″	5′-0″	5′-6″	—	4′-6″	5′-6″	—	—
14	5′-0″	5′-6″	6′-0″	6′-6″	5′-0″	5′-6″	6′-0″	6′-6″	5′-6″	6′-0″	—	—	6′-0″	—	—	—
16	6′-6″	7′-0″	7′-6″	—	6′-0″	6′-6″	7′-6″	—	6′-6″	7′-6″	—	—	7′-0″	—	—	—
18	7′-6″	8′-0″	8′-6″	—	7′-6″	8′-0″	8′-6″	—	8′-0″	—	—	—	8′-6″	—	—	—
20	9′-0″	9′-6″	—	—	8′-6″	9′-0″	—	—	9′-0″	—	—	—	9′-6″	—	—	—
22	10′-0″	10′-6″	—	—	10′-0″	10′-6″	—	—	10′-6″	—	—	—	—	—	—	—
24	11′-6″	—	—	—	11′-0″	11′-6″	—	—	—	—	—	—	—	—	—	—
26	—	—	—	—	12′-6″	—	—	—	—	—	—	—	—	—	—	—
28	—	—	—	—	13′-6″	—	—	—	—	—	—	—	—	—	—	—

❑ Step 2. Locate the centerline of the hole a distance equal to or greater than the length from the nearest support.

- Select a table row based on joist depth and the actual joist span rounded up to the nearest table span. Scan across the row to the column headed by the appropriate round hole diameter or rectangular hole side. Use the longest side of a rectangular hole. The table value is the closest that the centerline of the hole may be to the centerline of the nearest support.
- For multiple holes, the amount of uncut web between holes must equal at least twice the diameter (or longest side) of the largest hole.
- Holes may be positioned vertically anywhere in the web. The joist may be set with the 1½-in. knockout holes turned either up or down.

SPECIAL CONSIDERATIONS FOR ENGINEERED JOISTS

The codes require that the manufacturer's installation instructions be strictly followed!

General Dos and Don'ts

BCI dos and don'ts (Figures 4-7 to 4-10) are courtesy of the Boise Cascade Corporation.

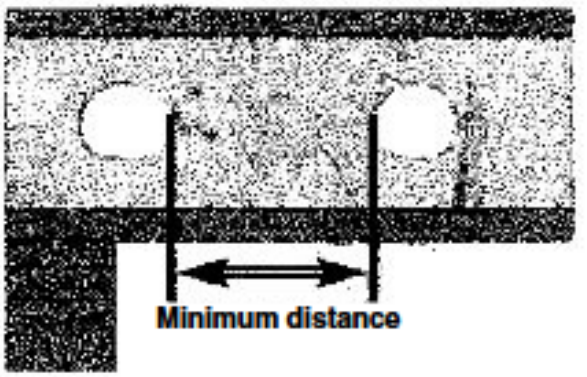


Figure 4-7 DO NOT CUT HOLES NEAR BEARING SUPPORTS (USE THE HOLE CUTTING CHARTS FROM THE MANUFACTURER)

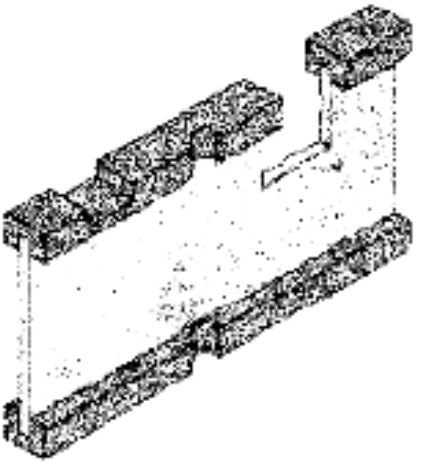


Figure 4-8 NEVER CUT, NOTCH, OR DRILL FLANGES (EXCEPT FOR ROOF DETAILS)

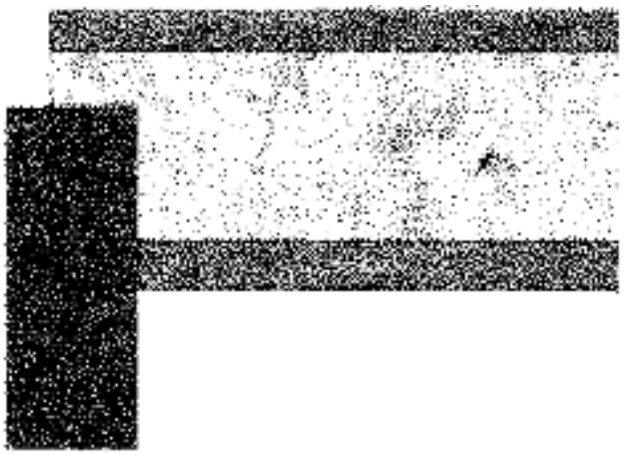


Figure 4-9 NEVER HANG JOIST BY TOP FLANGE OR WEB

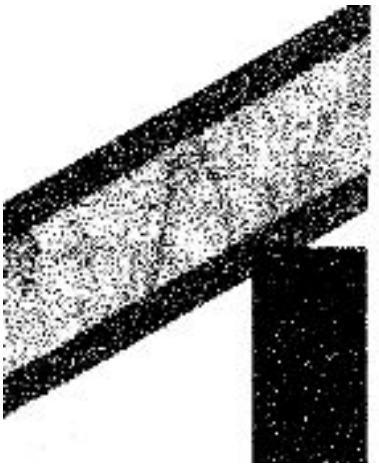


Figure 4-10 NEVER PLACE BIRD'S-MOUTH CUT IN BOTTOM FLANGE AT HIGH END OF RAFTER

Spans and Loads

Refer to Tables 4-8 and 4-9 for allowable loads for the AJS 20 and AJS 25. The following notes (courtesy of Boise Cascade Corporation) apply to calculations of allowable uniform loads on AJS 20 and AJS 25 engineered joists (Tables 4-8 and 4-9):

- Total load values are limited by shear, moment, or total load deflection equal to *L*/240 (refer to Figure 4-15 on page 55).
- Live load values are limited by deflection equal to *L*/480. For deflection limited to *L*/360 or *L*/960, multiply live load value by 1.33 and 0.5, respectively.
- Both the total load and live load columns must be checked. Where a live load is not shown, the total load value will control.
- Table values assume no composite action provided by sheathing.
- Table values assume no repetitive member increase in bending capacities.
- Total load values assume minimum bearing lengths without web stiffeners for joist depths of 16 in. and less (see Figure 4-11).
- Table values apply to either simple or continuous span joists. Span is measured center to center of the minimum required bearing length. Analyze continuous span joists with

TABLE 4-8 AJS 20 ALLOWABLE UNIFORM LOADS

Span (ft)	Joist depth (in.)							
	9½		11⅞		14		16	
	Live load	Total load	Live load	Total load	Live load	Total load	Live load	Total load
6	—	309	—	381	—	381	—	381
7	—	265	—	326	—	326	—	326
8	—	232	—	286	—	286	—	286
9	—	206	—	254	—	254	—	254
10	—	185	—	228	—	228	—	228
11	154	168	—	208	—	208	—	208
12	122	154	—	190	—	190	—	190
13	98	142	160	176	—	176	—	176
14	79	132	130	163	—	163	—	163
15	65	120	108	152	—	152	—	152
16	54	106	90	137	129	143	—	143
17	46	92	76	121	109	134	—	134
18	39	78	65	108	93	127	124	127
19	33	67	55	97	80	117	107	120
20	28	57	48	87	69	105	93	114
21	25	50	41	79	60	96	81	108
22	21	43	36	72	52	87	71	101
23	19	38	32	64	46	80	62	92
24	17	34	28	56	41	—	55	85
25	15	30	25	50	36	67	49	78

Note: Loads are given in pounds per lineal foot (plf). Courtesy of Boise Cascade Corporation.

TABLE 4-9 AJS 25 ALLOWABLE UNIFORM LOADS

Span (ft)	Joist depth (in.)							
	9½		11⅞		14		16	
	Live load	Total load	Live load	Total load	Live load	Total load	Live load	Total load
6	—	309	—	381	—	381	—	381
7	—	265	—	326	—	326	—	326
8	—	—	—	286	—	286	—	286
9	—	206	—	254	—	254	—	254
10	—	185	—	228	—	228	—	228
11	—	168	—	208	—	208	—	208
12	—	154	—	190	—	190	—	190
13	131	142	—	176	—	176	—	176
14	10	132	—	163	—	163	—	163
15	88	123	144	152	—	152	—	152
16	—	116	121	143	—	143	—	143
17	62	109	102	134	—	134	—	134
18	—	103	87	127	124	127	—	127
19	45	91	75	120	107	120	—	120
20	39	79	65	—	93	—	—	114
21	34	68	56	108	81	108	—	108
22	30	60	49	99	71	104	95	104
23	26	52	43	87	63	99	84	99
24	—	46	38	—	—	95	—	95
25	20	41	34	69	49	91	66	91

Note: Loads are given in pounds per lineal foot (plf). Courtesy of Boise Cascade Corporation.

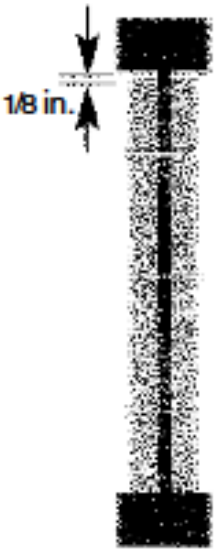


Figure 4-11 WEB STIFFENERS IN ENGINEERED WOOD JOISTS

the BC CALC software if the length of any span is less than half the length of an adjacent span.

- Tables 4-8 and 4-9 were designed to apply to a broad range of applications. It may be possible to exceed the limitations by analyzing a specific application with the BC CALC software. For more information, visit www.BoiseBuilding.com/EWP.

Squash Blocks

Refer to Figure 4-12.

- Squash blocks are to be in full contact with upper floor and lower wall plate.

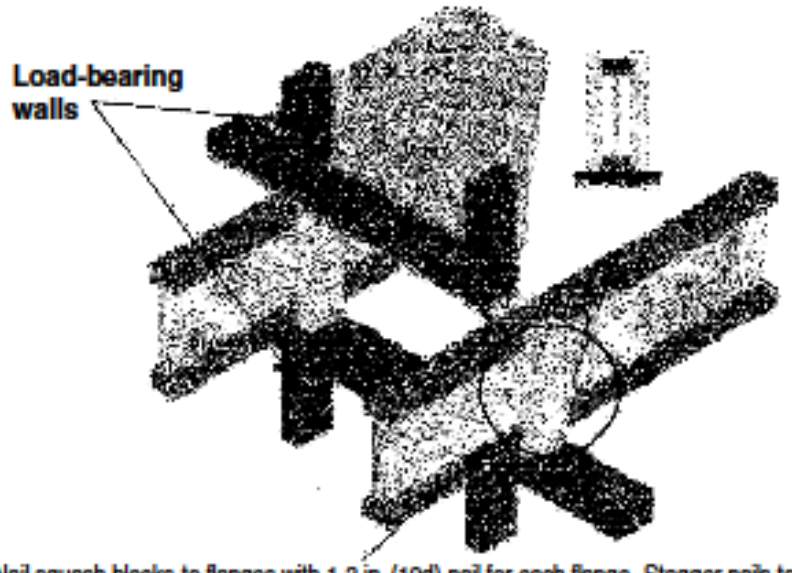


Figure 4-12 SQUASH BLOCKS (COURTESY OF BOISE CASCADE CORPORATION)

- Squash blocks are to be 1/16 in. higher than the joist.
- Squash blocks are to be spruce–pine–fir grade 2 or better.
- Solid block all posts to bearing below with 2 × 4 (minimum) squash blocks.
- Web stiffeners are not recommended for this detail.
- Add blocking panel (not shown in Figure 4-12) at 8 ft 0 in. OC for lateral support.
- Nail squash blocks to flanges using one 3-in. (10d) nail per flange. Stagger nails to avoid splitting.

Blocking Panels

Refer to Figure 4-13.

- Blocking panels are to be used in dry conditions only.
- Blocking panels are to be in full contact with upper floor and lower wall plate.
- Blocking panels must be adequately designed to act as a load transfer point for gravity loads from floor and roof above.
- Use 3-in. (10d) nails at 6 in. OC for Alljoist blocking panels.

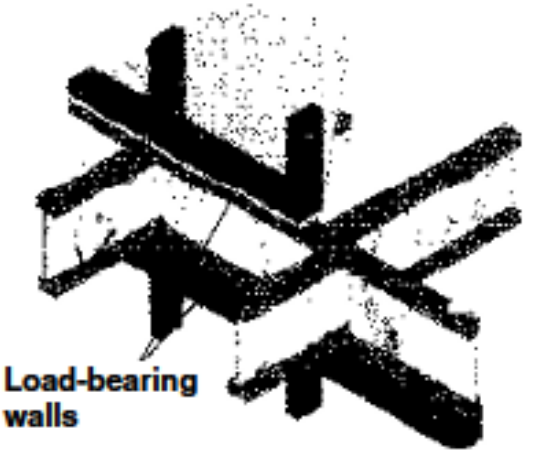


Figure 4-13 BLOCKING PANEL (COURTESY OF BOISE CASCADE CORPORATION)

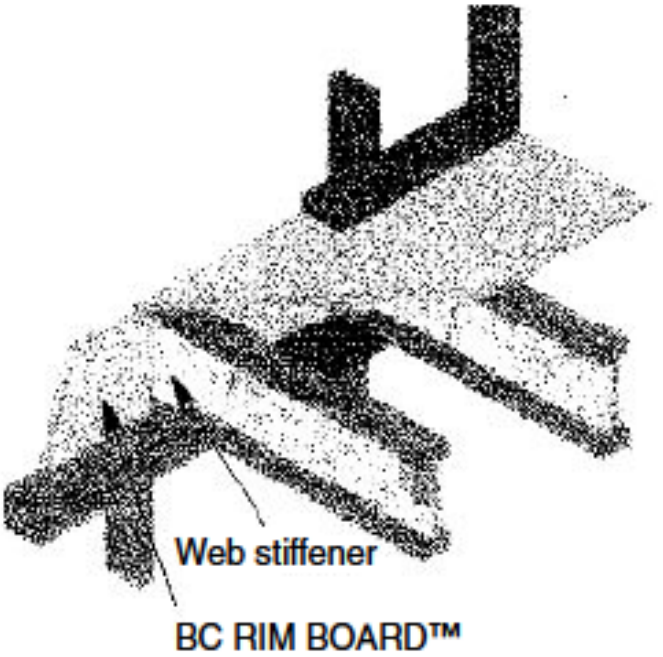


Figure 4-14 WEB STIFFENER (COURTESY BOISE CASCADE CORPORATION)

Web Stiffeners

Refer to Figure 4-14.

- Stiffeners are required on both sides of the web for hangers with side nailing or any hanger with sides not containing the top flange of the joist.
- Web stiffeners are required when joist hangers do not laterally support the top flange of the joist.
- Install web stiffeners tight against top flange and with a ⅛-in. gap between bottom flange.

- Web stiffeners are required to prevent buckling of web as loads are being transferred to end reactions or when concentrated loads are being transferred along the span.
- Web stiffeners are required when point load exceeds 1500 pounds.
- Verify adequacy of joist to carry concentrated load.

READING SPAN TABLES

- The type of species and grade of wood for the rafters and joists determine the maximum allowable stress in bending (f_b) and its modulus of elasticity (e). These two values determine how far a rafter or joist can span and still meet the minimum deflection requirements. Excessive deflection of these members can cause damage to drywall or finishes and may lead to bouncy floors.
- The code tables express the framing member in terms of its strength and stiffness. Both are considered of equal importance. All lumber when loaded will bend or deflect. Codes limit the amount of this deflection depending on the area's intended use; for example, a living room has a different limit than a bedroom. Roof rafters are limited as to their pitch or slope. The lower the pitch

the stronger they must be. The deflection is expressed as a fraction of the span length *L*, such as *L*/180, *L*/360, or *L*/240 (Figure 4-15). The maximum allowable deflection is determined by taking the length of the clear span and dividing that number by the denominator, usually 180, 240, or 360.

- Stiffness of the member is expressed as the modulus of elasticity or e. Along with the bending design value or f_b, the e values are expressed in millions of pounds per square inch (psi). A value in table such as 1.1 is 1,100,000 psi. The force f_b is measured in pounds per square inch. The code tables will identify these two values when you have taken the span that you are working with and

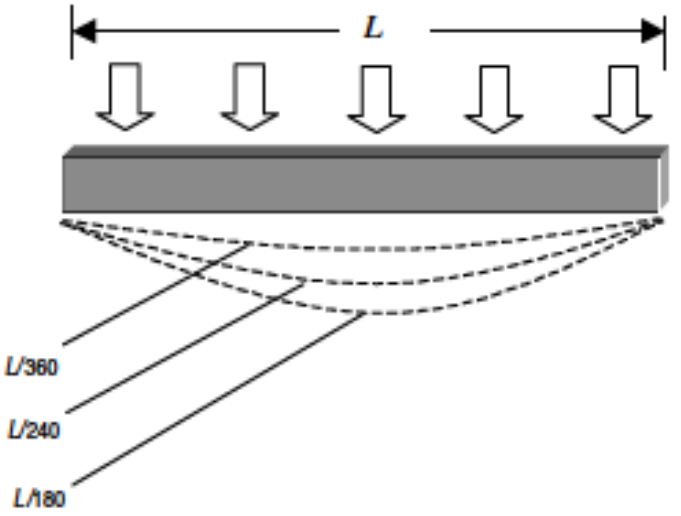


Figure 4-15 DESIGNED DEFLECTIONS

the spacing of the members, that is, 12 in. OC, 16 in. OC, etc. Determining these minimum acceptable values is the first thing necessary in deciding on which type and grade of wood will meet the applicable codes.

- Once you have identified the e and f_b, you can then go into the appropriate code table (make sure to check the heading). Chances are that you will not find a grade that the e and f_b numbers match exactly. Always use the next higher value available in the code table.
- The span tables listed in the next sections are simplified and do not show all the wood species available. Consult local code requirements. All spans are considered clear horizontal simple beams with ends fixed.

Loads

Many builders do not fully understand how to use the lumber span tables in the codes. Rafters and joists obviously carry loads or are weighted down by something. These loads are commonly referred to as live loads, dead loads, snow loads, and wind loads.

Live loads These are the weights of such things as people, furniture, and others that are imposed by the particular use that the room or structure will be subjected to.

Dead loads These are the weights of the actual building materials and systems (such as the weight of roofing materials, joists, and the HVAC unit in the attic space).

Snow load These are the weights of snow accumulation that can be expected. These are usually stipulated by the code enforcement department in your area.

Wind loads These are the same as snow loads. However, the wind load may also depend on where the structure is to be located such as at the bottom of a hill or in a forested area where it will be better protected from the force imposed by the wind. Structures in designated high wind areas have more stringent code requirements.

Wind Exposure Categories

For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities should be determined for the site at which the building or structure is to be constructed. For a site located in the transition zone between categories, the category resulting in the largest wind forces shall apply. Account should be taken of variations in ground surface roughness

that arise from natural topography, from vegetation (which may vary with season), as well as from constructed features.

The code defines exposures as follows:

Exposure A Exposure A refers to large city centers with at least 50% of the buildings having a height in excess of 70 ft. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least 0.5 mile or 10 times the height of the building or other structure, whichever is greater. Possible channeling effects or increased velocity pressures due to the building or structure being located in the wake of adjacent buildings must be taken into account.

Exposure B Exposure B refers to urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure B should be assumed unless the site meets the definition of another type exposure.

Exposure C Exposure C refers to open terrain with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 ft extending more than 1500 ft from the building site in any quadrant. This exposure shall also apply to any build-

ing located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 ft. This category includes flat open country, grasslands, and shorelines in hurricane-prone regions.

Exposure D Exposure D refers to flat, unobstructed areas exposed to wind flowing over open water (excluding shorelines in hurricane-prone regions) for a distance of at least 1 mile. Shorelines in Exposure D include inland waterways, the Great Lakes, and coastal areas of California, Oregon, Washington, and Alaska. This exposure shall apply only to those buildings and other structures exposed to wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1500 ft or 10 times the height of the building or structure, whichever is greater.

FLOOR JOIST SPANS

Refer to Tables 4-10 through 4-17 for floor joist span specifications for live loads of 30 psf and a maximum allowed deflection of *L*/360 (see Figure 4-15). Tables 4-18 to 4-25 give span tables for 40 psf live loads. Note that span tables in this book have been simplified.

TABLE 4-10 FLOOR JOIST SPANS (2 × 6) FOR 30 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	12-6
	Douglas-fir–larch	#1	12-0
	Douglas-fir–larch	#2	11-10
	Douglas-fir–larch	#3	9-8
	Hemlock–fir	SS	11-10
	Hemlock–fir	#1	11-7
	Hemlock–fir	#2	11-0
	Hemlock–fir	#3	9-8
	Southern pine	SS	12-3
	Southern pine	#1	12-0
	Southern pine	#2	11-10
	Southern pine	#3	10-5
	Spruce–pine–fir	SS	11-7
	Spruce–pine–fir	#1	11-3
	Spruce–pine–fir	#2	11-3
	Spruce–pine–fir	#3	9-8
16	Douglas-fir–larch	SS	11-4
	Douglas-fir–larch	#1	10-11
	Douglas-fir–larch	#2	10-9
	Douglas-fir–larch	#3	8-5
	Hemlock–fir	SS	10-9
	Hemlock–fir	#1	10-6
	Hemlock–fir	#2	10-0
	Hemlock–fir	#3	8-5

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Southern pine	SS	11-2
	Southern pine	#1	10-11
	Southern pine	#2	10-9
	Southern pine	#3	9-0
	Spruce–pine–fir	SS	10-6
	Spruce–pine–fir	#1	10-3
	Spruce–pine–fir	#2	10-3
	Spruce–pine–fir	#3	8-5
24	Douglas-fir–larch	SS	9-11
	Douglas-fir–larch	#1	9-7
	Douglas-fir–larch	#2	9-1
	Douglas-fir–larch	#3	6-10
	Hemlock–fir	SS	9-4
	Hemlock–fir	#1	9-2
	Hemlock–fir	#2	8-9
	Hemlock–fir	#3	6-10
	Southern pine	SS	9-9
	Southern pine	#1	9-7
	Southern pine	#2	9-4
	Southern pine	#3	7-4
	Spruce–pine–fir	SS	9-2
	Spruce–pine–fir	#1	8-11
	Spruce–pine–fir	#2	8-11
	Spruce–pine–fir	#3	6-10

TABLE 4-11 FLOOR JOIST SPANS (2 × 8) FOR 30 PSF LIVE LOAD AND 10 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	16-6
	Douglas-fir–larch	#1	15-10
	Douglas-fir–larch	#2	15-7
	Douglas-fir–larch	#3	12-4
	Hemlock–fir	SS	15-7
	Hemlock–fir	#1	15-3
	Hemlock–fir	#2	14-6
	Hemlock–fir	#3	12-4
	Southern pine	SS	16-2
	Southern pine	#1	15-10
	Southern pine	#2	15-7
	Southern pine	#3	13-3
	Spruce–pine–fir	SS	15-3
	Spruce–pine–fir	#1	14-11
	Spruce–pine–fir	#2	14-11
	Spruce–pine–fir	#3	12-4
16	Douglas-fir–larch	SS	15-0
	Douglas-fir–larch	#1	14-5
	Douglas-fir–larch	#2	14-1
	Douglas-fir–larch	#3	10-8
	Hemlock–fir	SS	14-2
	Hemlock–fir	#1	13-10
	Hemlock–fir	#2	13-2
	Hemlock–fir	#3	10-8
	Southern pine	SS	14-8

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Southern pine	#1	14-5
	Southern pine	#2	14-2
	Southern pine	#3	11-6
	Spruce–pine–fir	SS	13-10
	Spruce–pine–fir	#1	13-6
	Spruce–pine–fir	#2	13-6
	Spruce–pine–fir	#3	10-8
24	Douglas-fir–larch	SS	13-1
	Douglas-fir–larch	#1	12-4
	Douglas-fir–larch	#2	11-6
	Douglas-fir–larch	#3	8-8
	Hemlock–fir	SS	12-4
	Hemlock–fir	#1	12-0
	Hemlock–fir	#2	11-4
	Hemlock–fir	#3	8-8
	Southern pine	SS	12-10
	Southern pine	#1	12-7
	Southern pine	#2	12-4
	Southern pine	#3	9-5
	Spruce–pine–fir	SS	12-1
	Spruce–pine–fir	#1	11-6
	Spruce–pine–fir	#2	11-6
	Spruce–pine–fir	#3	8-8

TABLE 4-12 FLOOR JOIST SPANS (2 × 10) FOR 30 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	21-0
	Douglas-fir–larch	#1	20-3
	Douglas-fir–larch	#2	19-10
	Douglas-fir–larch	#3	15-0
	Hemlock–fir	SS	19-10
	Hemlock–fir	#1	19-5
	Hemlock–fir	#2	18-6
	Hemlock–fir	#3	15-0
	Southern pine	SS	20-8
	Southern pine	#1	20-3
	Southern pine	#2	19-10
	Southern pine	#3	15-8
	Spruce–pine–fir	SS	19-5
	Spruce–pine–fir	#1	19-0
	Spruce–pine–fir	#2	19-0
	Spruce–pine–fir	#3	15-0
16	Douglas-fir–larch	SS	19-1
	Douglas-fir–larch	#1	18-5
	Douglas-fir–larch	#2	17-2
	Douglas-fir–larch	#3	13-0
	Hemlock–fir	SS	18-0
	Hemlock–fir	#1	17-8
	Hemlock–fir	#2	16-10
	Hemlock–fir	#3	13-0
	Southern pine	SS	18-9

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Southern pine	#1	18-5
	Southern pine	#2	18-0
	Southern pine	#3	13-7
	Spruce–pine–fir	SS	17-8
	Spruce–pine–fir	#1	17-2
	Spruce–pine–fir	#2	17-2
	Spruce–pine–fir	#3	13-0
24	Douglas-fir–larch	SS	16-8
	Douglas-fir–larch	#1	15-0
	Douglas-fir–larch	#2	14-1
	Douglas-fir–larch	#3	10-7
	Hemlock–fir	SS	15-9
	Hemlock–fir	#1	14-8
	Hemlock–fir	#2	13-10
	Hemlock–fir	#3	10-7
	Southern pine	SS	16-5
	Southern pine	#1	16-1
	Southern pine	#2	14-8
	Southern pine	#3	11-1
	Spruce–pine–fir	SS	15-5
	Spruce–pine–fir	#1	14-1
	Spruce–pine–fir	#2	14-1
	Spruce–pine–fir	#3	10-7

TABLE 4-13 FLOOR JOIST SPANS (2 × 12) FOR 30 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
12	Douglas-fir–larch	SS	25-7
	Douglas-fir–larch	#1	24-8
	Douglas-fir–larch	#2	23-0
	Douglas-fir–larch	#3	17-5
	Hemlock–fir	SS	24-2
	Hemlock–fir	#1	23-7
	Hemlock–fir	#2	22-6
	Hemlock–fir	#3	17-5
	Southern pine	SS	25-1
	Southern pine	#1	24-8
	Southern pine	#2	18-8
	Southern pine	#3	18-8
	Spruce–pine–fir	SS	23-7
	Spruce–pine–fir	#1	23-0
	Spruce–pine–fir	#2	23-0
	Spruce–pine–fir	#3	17-5
16	Douglas-fir–larch	SS	23-3
	Douglas-fir–larch	#1	21-4
	Douglas-fir–larch	#2	19-11
	Douglas-fir–larch	#3	15-1
	Hemlock–fir	SS	21-11
	Hemlock–fir	#1	20-9
	Hemlock–fir	#2	19-8
	Hemlock–fir	#3	15-1
	Southern pine	SS	22-10

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
16	Southern pine	#1	22-5
	Southern pine	#2	21-1
	Southern pine	#3	16-2
	Spruce–pine–fir	SS	21-6
	Spruce–pine–fir	#1	19-11
	Spruce–pine–fir	#2	19-11
	Spruce–pine–fir	#3	15-1
24	Douglas-fir–larch	SS	20-3
	Douglas-fir–larch	#1	17-5
	Douglas-fir–larch	#2	16-3
	Douglas-fir–larch	#3	12-4
	Hemlock–fir	SS	19-2
	Hemlock–fir	#1	17-0
	Hemlock–fir	#2	16-1
	Hemlock–fir	#3	12-4
	Southern pine	SS	19-11
	Southern pine	#1	19-6
	Southern pine	#2	17-2
	Southern pine	#3	13-2
	Spruce–pine–fir	SS	18-9
	Spruce–pine–fir	#1	16-3
	Spruce–pine–fir	#2	16-3
	Spruce–pine–fir	#3	12-4

TABLE 4-14 FLOOR JOIST SPANS (2 × 6) FOR 30 PSF LIVE LOAD AND 20 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	12-6
	Douglas-fir–larch	#1	12-0
	Douglas-fir–larch	#2	11-6
	Douglas-fir–larch	#3	8-8
	Hemlock–fir	SS	11-10
	Hemlock–fir	#1	11-7
	Hemlock–fir	#2	11-0
	Hemlock–fir	#3	8-8
	Southern pine	SS	12-3
	Southern pine	#1	12-0
	Southern pine	#2	11-10
	Southern pine	#3	9-4
	Spruce–pine–fir	SS	11-7
	Spruce–pine–fir	#1	11-3
	Spruce–pine–fir	#2	11-3
	Spruce–pine–fir	#3	8-8
16	Douglas-fir–larch	SS	11-4
	Douglas-fir–larch	#1	10-8
	Douglas-fir–larch	#2	9-11
	Douglas-fir–larch	#3	7-6
	Hemlock–fir	SS	10-9
	Hemlock–fir	#1	10-4
	Hemlock–fir	#2	9-10
	Hemlock–fir	#3	7-6
	Southern pine	SS	11-2

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Southern pine	#1	10-11
	Southern pine	#2	10-5
	Southern pine	#3	8-1
	Spruce–pine–fir	SS	10-6
	Spruce–pine–fir	#1	9-11
	Spruce–pine–fir	#2	9-11
	Spruce–pine–fir	#3	7-6
24	Douglas-fir–larch	SS	9-11
	Douglas-fir–larch	#1	8-8
	Douglas-fir–larch	#2	8-1
	Douglas-fir–larch	#3	6-2
	Hemlock–fir	SS	9-4
	Hemlock–fir	#1	8-6
	Hemlock–fir	#2	8-0
	Hemlock–fir	#3	6-2
	Southern pine	SS	9-9
	Southern pine	#1	9-7
	Southern pine	#2	8-6
	Southern pine	#3	6-7
	Spruce–pine–fir	SS	9-2
	Spruce–pine–fir	#1	8-1
	Spruce–pine–fir	#2	8-1
	Spruce–pine–fir	#3	6-2

TABLE 4-15 FLOOR JOIST SPANS (2 × 8) FOR 30 PSF LIVE LOAD AND 20 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	16-6
	Douglas-fir–larch	#1	15-7
	Douglas-fir–larch	#2	14-7
	Douglas-fir–larch	#3	11-0
	Hemlock–fir	SS	15-7
	Hemlock–fir	#1	15-2
	Hemlock–fir	#2	14-4
	Hemlock–fir	#3	11-0
	Southern pine	SS	16-2
	Southern pine	#1	15-10
	Southern pine	#2	15-7
	Southern pine	#3	11-11
	Spruce–pine–fir	SS	15-3
	Spruce–pine–fir	#1	14-7
	Spruce–pine–fir	#2	14-7
	Spruce–pine–fir	#3	11-0
16	Douglas-fir–larch	SS	15-0
	Douglas-fir–larch	#1	13-6
	Douglas-fir–larch	#2	12-7
	Douglas-fir–larch	#3	9-6
	Hemlock–fir	SS	14-2
	Hemlock–fir	#1	13-1
	Hemlock–fir	#2	12-5
	Hemlock–fir	#3	9-6
	Southern pine	SS	14-8

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Southern pine	#1	14-5
	Southern pine	#2	13-6
	Southern pine	#3	10-3
	Spruce–pine–fir	SS	13-10
	Spruce–pine–fir	#1	12-7
	Spruce–pine–fir	#2	12-7
	Spruce–pine–fir	#3	9-6
24	Douglas-fir–larch	SS	13-1
	Douglas-fir–larch	#1	11-0
	Douglas-fir–larch	#2	10-3
	Douglas-fir–larch	#3	7-9
	Hemlock–fir	SS	12-4
	Hemlock–fir	#1	10-9
	Hemlock–fir	#2	10-2
	Hemlock–fir	#3	7-9
	Southern pine	SS	12-10
	Southern pine	#1	12-4
	Southern pine	#2	11-0
	Southern pine	#3	8-5
	Spruce–pine–fir	SS	12-1
	Spruce–pine–fir	#1	10-3
	Spruce–pine–fir	#2	10-3
	Spruce–pine–fir	#3	7-9

TABLE 4-16 FLOOR JOIST SPANS (2 × 10) FOR 30 PSF LIVE LOAD AND 20 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	21-0
	Douglas-fir–larch	#1	19-0
	Douglas-fir–larch	#2	17-9
	Douglas-fir–larch	#3	13-5
	Hemlock–fir	SS	19-10
	Hemlock–fir	#1	18-6
	Hemlock–fir	#2	17-6
	Hemlock–fir	#3	13-5
	Southern pine	SS	20-8
	Southern pine	#1	20-3
	Southern pine	#2	18-7
	Southern pine	#3	14-0
	Spruce–pine–fir	SS	19-5
	Spruce–pine–fir	#1	17-9
	Spruce–pine–fir	#2	17-9
	Spruce–pine–fir	#3	13-5
16	Douglas-fir–larch	SS	19-1
	Douglas-fir–larch	#1	16-5
	Douglas-fir–larch	#2	15-5
	Douglas-fir–larch	#3	11-8
	Hemlock–fir	SS	18-0
	Hemlock–fir	#1	16-0
	Hemlock–fir	#2	15-2
	Hemlock–fir	#3	11-8
	Southern pine	SS	18-9

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Southern pine	#1	17-11
	Southern pine	#2	16-1
	Southern pine	#3	12-2
	Spruce–pine–fir	SS	17-8
	Spruce–pine–fir	#1	15-5
	Spruce–pine–fir	#2	15-5
	Spruce–pine–fir	#3	11-8
24	Douglas-fir–larch	SS	16-2
	Douglas-fir–larch	#1	13-5
	Douglas-fir–larch	#2	12-7
	Douglas-fir–larch	#3	9-6
	Hemlock–fir	SS	15-9
	Hemlock–fir	#1	13-1
	Hemlock–fir	#2	12-5
	Hemlock–fir	#3	9-6
	Southern pine	SS	16-5
	Southern pine	#1	14-7
	Southern pine	#2	13-1
	Southern pine	#3	9-11
	Spruce–pine–fir	SS	15-0
	Spruce–pine–fir	#1	12-7
	Spruce–pine–fir	#2	12-7
	Spruce–pine–fir	#3	9-6

TABLE 4-17 FLOOR JOIST SPANS (2 × 12) FOR 30 PSF LIVE LOAD AND 20 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
12	Douglas-fir–larch	SS	25-7
	Douglas-fir–larch	#1	22-0
	Douglas-fir–larch	#2	20-7
	Douglas-fir–larch	#3	15-7
	Hemlock–fir	SS	24-2
	Hemlock–fir	#1	21-6
	Hemlock–fir	#2	20-4
	Hemlock–fir	#3	15-7
	Southern pine	SS	25-1
	Southern pine	#1	24-8
	Southern pine	#2	21-9
	Southern pine	#3	16-8
	Spruce–pine–fir	SS	23-7
	Spruce–pine–fir	#1	20-7
	Spruce–pine–fir	#2	20-7
	Spruce–pine–fir	#3	15-7
16	Douglas-fir–larch	SS	23-0
	Douglas-fir–larch	#1	19-1
	Douglas-fir–larch	#2	17-10
	Douglas-fir–larch	#3	13-6
	Hemlock–fir	SS	21-11
	Hemlock–fir	#1	18-7
	Hemlock–fir	#2	17-7
	Hemlock–fir	#3	13-6
	Southern pine	SS	22-10

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
16	Southern pine	#1	21-4
	Southern pine	#2	18-10
	Southern pine	#3	14-6
	Spruce–pine–fir	SS	21-4
	Spruce–pine–fir	#1	17-10
	Spruce–pine–fir	#2	17-10
	Spruce–pine–fir	#3	13-6
24	Douglas-fir–larch	SS	18-9
	Douglas-fir–larch	#1	15-7
	Douglas-fir–larch	#2	14-7
	Douglas-fir–larch	#3	11-0
	Hemlock–fir	SS	18-5
	Hemlock–fir	#1	15-2
	Hemlock–fir	#2	14-4
	Hemlock–fir	#3	11-0
	Southern pine	SS	19-11
	Southern pine	#1	17-5
	Southern pine	#2	15-5
	Southern pine	#3	11-10
	Spruce–pine–fir	SS	17-5
	Spruce–pine–fir	#1	14-7
	Spruce–pine–fir	#2	14-7
	Spruce–pine–fir	#3	11-0

TABLE 4-18 FLOOR JOIST SPANS (2 × 6) FOR 40 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	11-4
	Douglas-fir–larch	#1	10-11
	Douglas-fir–larch	#2	10-9
	Douglas-fir–larch	#3	8-8
	Hemlock–fir	SS	10-9
	Hemlock–fir	#1	10-6
	Hemlock–fir	#2	10-0
	Hemlock–fir	#3	8-8
	Southern pine	SS	11-2
	Southern pine	#1	10-11
	Southern pine	#2	10-9
	Southern pine	#3	9-4
	Spruce–pine–fir	SS	10-6
	Spruce–pine–fir	#1	10-3
	Spruce–pine–fir	#2	10-3
	Spruce–pine–fir	#3	8-8
16	Douglas-fir–larch	SS	10-4
	Douglas-fir–larch	#1	9-11
	Douglas-fir–larch	#2	9-9
	Douglas-fir–larch	#3	7-6
	Hemlock–fir	SS	9-9
	Hemlock–fir	#1	9-6
	Hemlock–fir	#2	9-1
	Hemlock–fir	#3	7-6
	Southern pine	SS	10-2

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Southern pine	#1	9-11
	Southern pine	#2	9-9
	Southern pine	#3	8-1
	Spruce–pine–fir	SS	9-6
	Spruce–pine–fir	#1	9-4
	Spruce–pine–fir	#2	9-4
	Spruce–pine–fir	#3	7-6
24	Douglas-fir–larch	SS	9-0
	Douglas-fir–larch	#1	8-8
	Douglas-fir–larch	#2	8-1
	Douglas-fir–larch	#3	6-2
	Hemlock–fir	SS	8-6
	Hemlock–fir	#1	8-4
	Hemlock–fir	#2	7-11
	Hemlock–fir	#3	6-2
	Southern pine	SS	8-10
	Southern pine	#1	8-8
	Southern pine	#2	8-6
	Southern pine	#3	6-7
	Spruce–pine–fir	SS	8-4
	Spruce–pine–fir	#1	8-1
	Spruce–pine–fir	#2	8-1
	Spruce–pine–fir	#3	6-2

TABLE 4-19 FLOOR JOIST SPANS (2 × 8) FOR 40 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	15-0
	Douglas-fir–larch	#1	14-5
	Douglas-fir–larch	#2	14-2
	Douglas-fir–larch	#3	11-0
	Hemlock–fir	SS	14-2
	Hemlock–fir	#1	13-10
	Hemlock–fir	#2	13-2
	Hemlock–fir	#3	11-0
	Southern pine	SS	14-8
	Southern pine	#1	14-5
	Southern pine	#2	14-2
	Southern pine	#3	11-11
	Spruce–pine–fir	SS	13-10
	Spruce–pine–fir	#1	13-6
	Spruce–pine–fir	#2	13-6
	Spruce–pine–fir	#3	11-0
16	Douglas-fir–larch	SS	13-7
	Douglas-fir–larch	#1	13-1
	Douglas-fir–larch	#2	12-7
	Douglas-fir–larch	#3	9-6
	Hemlock–fir	SS	12-10
	Hemlock–fir	#1	12-7
	Hemlock–fir	#2	12-0
	Hemlock–fir	#3	9-6
	Southern pine	SS	13-4

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Southern pine	#1	13-1
	Southern pine	#2	12-10
	Southern pine	#3	10-3
	Spruce–pine–fir	SS	12-7
	Spruce–pine–fir	#1	12-3
	Spruce–pine–fir	#2	12-3
	Spruce–pine–fir	#3	9-6
24	Douglas-fir–larch	SS	11-11
	Douglas-fir–larch	#1	11-0
	Douglas-fir–larch	#2	10-3
	Douglas-fir–larch	#3	7-9
	Hemlock–fir	SS	11-3
	Hemlock–fir	#1	10-9
	Hemlock–fir	#2	10-2
	Hemlock–fir	#3	7-9
	Southern pine	SS	11-8
	Southern pine	#1	11-5
	Southern pine	#2	11-0
	Southern pine	#3	8-5
	Spruce–pine–fir	SS	11-0
	Spruce–pine–fir	#1	10-3
	Spruce–pine–fir	#2	10-3
	Spruce–pine–fir	#3	7-9

TABLE 4-20 FLOOR JOIST SPANS (2 × 10) FOR 40 PSF LIVE LOAD AND 10 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	19-1
	Douglas-fir–larch	#1	18-5
	Douglas-fir–larch	#2	17-9
	Douglas-fir–larch	#3	13-5
	Hemlock–fir	SS	18-0
	Hemlock–fir	#1	17-8
	Hemlock–fir	#2	16-10
	Hemlock–fir	#3	13-5
	Southern pine	SS	18-9
	Southern pine	#1	18-5
	Southern pine	#2	18-0
	Southern pine	#3	14-0
	Spruce–pine–fir	SS	17-8
	Spruce–pine–fir	#1	17-3
	Spruce–pine–fir	#2	17-3
	Spruce–pine–fir	#3	13-5
16	Douglas-fir–larch	SS	17-4
	Douglas-fir–larch	#1	16-5
	Douglas-fir–larch	#2	15-5
	Douglas-fir–larch	#3	11-8
	Hemlock–fir	SS	16-5
	Hemlock–fir	#1	16-0
	Hemlock–fir	#2	15-2
	Hemlock–fir	#3	11-8
	Southern pine	SS	17-0

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Southern pine	#1	16-9
	Southern pine	#2	16-1
	Southern pine	#3	12-2
	Spruce–pine–fir	SS	16-0
	Spruce–pine–fir	#1	15-5
	Spruce–pine–fir	#2	15-5
	Spruce–pine–fir	#3	11-8
24	Douglas-fir–larch	SS	15-2
	Douglas-fir–larch	#1	13-5
	Douglas-fir–larch	#2	12-7
	Douglas-fir–larch	#3	9-6
	Hemlock–fir	SS	14-4
	Hemlock–fir	#1	13-1
	Hemlock–fir	#2	12-5
	Hemlock–fir	#3	9-6
	Southern pine	SS	14-11
	Southern pine	#1	14-7
	Southern pine	#2	13-1
	Southern pine	#3	9-11
	Spruce–pine–fir	SS	14-0
	Spruce–pine–fir	#1	12-7
	Spruce–pine–fir	#2	12-7
	Spruce–pine–fir	#3	9-6

TABLE 4-21 FLOOR JOIST SPANS (2 × 12) FOR 40 PSF LIVE LOAD AND 10 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
12	Douglas-fir–larch	SS	23-3
	Douglas-fir–larch	#1	22-0
	Douglas-fir–larch	#2	20-7
	Douglas-fir–larch	#3	15-7
	Hemlock–fir	SS	21-11
	Hemlock–fir	#1	21-6
	Hemlock–fir	#2	20-4
	Hemlock–fir	#3	15-7
	Southern pine	SS	22-10
	Southern pine	#1	22-5
	Southern pine	#2	21-9
	Southern pine	#3	16-8
	Spruce–pine–fir	SS	21-6
	Spruce–pine–fir	#1	20-7
	Spruce–pine–fir	#2	20-7
	Spruce–pine–fir	#3	15-7
16	Douglas-fir–larch	SS	21-1
	Douglas-fir–larch	#1	19-1
	Douglas-fir–larch	#2	17-10
	Douglas-fir–larch	#3	13-6
	Hemlock–fir	SS	19-11
	Hemlock–fir	#1	18-7
	Hemlock–fir	#2	17-7
	Hemlock–fir	#3	13-6
	Southern pine	SS	20-9

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
16	Southern pine	#1	20-4
	Southern pine	#2	18-10
	Southern pine	#3	14-6
	Spruce–pine–fir	SS	19-6
	Spruce–pine–fir	#1	17-10
	Spruce–pine–fir	#2	17-10
	Spruce–pine–fir	#3	13-6
24	Douglas-fir–larch	SS	18-5
	Douglas-fir–larch	#1	15-7
	Douglas-fir–larch	#2	14-7
	Douglas-fir–larch	#3	11-0
	Hemlock–fir	SS	17-5
	Hemlock–fir	#1	15-2
	Hemlock–fir	#2	14-4
	Hemlock–fir	#3	11-0
	Southern pine	SS	18-1
	Southern pine	#1	17-5
	Southern pine	#2	15-5
	Southern pine	#3	11-10
	Spruce–pine–fir	SS	17-0
	Spruce–pine–fir	#1	14-7
	Spruce–pine–fir	#2	14-7
	Spruce–pine–fir	#3	11-0

TABLE 4-22 FLOOR JOIST SPANS (2 × 6) FOR 40 PSF LIVE LOAD AND 20 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	11-4
	Douglas-fir–larch	#1	10-11
	Douglas-fir–larch	#2	10-6
	Douglas-fir–larch	#3	7-11
	Hemlock–fir	SS	10-9
	Hemlock–fir	#1	10-6
	Hemlock–fir	#2	10-0
	Hemlock–fir	#3	7-11
	Southern pine	SS	11-2
	Southern pine	#1	10-11
	Southern pine	#2	10-9
	Southern pine	#3	8-6
	Spruce–pine–fir	SS	10-6
	Spruce–pine–fir	#1	10-3
	Spruce–pine–fir	#2	10-3
	Spruce–pine–fir	#3	7-11
16	Douglas-fir–larch	SS	10-4
	Douglas-fir–larch	#1	9-8
	Douglas-fir–larch	#2	9-1
	Douglas-fir–larch	#3	6-10
	Hemlock–fir	SS	9-9
	Hemlock–fir	#1	9-6
	Hemlock–fir	#2	8-11
	Hemlock–fir	#3	6-10
	Southern pine	SS	10-2

Joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Southern pine	#1	9-11
	Southern pine	#2	9-6
	Southern pine	#3	7-4
	Spruce–pine–fir	SS	9-6
	Spruce–pine–fir	#1	9-1
	Spruce–pine–fir	#2	9-1
	Spruce–pine–fir	#3	6-10
24	Douglas-fir–larch	SS	9-0
	Douglas-fir–larch	#1	7-11
	Douglas-fir–larch	#2	7-5
	Douglas-fir–larch	#3	5-7
	Hemlock–fir	SS	8-6
	Hemlock–fir	#1	7-9
	Hemlock–fir	#2	7-4
	Hemlock–fir	#3	5-7
	Southern pine	SS	8-10
	Southern pine	#1	8-8
	Southern pine	#2	7-9
	Southern pine	#3	6-0
	Spruce–pine–fir	SS	8-4
	Spruce–pine–fir	#1	7-5
	Spruce–pine–fir	#2	7-5
	Spruce–pine–fir	#3	5-7

TABLE 4-23 FLOOR JOIST SPANS (2 × 8) 40 PSF LIVE LOAD OR 20 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	15-0
	Douglas-fir–larch	#1	14-2
	Douglas-fir–larch	#2	13-3
	Douglas-fir–larch	#3	10-0
	Hemlock–fir	SS	14-2
	Hemlock–fir	#1	13-10
	Hemlock–fir	#2	13-1
	Hemlock–fir	#3	10-0
	Southern pine	SS	14-8
	Southern pine	#1	14-5
	Southern pine	#2	14-2
	Southern pine	#3	10-10
	Spruce–pine–fir	SS	13-10
	Spruce–pine–fir	#1	13-3
	Spruce–pine–fir	#2	13-3
	Spruce–pine–fir	#3	10-0
16	Douglas-fir–larch	SS	13-7
	Douglas-fir–larch	#1	12-4
	Douglas-fir–larch	#2	11-6
	Douglas-fir–larch	#3	8-8
	Hemlock–fir	SS	12-10
	Hemlock–fir	#1	12-0
	Hemlock–fir	#2	11-4
	Hemlock–fir	#3	8-8
	Southern pine	SS	13-4

Joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Southern pine	#1	13-1
	Southern pine	#2	12-4
	Southern pine	#3	9-5
	Spruce–pine–fir	SS	12-7
	Spruce–pine–fir	#1	11-6
	Spruce–pine–fir	#2	11-6
	Spruce–pine–fir	#3	8-8
24	Douglas-fir–larch	SS	11-11
	Douglas-fir–larch	#1	10-0
	Douglas-fir–larch	#2	9-5
	Douglas-fir–larch	#3	7-1
	Hemlock–fir	SS	11-3
	Hemlock–fir	#1	9-9
	Hemlock–fir	#2	9-3
	Hemlock–fir	#3	7-1
	Southern pine	SS	11-8
	Southern pine	#1	11-3
	Southern pine	#2	10-0
	Southern pine	#3	7-8
	Spruce–pine–fir	SS	11-0
	Spruce–pine–fir	#1	9-5
	Spruce–pine–fir	#2	9-5
	Spruce–pine–fir	#3	7-1

TABLE 4-24 FLOOR JOIST SPANS (2 × 10) FOR 40 PSF LIVE LOAD AND 20 PSF DEAD LOAD

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	19-1
	Douglas-fir–larch	#1	17-4
	Douglas-fir–larch	#2	16-3
	Douglas-fir–larch	#3	12-3
	Hemlock–fir	SS	18-0
	Hemlock–fir	#1	16-11
	Hemlock–fir	#2	16-0
	Hemlock–fir	#3	12-3
	Southern pine	SS	18-9
	Southern pine	#1	18-5
	Southern pine	#2	16-11
	Southern pine	#3	12-10
	Spruce–pine–fir	SS	17-8
	Spruce–pine–fir	#1	16-3
	Spruce–pine–fir	#2	16-3
	Spruce–pine–fir	#3	12-3
16	Douglas-fir–larch	SS	17-4
	Douglas-fir–larch	#1	15-0
	Douglas-fir–larch	#2	14-1
	Douglas-fir–larch	#3	10-7
	Hemlock–fir	SS	16-5
	Hemlock–fir	#1	14-8
	Hemlock–fir	#2	13-10
	Hemlock–fir	#3	10-7
	Southern pine	SS	17-0

Joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Southern pine	#1	16-4
	Southern pine	#2	14-8
	Southern pine	#3	11-1
	Spruce–pine–fir	SS	16-0
	Spruce–pine–fir	#1	14-1
	Spruce–pine–fir	#2	14-1
	Spruce–pine–fir	#3	10-7
24	Douglas-fir–larch	SS	14-9
	Douglas-fir–larch	#1	12-3
	Douglas-fir–larch	#2	11-6
	Douglas-fir–larch	#3	8-8
	Hemlock–fir	SS	14-4
	Hemlock–fir	#1	11-11
	Hemlock–fir	#2	11-4
	Hemlock–fir	#3	8-8
	Southern pine	SS	14-11
	Southern pine	#1	13-4
	Southern pine	#2	12-0
	Southern pine	#3	9-1
	Spruce–pine–fir	SS	13-8
	Spruce–pine–fir	#1	11-6
	Spruce–pine–fir	#2	11-6
	Spruce–pine–fir	#3	8-8

TABLE 4-25 FLOOR JOIST SPANS (2 × 12) FOR 40 PSF LIVE LOAD AND 20 PSF DEAD LOAD			
Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
12	Douglas-fir–larch	SS	23-3
	Douglas-fir–larch	#1	20-1
	Douglas-fir–larch	#2	18-10
	Douglas-fir–larch	#3	14-3
	Hemlock–fir	SS	21-11
	Hemlock–fir	#1	19-7
	Hemlock–fir	#2	18-6
	Hemlock–fir	#3	14-3
	Southern pine	SS	22-10
	Southern pine	#1	22-5
	Southern pine	#2	19-10
	Southern pine	#3	15-3
	Spruce–pine–fir	SS	21-6
	Spruce–pine–fir	#1	18-10
	Spruce–pine–fir	#2	18-10
	Spruce–pine–fir	#3	14-3
16	Douglas-fir–larch	SS	21-0
	Douglas-fir–larch	#1	17-5
	Douglas-fir–larch	#2	16-3
	Douglas-fir–larch	#3	12-4
	Hemlock–fir	SS	19-11
	Hemlock–fir	#1	17-0
	Hemlock–fir	#2	16-1
	Hemlock–fir	#3	12-4
	Southern pine	SS	20-9

Joist spacing (in.)	Species and grade		2 × 12 (ft-in.)
16	Southern pine	#1	19-6
	Southern pine	#2	17-2
	Southern pine	#3	13-2
	Spruce–pine–fir	SS	19-6
	Spruce–pine–fir	#1	16-3
	Spruce–pine–fir	#2	16-3
	Spruce–pine–fir	#3	12-4
24	Douglas-fir–larch	SS	17-1
	Douglas-fir–larch	#1	14-3
	Douglas-fir–larch	#2	13-4
	Douglas-fir–larch	#3	10-1
	Hemlock–fir	SS	16-10
	Hemlock–fir	#1	13-10
	Hemlock–fir	#2	13-1
	Hemlock–fir	#3	10-1
	Southern pine	SS	18-1
	Southern pine	#1	15-11
	Southern pine	#2	14-0
	Southern pine	#3	10-9
	Spruce–pine–fir	SS	15-11
	Spruce–pine–fir	#1	13-4
	Spruce–pine–fir	#2	13-4
	Spruce–pine–fir	#3	10-1

CEILING JOIST SPANS

Refer to Tables 4-26 through 4-31 for ceiling joist span specifications.

TABLE 4-26 CEILING JOIST SPANS (2 × 6) (UNINHABITABLE ATTICS WITHOUT STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 5 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	20-8
	Douglas-fir–larch	#1	19-11
	Douglas-fir–larch	#2	19-6
	Douglas-fir–larch	#3	15-10
	Hemlock–fir	SS	19-6
	Hemlock–fir	#1	19-1
	Hemlock–fir	#2	18-2
	Hemlock–fir	#3	15-10
	Southern pine	SS	20-3
	Southern pine	#1	19-11
	Southern pine	#2	19-6
	Southern pine	#3	17-0
	Spruce–pine–fir	SS	19-1
	Spruce–pine–fir	#1	18-8
	Spruce–pine–fir	#2	18-8
	Spruce–pine–fir	#3	15-10
16	Douglas-fir–larch	SS	18-9
	Douglas-fir–larch	#1	18-1
	Douglas-fir–larch	#2	17-8
	Douglas-fir–larch	#3	13-9
	Hemlock–fir	SS	17-8

Ceiling joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Hemlock–fir	#1	17-4
	Hemlock–fir	#2	16-6
	Hemlock–fir	#3	13-9
	Southern pine	SS	18-5
	Southern pine	#1	18-1
	Southern pine	#2	17-8
	Southern pine	#3	14-9
	Spruce–pine–fir	SS	17-4
	Spruce–pine–fir	#1	16-11
	Spruce–pine–fir	#2	16-11
	Spruce–pine–fir	#3	13-9
24	Douglas-fir–larch	SS	16-4
	Douglas-fir–larch	#1	15-9
	Douglas-fir–larch	#2	14-10
	Douglas-fir–larch	#3	11-2
	Hemlock–fir	SS	15-6
	Hemlock–fir	#1	15-2
	Hemlock–fir	#2	14-5
	Hemlock–fir	#3	11-2
	Southern pine	SS	16-1
	Southern pine	#1	15-9
	Southern pine	#2	15-6
	Southern pine	#3	12-0
	Spruce–pine–fir	SS	15-2
	Spruce–pine–fir	#1	14-9
	Spruce–pine–fir	#2	14-9
	Spruce–pine–fir	#3	11-2

Note: Check availability of lumber over 20 ft in length.

TABLE 4-27 CEILING JOIST SPANS (2 × 8) (UNINHABITABLE ATTICS WITHOUT STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 5 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	See note
	Douglas-fir–larch	#1	See note
	Douglas-fir–larch	#2	25-8
	Douglas-fir–larch	#3	20-1
	Hemlock–fir	SS	25-8
	Hemlock–fir	#1	25-2
	Hemlock–fir	#2	24-0
	Hemlock–fir	#3	20-1
	Southern pine	SS	See note
	Southern pine	#1	See note
	Southern pine	#2	25-8
	Southern pine	#3	21-8
	Spruce–pine–fir	SS	25-2
	Spruce–pine–fir	#1	24-7
	Spruce–pine–fir	#2	24-7
	Spruce–pine–fir	#3	20-1
16	Douglas-fir–larch	SS	24-8
	Douglas-fir–larch	#1	23-10
	Douglas-fir–larch	#2	23-0
	Douglas-fir–larch	#3	17-5
	Hemlock–fir	SS	23-4
	Hemlock–fir	#1	22-10
	Hemlock–fir	#2	21-9
	Hemlock–fir	#3	17-5

Ceiling joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Southern pine	SS	24-3
	Southern pine	#1	23-1
	Southern pine	#2	23-4
	Southern pine	#3	18-9
	Spruce–pine–fir	SS	22-10
	Spruce–pine–fir	#1	22-4
	Spruce–pine–fir	#2	22-4
	Spruce–pine–fir	#3	17-5
24	Douglas-fir–larch	SS	21-7
	Douglas-fir–larch	#1	20-1
	Douglas-fir–larch	#2	18-9
	Douglas-fir–larch	#3	14-2
	Hemlock–fir	SS	20-5
	Hemlock–fir	#1	19-7
	Hemlock–fir	#2	18-6
	Hemlock–fir	#3	14-2
	Southern pine	SS	21-2
	Southern pine	#1	20-10
	Southern pine	#2	20-1
	Southern pine	#3	15-4
	Spruce–pine–fir	SS	19-11
	Spruce–pine–fir	#1	18-9
	Spruce–pine–fir	#2	18-9
	Spruce–pine–fir	#3	14-2

Note: Check availability of lumber over 20 ft in length.

TABLE 4-28 CEILING JOIST SPANS (2 × 10) (UNINHABITABLE ATTICS WITHOUT STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 5 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	See note
	Douglas-fir–larch	#1	See note
	Douglas-fir–larch	#2	See note
	Douglas-fir–larch	#3	24-6
	Hemlock–fir	SS	See note
	Hemlock–fir	#1	See note
	Hemlock–fir	#2	See note
	Hemlock–fir	#3	24-6
	Southern pine	SS	See note
	Southern pine	#1	See note
	Southern pine	#2	See note
	Southern pine	#3	25-7
	Spruce–pine–fir	SS	See note
	Spruce–pine–fir	#1	See note
	Spruce–pine–fir	#2	See note
	Spruce–pine–fir	#3	24-6
16	Douglas-fir–larch	SS	See note
	Douglas-fir–larch	#1	See note
	Douglas-fir–larch	#2	See note
	Douglas-fir–larch	#3	21-3
	Hemlock–fir	SS	See note
	Hemlock–fir	#1	See note
	Hemlock–fir	#2	See note
	Hemlock–fir	#3	21-3

Ceiling joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Southern pine	SS	See note
	Southern pine	#1	See note
	Southern pine	#2	See note
	Southern pine	#3	22-2
	Spruce–pine–fir	SS	See note
	Spruce–pine–fir	#1	See note
	Spruce–pine–fir	#2	See note
	Spruce–pine–fir	#3	21-3
24	Douglas-fir–larch	SS	See note
	Douglas-fir–larch	#1	24-6
	Douglas-fir–larch	#2	22-11
	Douglas-fir–larch	#3	17-4
	Hemlock–fir	SS	See note
	Hemlock–fir	#1	23-11
	Hemlock–fir	#2	22-7
	Hemlock–fir	#3	17-4
	Southern pine	SS	See note
	Southern pine	#1	See note
	Southern pine	#2	23-11
	Southern pine	#3	18-1
	Spruce–pine–fir	SS	25-5
	Spruce–pine–fir	#1	22-11
	Spruce–pine–fir	#2	22-11
	Spruce–pine–fir	#3	17-4

Note: Check availability of lumber over 20 ft in length.

TABLE 4-29 CEILING JOIST SPANS (2 × 6) (UNINHABITABLE ATTICS WITH LIMITED STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 10 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
12	Douglas-fir–larch	SS	16-4
	Douglas-fir–larch	#1	15-9
	Douglas-fir–larch	#2	14-10
	Douglas-fir–larch	#3	11-2
	Hemlock–fir	SS	15-6
	Hemlock–fir	#1	15-2
	Hemlock–fir	#2	14-5
	Hemlock–fir	#3	11-2
	Southern pine	SS	16-1
	Southern pine	#1	15-9
	Southern pine	#2	15-6
	Southern pine	#3	12-0
	Spruce–pine–fir	SS	15-2
	Spruce–pine–fir	#1	14-9
	Spruce–pine–fir	#2	14-9
	Spruce–pine–fir	#3	11-2
16	Douglas-fir–larch	SS	14-11
	Douglas-fir–larch	#1	13-9
	Douglas-fir–larch	#2	12-10
	Douglas-fir–larch	#3	9-8
	Hemlock–fir	SS	14-1
	Hemlock–fir	#1	13-5
	Hemlock–fir	#2	12-8

Ceiling joist spacing (in.)	Species and grade		2 × 6 (ft-in.)
16	Hemlock–fir	#3	9-8
	Southern pine	SS	14-7
	Southern pine	#1	14-4
	Southern pine	#2	13-6
	Southern pine	#3	10-5
	Spruce–pine–fir	SS	13-9
	Spruce–pine–fir	#1	12-10
	Spruce–pine–fir	#2	12-10
	Spruce–pine–fir	#3	9-8
24	Douglas-fir–larch	SS	13-0
	Douglas-fir–larch	#1	11-2
	Douglas-fir–larch	#2	10-6
	Douglas-fir–larch	#3	7-11
	Hemlock–fir	SS	12-3
	Hemlock–fir	#1	10-11
	Hemlock–fir	#2	10-4
	Hemlock–fir	#3	7-11
	Southern pine	SS	12-9
	Southern pine	#1	12-6
	Southern pine	#2	11-0
	Southern pine	#3	8-6
	Spruce–pine–fir	SS	12-0
	Spruce–pine–fir	#1	10-6
	Spruce–pine–fir	#2	10-6
	Spruce–pine–fir	#3	7-11

Note: Check availability of lumber over 20 ft in length.

TABLE 4-30 CEILING JOIST SPANS (2 × 8) (UNINHABITABLE ATTICS WITH LIMITED STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 10 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
12	Douglas-fir–larch	SS	21-7
	Douglas-fir–larch	#1	20-1
	Douglas-fir–larch	#2	18-9
	Douglas-fir–larch	#3	14-2
	Hemlock–fir	SS	20-5
	Hemlock–fir	#1	19-7
	Hemlock–fir	#2	18-6
	Hemlock–fir	#3	14-2
	Southern pine	SS	21-2
	Southern pine	#1	20-10
	Southern pine	#2	20-1
	Southern pine	#3	15-4
	Spruce–pine–fir	SS	19-11
	Spruce–pine–fir	#1	18-9
	Spruce–pine–fir	#2	18-9
	Spruce–pine–fir	#3	14-2
16	Douglas-fir–larch	SS	19-7
	Douglas-fir–larch	#1	17-5
	Douglas-fir–larch	#2	16-3
	Douglas-fir–larch	#3	12-4
	Hemlock–fir	SS	18-6
	Hemlock–fir	#1	16-10
	Hemlock–fir	#2	16-0

Ceiling joist spacing (in.)	Species and grade		2 × 8 (ft-in.)
16	Hemlock–fir	#3	12-4
	Southern pine	SS	19-3
	Southern pine	#1	18-11
	Southern pine	#2	17-5
	Southern pine	#3	13-3
	Spruce–pine–fir	SS	18-1
	Spruce–pine–fir	#1	16-3
	Spruce–pine–fir	#2	16-3
	Spruce–pine–fir	#3	12-4
24	Douglas-fir–larch	SS	17-1
	Douglas-fir–larch	#1	14-2
	Douglas-fir–larch	#2	13-3
	Douglas-fir–larch	#3	10-0
	Hemlock–fir	SS	16-2
	Hemlock–fir	#1	13-10
	Hemlock–fir	#2	13-1
	Hemlock–fir	#3	10-0
	Southern pine	SS	16-10
	Southern pine	#1	15-10
	Southern pine	#2	14-2
	Southern pine	#3	10-10
	Spruce–pine–fir	SS	15-10
	Spruce–pine–fir	#1	13-3
	Spruce–pine–fir	#2	13-3
	Spruce–pine–fir	#3	10-0

Note: Check availability of lumber over 20 ft in length.

TABLE 4-31 CEILING JOIST SPANS (2 × 10) (UNINHABITABLE ATTICS WITH LIMITED STORAGE, LIVE LOAD 10 PSF, DEAD LOAD 10 PSF, DEFLECTION *L*/240)

Ceiling joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
12	Douglas-fir–larch	SS	See note
	Douglas-fir–larch	#1	24-6
	Douglas-fir–larch	#2	22-11
	Douglas-fir–larch	#3	17-4
	Hemlock–fir	SS	See note
	Hemlock–fir	#1	23-11
	Hemlock–fir	#2	22-7
	Hemlock–fir	#3	17-4
	Southern pine	SS	See note
	Southern pine	#1	See note
	Southern pine	#2	23-11
	Southern pine	#3	18-1
	Spruce–pine–fir	SS	25-5
	Spruce–pine–fir	#1	22-11
	Spruce–pine–fir	#2	22-11
	Spruce–pine–fir	#3	17-4
16	Douglas-fir–larch	SS	25-0
	Douglas-fir–larch	#1	21-3
	Douglas-fir–larch	#2	19-10
	Douglas-fir–larch	#3	15-0
	Hemlock–fir	SS	23-8
	Hemlock–fir	#1	20-8
	Hemlock–fir	#2	19-7

Ceiling joist spacing (in.)	Species and grade		2 × 10 (ft-in.)
16	Hemlock–fir	#3	15-0
	Southern pine	SS	24-7
	Southern pine	#1	23-1
	Southern pine	#2	20-9
	Southern pine	#3	15-8
	Spruce–pine–fir	SS	23-1
	Spruce–pine–fir	#1	19-10
	Spruce–pine–fir	#2	19-10
	Spruce–pine–fir	#3	15-0
24	Douglas-fir–larch	SS	20-11
	Douglas-fir–larch	#1	17-4
	Douglas-fir–larch	#2	16-3
	Douglas-fir–larch	#3	12-3
	Hemlock–fir	SS	20-6
	Hemlock–fir	#1	16-11
	Hemlock–fir	#2	16-0
	Hemlock–fir	#3	12-3
	Southern pine	SS	21-6
	Southern pine	#1	18-10
	Southern pine	#2	16-11
	Southern pine	#3	12-10
	Spruce–pine–fir	SS	19-5
	Spruce–pine–fir	#1	16-3
	Spruce–pine–fir	#2	16-3
	Spruce–pine–fir	#3	12-3

Note: Check availability of lumber over 20 ft in length.

FLOOR SHEATHING

Refer to Tables 4-32 to 4-35 for floor sheathing and plywood specifications.

TABLE 4-32 MINIMUM THICKNESS OF FLOOR SHEATHING

Joist spacing (in. OC)	*Minimum thickness (in.)*	
	Perpendicular to joist	Diagonal to joist
24	11/16	3/4
16	5/8	5/8
48	1 1/2 tongue and groove	N/A
54	1 1/2 tongue and groove	N/A
60	1 1/2 tongue and groove	N/A

Note: N/A, Not applicable.

TABLE 4-33 PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT

	Thickness (in.) for joist spacing (in. OC) of	
Plywood group	16	24
1	1/2 in.	3/4 in.
2 and 3	5/8 in.	7/8 in.
4	3/4 in.	1 in.

Note: Refer to Table 4-34 for plywood classifications.

TABLE 4-34 PLYWOOD CLASSIFICATIONS

Group	Species
1	Birch, Douglas-fir, larch, pine, maple, southern pine, tan oak
2	Cedar, cypress, fir, hemlock, lauan, black maple, western white pine, spruce, sweet gum, yellow poplar
3	Red alder, birch, maple, ponderosa pine, redwood, spruce
4	Aspen, cedar, cottonwood, sugar pine, eastern white pine
5	Basswood, fir, balsam, poplar

- Particle board sheathing cannot be less than ¼ in. thick.
- Sheathing sections need to span at least two supports.
- Subflooring may be omitted if joist spacing is 16 in. or less and if 1-in. tongue and groove is used.
- Notches cannot be longer than ⅓ the depth on the joist.

TABLE 4-35 GRADES OF VENEER-QUALITY PLYWOOD	
Grade	**Characteristics**
N	High quality intended for natural finish, allows some repairs, free of all open defects.
A	Paintable and very smooth, can be used as natural finish with minimal repairs permissible.
B	Solid surface with repair plugs and tight knots permitted. Can be painted.
C	Some sanding defects that do not affect strength or service of panel, typical knotholes less than 1½ in. and splits less than ½ in.
C (plugged)	Higher quality than c above. Surfaces are fully sanded.
D	Lesser quality, used in interior backing not seen. Knotholes up to 2½ in. permitted as well as limited splits.

Subflooring and Underlayment

- Provide space for ¼-in. clearance at walls.
- Be sure that underlayment joints are offset from parallel subflooring joints.
- When a combination subfloor is used support all joints except tongue-and-groove edges.
- Surfaces, including joints and fastener locations, should be smooth for finish flooring.
- Is correct side of material used?

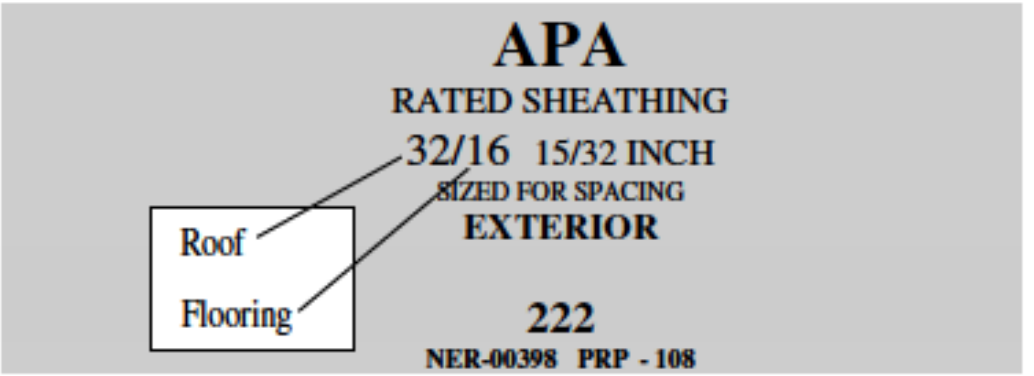
Furring Strips

- Provide a true even plane for finish material. Check with straight edge and/or stringline.

- Shim between furring and framing as necessary to produce a true even plane. This is necessary on walls as well as ceilings.
- Furring strips are required to have pressure preservative treatment when fastened to the inside face of exterior masonry or concrete and when located below grade.

Plywood Groups and Exposure Ratings

Refer to Tables 4-34 and 4-35 for plywood groups and characteristics. Exposure ratings (see Figure 4-16) are as follows:



(first number is maximum span allowed for roof decking while second is maximum allowed for floor decking)

Figure 4-16 TYPICAL PLYWOOD STAMP (FIRST NUMBER IS MAXIMUM SPAN ALLOWED FOR ROOF DECKING WHILE SECOND IS MAXIMUM ALLOWED FOR FLOOR DECKING)

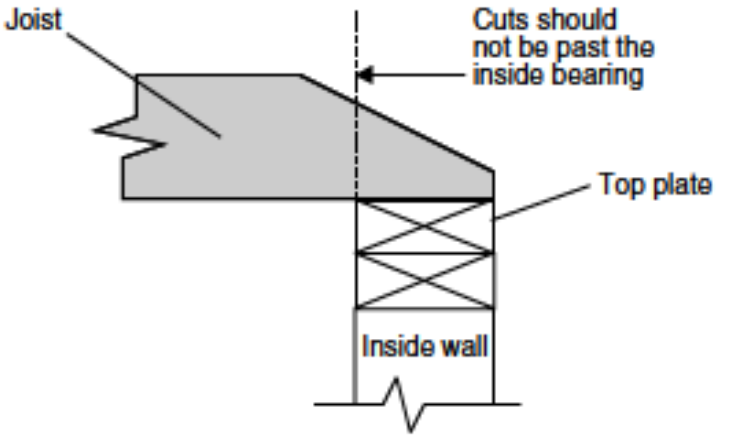


Figure 4-17

Exterior Fully waterproof bond. Designed for applications where panels are subject to permanent ongoing exposure to moisture.

Exterior, Exposure 1 Fully waterproof bond, but not intended for permanent ongoing exposure to moisture.

Exterior, Exposure 2 Interior type with intermediate glue. Intended for protected applications where only slight exposure to moisture is likely to occur.

Interior Designed for interior applications only.

THINK SAFETY AT ALL TIMES

CHAPTER 5
WALL FRAMING

WALL AND PARTITION FRAMING

- ❑ Check stud size, heights, and spacing.
- ❑ Check bottom plate. Make sure it is preservative treated.
- ❑ Check stud grade stamps.
- ❑ Ensure that top plates are doubled up for bearing walls and bearing partitions.
- ❑ Ensure that top plates are correctly lapped.
- ❑ Ensure that top plate joints are correctly offset.
- ❑ Check for horizontal blocking if required.
- ❑ Check specifications. Is solid bearing specified for all edges and ends of gypsum board, plywood, fiber board, and similar sheet materials? If so, check for continuous blocking between studs, joists, and/or furring.
- ❑ See that nailing of studs to plates is per code.
- ❑ Check wind bracing requirements. Is special diagonal wind bracing called for? Check seismic zone.
- ❑ Ensure that solid blocking is provided for the hanging of fixtures, handrails, cabinets, baseboard, or wall hung heaters and similar items.

- ❏ Check doubling of studs at openings.
- ❏ Check both load-bearing and non-load-bearing studs for cuts, holes, and notches in excess of minimum code requirements.

Refer to Tables 5-1 to 5-3 for stud height and spacing specifications. The following design is used for Tables 5-1 to 5-3:

TABLE 5-1 STUD HEIGHTS AND SPACING, ONE FLOOR

	Spacing (in. OC)			
Height (ft)	**24**	**16**	**12**	**8**
<10	2×4	2×4	2×4	2×4
<12	2×6	2×4	2×4	2×4
<14	2×6	2×6	2×4	2×4
<16	2×6	2×6	2×6	2×4
<18	Design	2×6	2×6	2×6
<20	Design	Design	2×6	2×6
<24	Design	Design	Design	2×6

Note: See text for design details.

TABLE 5-2 STUD HEIGHTS AND SPACING, ONE FLOOR AND ONE ROOF

Height (ft)	*Spacing (in. OC)*			
	24	16	12	8
<10	2×6	2×4	2×4	2×4
<12	2×6	2×6	2×6	2×4
<14	2×6	2×6	2×6	2×6
<16	Design	2×6	2×6	2×6
<18	Design	2×6	2×6	2×6
<20	Design	Design	2×6	2×6
<24	Design	Design	Design	2×6

Note: See text for design details.

TABLE 5-3 STUD HEIGHTS AND SPACING, TWO FLOORS AND ONE ROOF

Height (ft)	*Spacing (in. OC)*			
	24	16	12	8
<10	2×6	2×6	2×4	2×4
<12	2×6	2×6	2×6	2×6
<14	2×6	2×6	2×6	2×6
<16	Design	Design	2×6	2×6
<18	Design	Design	2×6	2×6
<20	Design	Design	Design	2×6
<24	Design	Design	Design	Design

Note: See text for design details.

- Snow load <25 psf
- Bending force F_b > 1310 psi
- Elasticity E > 1,600,000 psi
- Tributary dimensions for floors and roofs <6 ft
- Maximum span not exceeding 12 ft
- Eaves <2 ft

INSPECTION OF STUDS

- ❑ Check that studs are selected to provide true plane surfaces.
- ❑ Check that alignment does not vary more than ⅛ in. from the plane of the faces.
- ❑ Check after installation for crook, bow, twist, oversized knots, and other imperfections over and above previous inspections. Unsuitable material should be repaired or removed and replaced as required by the specifications. For wood, drywall, or any sheet panel surfacing, it is especially important to check every stud for plumbness and minimum crook or bow.
- ❑ Check that the method of repair is restricted to an occasional stud and under no circumstances are two or more adjacent studs to be kerfed and scabbed.
- ❑ Review studs for proper grade:
  - Typical grading values of studs are select structural, no. 1, no. 2, no. 3, stud

grade, construction grade, standard grade, and utility grade.
- Studs need to be minimum no #3, standard, or stud grade.
- Studs may be utility if not supporting floors.

❑ Check for proper stud spacing (when studs are not more than 10 ft in height, see Tables 5-1 to 5-3).

❑ Check for a double top plate, with laps offset by at least 48 in. Interior non-load-bearing walls may have single top plate. A single

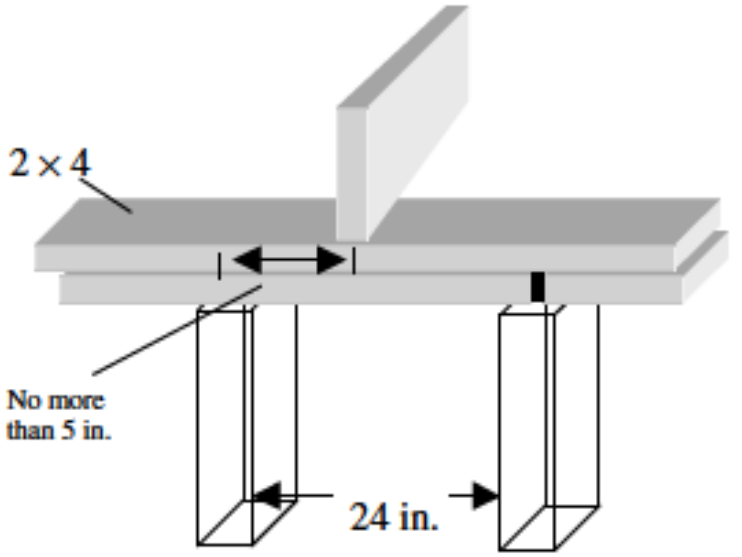


Figure 5-1 MAXIMUM JOIST OFFSET WHEN STUDS SPACED AT 24 IN. OC.

top plate also may be used under these conditions:

- A 3 × 6-in. .036-gauge plate is nailed to each wall segment.
- Rafters or joists are centered no more than 1 in. over studs.

❑ Check joist offset. If joists or rafters are spaced more than 16 in. and studs are 24 in. OC, they must rest within 5 in. of bearing studs (see Figure 5-1). (This requirement does not apply if using 2 × 6 plates.)

❑ Check non-load-bearing partitions:

- 2 × 4 (flat) if 16 in. OC
- 2 × 3 if 24 in. OC

❑ Check stud notching, cutting, and drilling (Tables 5-4 and 5-5):

- Any cuts or notches in exterior or load-bearing wall studs must be less than 25% of the width.
- Stud cuts in non-load-bearing walls must be less than 40% of the width.

TABLE 5-4 HOLES AND NOTCHING IN LOAD-BEARING STUDS

Nominal	Actual	Holes		Notching
		40%	60%	25%
2 × 4	1½ × 3½	1 13/32	2 3/32	7/8
2 × 6	1½ × 5½	2 3/16	3 5/16	1 3/8

TABLE 5-5 HOLES AND NOTCHING IN NON-LOAD-BEARING STUDS

Nominal	Actual	Holes		Notching
		40%	60%	40%
2 × 4	1½ × 3½	1 13/32	2 3/32	1 13/32
2 × 6	1½ × 5½	2 3/16	3 5/16	2 3/16

- Any holes must be less than 40% of the width.
- No holes are allowed within ⅝ in. of the edge.
- Holes may be up to 60% of width if studs are doubled, and no more than two holes in a row are allowed.

TOP PLATES

- ❑ Check that top plates are lapped at least 24″ in. (see Figure 5-2).
- ❑ Check that corner top plates are lapped.
- ❑ Ensure that if cut more than 50%, the top plate has a 24-gauge steel strap spanning between the two studs. Plumbing vents usually will dictate this.

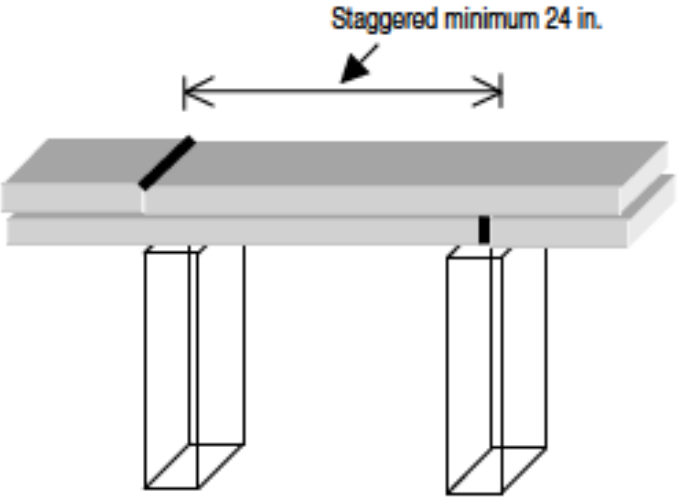


Figure 5-2 TOP PLATE LAP

WALL SHEATHING

Refer to Tables 5-6 to 5-8.

- ❑ Check sheathing or planks against specification requirements for:
  - Type of material
  - Grade
  - Moisture content
  - Thickness
  - Fire-rating
- ❑ Check that sizes and lengths of nails or fasteners are as specified.
- ❑ Check whether horizontal or diagonal application is required.
- ❑ Check that end joints occur only over framing members, and boards are accurately sawed.

TABLE 5-6 MINIMUM THICKNESS OF WALL SHEATHING

Sheathing type	Minimum thickness (in.)	Maximum wall stud spacing (in. OC)
Wood boards	5/8	24
Fiberboard	1/2	16
Wood structural panel (plywood)	In accordance with Table 5.7	—
M-S exterior glue and M-2 exterior glue particleboard	In accordance with Table 5-8	—
Gypsum sheathing	1/2	16
Gypsum wallboard	1/2	24
Reinforced cement mortar	1	24

- ❑ Check that sheathing extends over top and bottom plates.
- ❑ Check that specified sheathing paper is installed as soon as practical after sheathing installation.
- ❑ Check fastening to every bearing for specified number of nails at specified spacing.
- ❑ Check plywood or oriented strand board (OSB) sheathing for type, grade, and thickness required.
- ❑ Check for required space at joints.

TABLE 5-7 WOOD STRUCTURAL PANEL WALL SHEATHING (NOT EXPOSED TO WEATHER)

Minimum thickness (in.)	Panel span rating	Stud spacing (in.)		
			Nailable sheathing	
		Siding nailed to studs	Sheathing parallel to studs	Sheathing perpendicular to studs
5/16	12/0, 16/0, 20/0, wall 16 in. OC	16	—	16
3/8, 15/32, 1/2	16/0, 20/0, 24/0, 32/16, wall 24 in. OC	24	16	24
7/16, 15/32, 1/2	24/0, 24/16, 32/16, in. wall 24 in. OC	24	24	24

Note: Plywood must consist of four or more plies.

Wood Sheathing

- ❑ Ensure that all courses are driven up tight.
- ❑ Ensure that joints are staggered with at least two boards between joints.
- ❑ Ensure that there is 1/8-in. expansion allowance made at edges and ends of fiberboard sheathing.
- ❑ Ensure that joint edges of gypsum board sheathing are in light contact.

TABLE 5-8 ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING (NOT EXPOSED TO WEATHER)

Grade	Thickness (in.)	*Stud spacing (in.)* For siding nailed to studs
M-S exterior glue	3/8	16
M-2 exterior glue	1/2	16

- ❑ Ensure that 4-ft-wide gypsum board and fiberboard are installed vertically. Also, check for diagonal wind bracing requirement.

Particleboard Wall Sheathing

- ❑ Check that a 1/16-in. gap is left at the edges.
- ❑ Check that nailing is no closer than 3/8 in. to the edge.
- ❑ Check that joints are staggered (four joints can never touch).

Nailing

Refer to Table 5-9 for a typical nailing schedule for plywood and particleboard for subfloor, roof, and wall sheathing.

TABLE 5-9 CODE-REQUIRED NAILING SCHEDULE FOR SHEATHING

Thickness (in.)	Type nails	Edge (in.)	Intermediate (in.)
5/16–1/2	6d common		
	subfloor	6	12
	wall	6	12
19/32–1	8d common roof	6	12
	8d common	6	12
1⅛–1¼	10d common or 8d deformed	6	12

Nailing exterior wall sheathing at wall corners requires different nailing configuration than regular wall fastening. (See Figures 5-3 and 5-4.)

The code allows for staples to be used in lieu of the designated pennyweight nail, but the required spacing is altered (usually 3 in. OC instead of 6 in. OC for nails).

Flashing

Exterior sheathing should have proper flashing around wall openings (see Figure 5-5). House wraps are not flashing and do not meet the code for such.

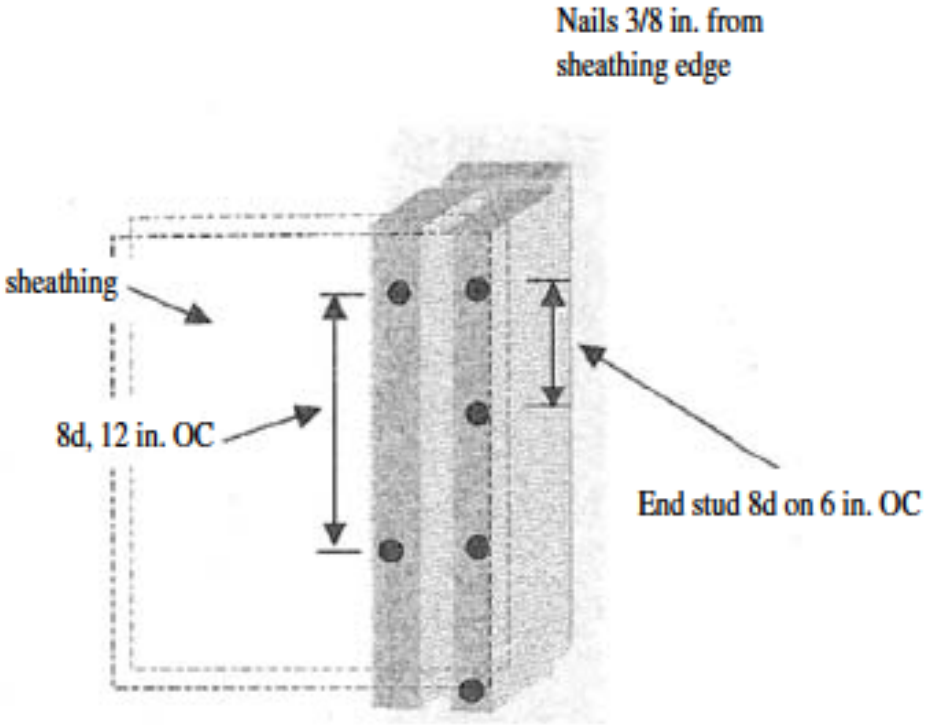


Figure 5-3 NAIL SPACING AT EXTERIOR WALL CORNERS

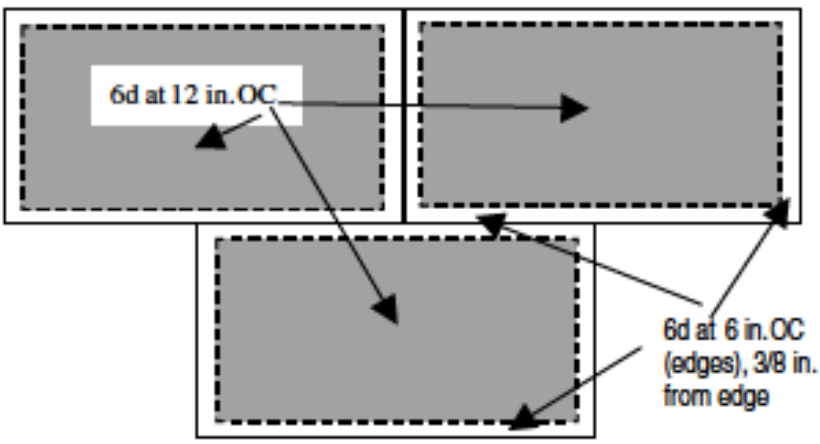


Figure 5-4 NAILING SHEATHING FOR WALLS AND SUBFLOORING (DARKENED AREA IS THE "FIELD")

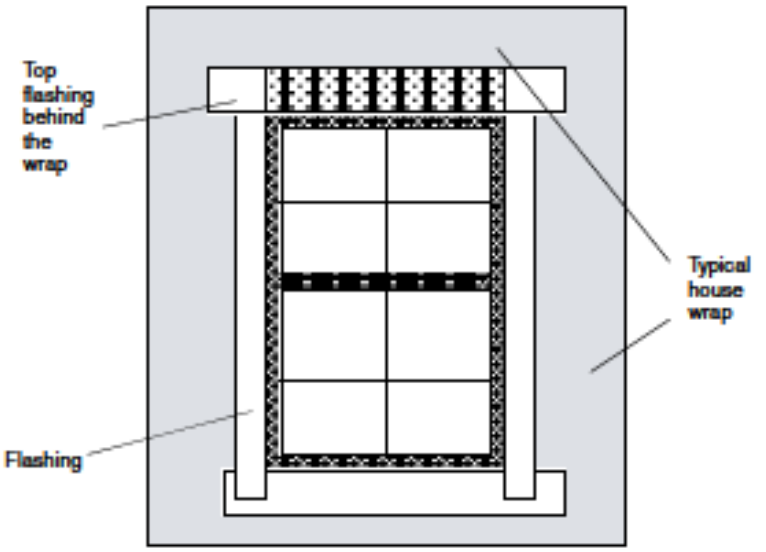


Figure 5-5 FLASHING AROUND OPENING WITH WALLS USING HOUSE WRAP

PLYWOOD GRADE DESIGNATIONS AND DESCRIPTIONS

APA Rated Sheathing EXT Exterior sheathing panel for subflooring and wall and roof sheathing, siding on service and farm buildings, crating, pallets, pallet bins, cable reels, etc. manufactured as conventional veneered plywood, as a composite, or as a nonveneered panel

APA Structural 1 and 2 Rated Sheathing EXT For engineered applications in construction and industry where resistance to permanent exposure to weather or moisture is

required; manufactured as conventional veneered plywood, as a composite, or as a nonveneered panel; unsanded, structural type more commonly available

APA Rated Sturd-I-Floor EXT For combination subfloor–underlayment under carpet where severe moisture conditions may be present, as in balcony decks; high concentrated and impact load resistance; manufactured as conventional veneered plywood, as a composite, or as a nonveneered panel; available in square-edge or tongue-and-groove

APA A-C EXT For use where the appearance of only one side is important: soffits, fences, structural uses, boxcar and truck linings, farm buildings, tanks, trays, and commercial refrigerators

APA B-C EXT Utility panel for farm service and work buildings, boxcar and truck linings, containers, tanks, agricultural equipment; also as a base for exterior coatings for walls and roofs

APA B-B EXT Utility panel with solid faces

APA Underlayment C-C Plugged EXT For application over structural subfloor; smooth surface for application of carpet and high concentrated and impact load resistance; touch-sanded;

for areas to be covered with thin resilient flooring (using panels with sanded face)

APA C-C Plugged EXT For use as an underlayment over structural subfloor, open soffits, and other similar applications where continuous or severe moisture may be present; smooth surface for carpet and high concentrated and impact load resistance; touch-sanded

APA B.B Plyform Class 1 and Class 2 EXT Concrete form grades with high reuse factor; sanded on both sides and mill-oiled unless otherwise specified; special restrictions on species; also available in HDO for very smooth concrete finish, in structural 1 (all plies limited to group 1 species; see Table 4-35), and with special overlays

APA Marine EXT Ideal for boat hulls; only of Douglas-fir or western larch; special solid jointed core construction

APA HDO EXT High-density overlay; hard semiopaque resin-fiber overlay on both faces; abrasion resistant; for concrete forms

APA MDO EXT Medium-density overlay; smooth, opaque, resin-fiber overlay on one or both faces; ideal base for paint, indoors and outdoors

APA-Rated Sheathing Exp 1 or 2 Specially designed for subflooring and wall and roof sheathing, but also used for a broad range of other applications; manufactured as conventional veneered plywood, as a composite, or as a nonveneered panel; exposure 1 for long construction delays

APA Structural 1- and 2-Rated Sheathing Exp 1 Unsanded panel grades for use where strength is of maximum importance: structural diaphragms, box beams, gusset plates, and stressed-skin panels; manufactured as conventional veneered plywood, as a composite, or as a nonveneered panel

APA-Rated Sturd-I-Floor Exp 1 or 2 Specially designed as combination subfloor–underlayment; smooth surface for application of carpet and high concentrated and impact load resistance; manufactured as conventional plywood, as a composite, or as a reconstituted wood panel (waferboard, oriented strand board, structural particleboard); available square-edge or tongue-and-groove

APA-Rated Sturd-I-Floor 48 OC (2-4-1) Exp 1 For combination subfloor–underlayment on 32-in. and 48-in. spans and for heavy timber roof construction; manufactured only as

conventional plywood; available square-edge or tongue-and-groove

APA Underlayment INT For application over structural subfloor; smooth surface for application of carpet and high concentrated and impact load resistance; touch-sanded; for areas to be covered with thin resilient flooring (using panels with fully sanded face)

APA A-D INT For use where appearance of only one side is important: paneling, built-ins, shelving, and partitions

APA B-D INT Utility panel with one solid side; good for backing, sides of built-ins, shelving, etc.

APA C-D Plugged INT For built-ins, wall and ceiling tile backing, cable reels, and walkways; not a substitute for underlayment or Sturd-I-Floor due to lack of their indentation resistance; touch-sanded; also available with exterior glue

APA A-A INT For applications with both sides on view: built-ins, cabinets, furniture, partitions; smooth face, suitable for painting

APA A-B INT For use where appearance of one side is less important but where two solid surfaces are necessary

APA B-B INT Utility panel with two solid surfaces

HEADERS

Refer to Figure 5-6.

- ❑ Check that headers for wide openings are constructed as detailed on the drawings.
- ❑ Check lumber grade.
- ❑ Check bearing of header members on studs at both ends.
- ❑ Check that there are the required number of jack studs.
- ❑ Check that the correct size and spacing of nails have been used.

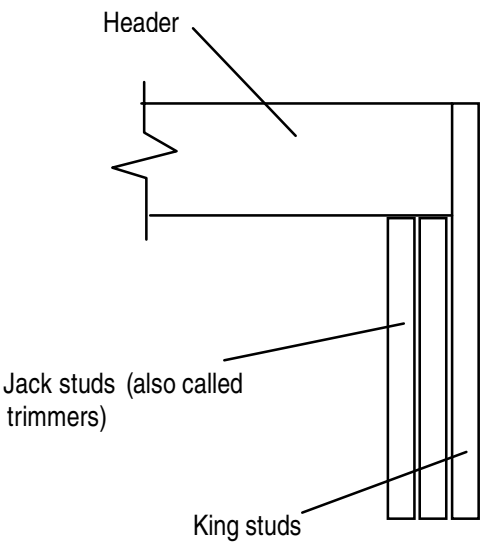


Figure 5-6 HEADER DESCRIPTION

- ❑ Check support needs. If headers are non-bearing, then they only need 2 × 4 laying flat (for up to 8 ft).
- ❑ Check that a minimum of No. 2 grade lumber is used.

EXTERIOR WALL HEADER SPANS

Refer to Tables 5-10 through 5-17 for exterior wall header span specifications.

TABLE 5-10 EXTERIOR WALLS HEADERS SUPPORTING ROOF AND CEILING, GROUND SNOW LOAD 30 PSF

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	5-5	1	4-8	1	4-2	1
2-2 × 8	6-10	1	5-11	2	5-4	2
2-2 × 10	8-5	2	7-3	2	6-6	2
2-2 × 12	9-9	2	8-5	2	7-6	2
3-2 × 8	8-4	1	7-5	1	6-8	1
3-2 × 10	10-6	1	9-1	2	8-2	2
3-2 × 12	12-2	2	10-7	2	9-5	2
4-2 × 8	7-0	1	6-1	2	5-5	2
4-2 × 10	11-8	1	10-6	1	9-5	2
4-2 × 12	14-1	1	12-2	2	10-11	2

TABLE 5-11 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND ONE CENTER-BEARING FLOOR, GROUND SNOW LOAD 30 PSF

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-6	1	4-0	1	3-7	2
2-2 × 8	5-9	2	5-0	2	4-6	2
2-2 × 10	7-0	2	6-2	2	5-6	2
2-2 × 12	8-1	2	7-1	2	6-5	2
3-2 × 8	7-2	1	6-3	2	5-8	2
3-2 × 12	10-2	2	8-11	2	8-0	2
4-2 × 8	5-10	2	5-2	2	4-8	2
4-2 × 10	10-1	1	8-10	2	8-0	2
4-2 × 12	11-9	2	10-3	2	9-3	2

TABLE 5-12 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND ONE CLEAR SPAN FLOOR, GROUND SNOW LOAD 30 PSF

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-11	1	3-5	2	3-0	2
2-2 × 8	5-0	2	4-4	2	3-10	2
2-2 × 10	6-1	2	5-3	2	4-8	2
2-2 × 12	7-1	2	6-1	3	5-5	3
3-2 × 8	6-3	2	5-5	2	4-10	2
3-2 × 10	7-7	2	6-7	2	5-11	2
3-2 × 12	8-10	2	7-8	2	6-10	2
4-2 × 8	5-1	2	4-5	2	3-11	2
4-2 × 10	8-9	2	7-7	2	6-10	2
4-2 × 12	10-2	2	8-10	2	7-11	2

TABLE 5-13 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND TWO CENTER-BEARING FLOORS, GROUND SNOW LOAD 30 PSF

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-9	2	3-3	2	2-11	2
2-2 × 8	4-9	2	4-2	2	3-9	2
2-2 × 10	5-9	2	5-1	2	4-7	3
2-2 × 12	6-8	2	5-10	3	5-3	3
3-2 × 8	5-11	2	5-2	2	4-8	2
3-2 × 12	8-5	2	7-4	2	6-7	2
4-2 × 8	4-10	2	4-3	2	3-10	2
4-2 × 10	8-4	2	7-4	2	6-7	2
4-2 × 12	9-8	2	8-6	2	7-8	2

TABLE 5-14 EXTERIOR WALL HEADERS SUPPORTING ROOF AND CEILING, GROUND SNOW LOAD 50 PSF

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-8	1	4-1	1	3-8	2
2-2 × 8	5-11	2	5-2	2	4-7	2
2-2 × 10	7-3	2	6-3	2	5-7	2
2-2 × 12	8-5	2	7-3	2	6-6	2
3-2 × 8	7-5	1	6-5	2	5-9	2
3-2 × 10	9-1	2	7-10	2	7-0	2
3-2 × 12	10-7	2	9-2	2	8-2	2
4-2 × 8	6-1	2	5-3	2	4-8	2
4-2 × 10	10-6	1	9-1	2	8-2	2
4-2 × 12	12-2	2	10-7	2	9-5	2

TABLE 5-15 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND ONE CENTER-BEARING FLOOR, GROUND SNOW LOAD 50 PSF

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	4-1	1	3-7	2	3-3	2
2-2 × 8	5-2	2	4-6	2	4-1	2
2-2 × 10	6-4	2	5-6	2	5-0	2
2-2 × 12	7-4	2	6-5	2	5-9	3
3-2 × 8	6-5	2	5-8	2	5-1	2
3-2 × 10	7-11	2	6-11	2	6-3	2
3-2 × 12	9-2	2	8-0	2	7-3	2
4-2 × 8	5-3	2	4-7	2	4-2	2
4-2 × 10	9-1	2	8-0	2	7-2	2
4-2 × 12	10-7	2	9-3	2	8-4	2

TABLE 5-16 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND ONE CLEAR SPAN FLOOR, GROUND SNOW LOAD 50 PSF

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-10	2	3-4	2	3-0	2
2-2 × 8	4-10	2	4-2	2	3-9	2
2-2 × 10	5-11	2	5-1	2	4-7	3
2-2 × 12	6-10	2	5-11	3	5-4	3
3-2 × 8	6-1	2	5-3	2	4-8	2
3-2 × 10	7-5	2	6-5	2	5-9	2
3-2 × 12	8-7	2	7-5	2	6-8	2
4-2 × 8	4-11	2	4-3	2	3-10	2
4-2 × 10	8-7	2	7-5	2	6-7	2
4-2 × 12	9-11	2	8-7	2	7-8	2

TABLE 5-17 EXTERIOR WALL HEADERS SUPPORTING ROOF, CEILING, AND TWO CENTER-BEARING FLOORS, GROUND SNOW LOAD 50 PSF

	Building width (ft)					
	20		*28*		*36*	
Size	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2 × 6	3-8	2	3-2	2	2-10	2
2-2 × 8	4-7	2	4-0	2	3-8	2
2-2 × 10	5-8	2	4-11	2	4-5	3
2-2 × 12	6-6	2	5-9	3	5-2	3
3-2 × 8	5-9	2	5-1	2	4-7	2
3-2 × 10	7-1	2	6-2	2	5-7	2
3-2 × 12	8-2	2	7-2	2	6-5	3
4-2 × 8	4-9	2	4-2	2	3-9	2
4-2 × 10	8-2	2	7-2	2	6-5	2
4-2 × 12	9-5	2	8-3	2	7-5	2

INTERIOR HEADER SPANS

Refer to Tables 5-18 and 5-19 for interior header span specifications.

TABLE 5-18 INTERIOR HEADERS SUPPORTING ONE FLOOR ONLY

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2×6	4-6	1	3-11	1	3-6	1
2-2×8	5-9	1	5-0	2	4-5	2
2-2×10	7-0	2	6-1	2	5-5	2
2-2×12	8-1	2	7-0	2	6-3	2
3-2×8	7-2	1	6-3	1	5-7	2
3-2×10	8-9	1	7-7	2	6-9	2
3-2×12	10-2	2	8-10	2	7-10	2
4-2×8	5-10	1	5-1	2	4-6	2
4-2×10	10-1	1	8-9	1	7-10	2
4-2×12	11-9	1	10-2	2	9-1	2

TABLE 5-19 INTERIOR HEADERS SUPPORTING TWO FLOORS ONLY

Size	*Building width (ft)*					
	20		*28*		*36*	
	Span	No. of jacks	Span	No. of jacks	Span	No. of jacks
2-2×6	3-2	2	2-9	2	2-5	2
2-2×8	4-1	2	3-6	2	3-2	2
2-2×10	4-11	2	4-3	2	3-10	3
2-2×12	5-9	2	5-0	3	4-5	3
3-2×8	5-1	2	4-5	2	3-11	2
3-2×10	6-2	2	5-4	2	4-10	2
3-2×12	7-2	2	6-3	2	5-7	3
4-2×8	4-2	2	3-7	2	3-2	2
4-2×10	7-2	2	6-2	2	5-6	2
4-2×12	8-4	2	7-2	2	6-5	2

WALL BRACING

Shown below are code standards for Seismic Cat A&B (low probability). Special considerations and attachments are required for seismic zones C, D1, and D2 or where winds exceed 100 mph. Check your area.

For code-approved braced wall methods, refer to Table 5-20 and the following:

Method 1: 1 by 4 let in bracing from bottom plate to top plate, angled not more than 60° or less than 45°

Method 2: 5/8-in. wood boards applied diagonally, spaced a maximum of 24 in.

Method 3: 5/16-in. wood structural panel sheathing for studs 16 in. OC (minimum of 3/8 in. for studs spaced on 24 in. OC)

Method 4: 1/2- or 25/32-in. structural fiberboard sheathing applied vertically for studs 16 in. OC

Method 5: 1/2-in. gypsum board on studs spaced 24 in. OC (fastened at 7 in. OC)

Method 6: Particle board installed in accordance to the international code fastener schedule

Method 7: Portland cement plaster on studs 16 in. OC when installed as per international code applications

Method 8: 7/16-in. minimum hardboard panel siding when installed with fasteners penetrating 1½ in. of the framing members on 6 in. OC for edges and 12 in. OC supplemental

TABLE 5-20 WALL BRACING METHODS

Area	Bracing method	Location and amount of bracing
One story, top of two or three story	1, 2, 3, 4, 5, 6, 7, or 8	Located at each end and at least every 25 ft OC but not less than 16% of braced wall line
First story of two story, second story of three story	1, 2, 3, 4, 5, 6, 7, or 8	Located at each end and at least every 25 ft but not less than 16% of braced wall line for method 3 and 25% for methods 2, 3, 4, 5, 6, 7, or 8
First story of three story	2, 3, 4, 5, 6, 7, or 8	Minimum of 48-in. wide panels at each end and at least every 25 ft OC, but not less than 25% of braced wall for method 3 and 35% of braced wall line for methods 2, 3, 4, 5, 6, 7, or 8

FIRE-STOPPING

Fire-stopping is required in the following situations:

- To cut off all concealed vertical and horizontal openings

- Between floors and roofs, soffits, drop ceilings, and cove ceilings
- In furred spaces at ceilings and floors
- Around vents, pipes, ducts, chimneys, and fireplaces

Fire-Stop Materials

The following is a list of code-approved fire-stopping materials:

- 2-in. nominal lumber
- 23/32-structural panel with joints backed with same
- ¾-in. particleboard with joints backed with same
- ½-in. gypsum board
- ¼-in. cement millboard
- Unfaced fiberglass for around vents, pipes, ducts, chimneys, and fireplaces

Unfaced fiberglass must fill the wall cavity a minimum of 16 in. vertically and must be packed around piping, conduits, etc.

FASTENERS AND NAILING SCHEDULES

Typical nails are shown in Figure 5-7.

Refer to Table 5-21 for nailing schedules in different building members.

TABLE 5-21 NAILING SCHEDULE

Building members	Number and type	Spacing (in. OC)
Joist to sill or girder	3-8d	N/A
Sole plate to joist or blocking, face nail	16d	16
Top plate/sole to stud, end nail	2-16d	N/A
Stud to sole plate, toe nail	3-8d or 2-16d	N/A
Double stud, face nail	10d	24
Double top plate, face nail	10d	24
Double top plate at splice, face nail	4-10d	N/A
Top plate at corners, face nail	2-10d	N/A
Headers with spacers, along each side	16d	16
Ceiling joist to top plate, toe nail	3-8d	N/A
Ceiling joist lapped, face nail	3-10d	N/A
Rafters to top plate, toe nail	2-16d	N/A
Corner studs	10d	24
Built-up girders and beams	10d	32 (staggered)

Note: N/A, Not applicable.

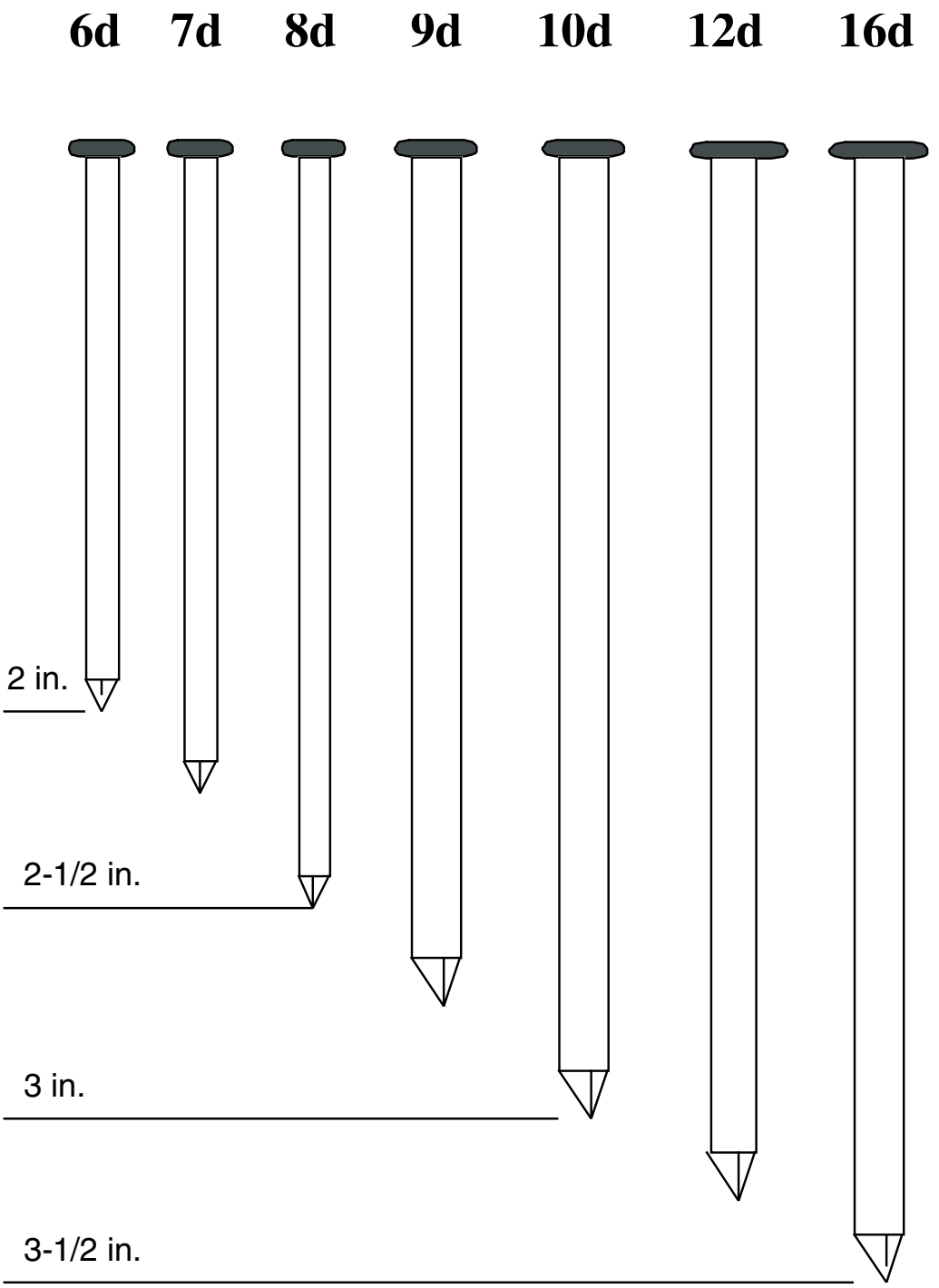


Figure 5-7 TYPICAL NAILS

CHAPTER 6
HOLES, CUTS, AND NOTCHES IN FRAMING MEMBERS

Refer to Figure 6-1 and Tables 6-1 through 6-4 for specifications on holes, cuts, and notches in framing members. Do not use a pre-engineered joist with dimensional lumber as the band board. Differences in shrinking can cause structural problems or failures!

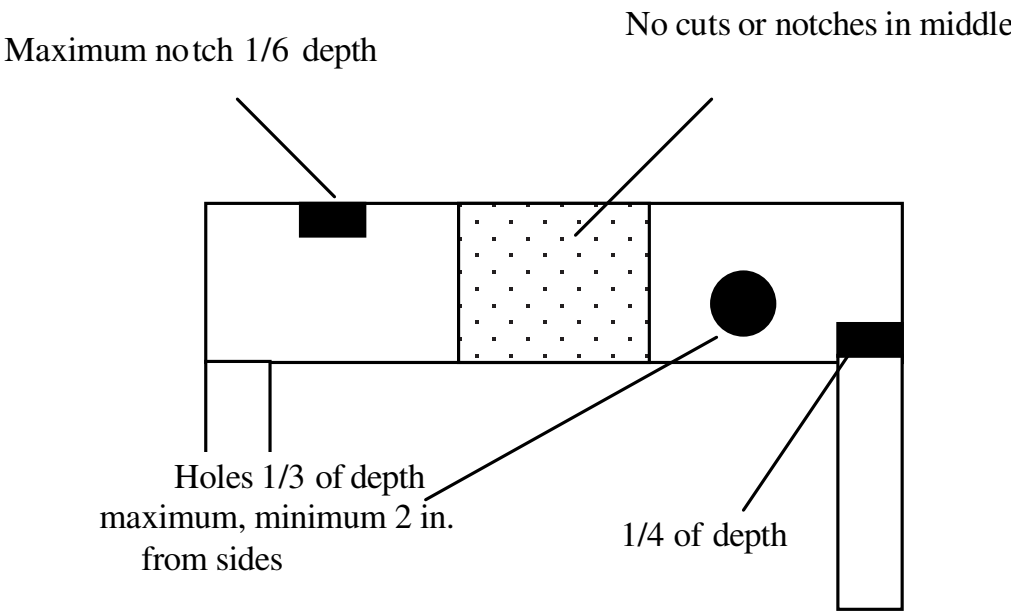


Figure 6-1 NOTCHES AND HOLES SPACING AND SIZES ALLOWED FOR JOIST.

TABLE 6-1 DRILLED HOLE MAXIMUMS IN JOISTS		
Nominal (in.)	Actual (in.)	⅓ or 33% (in.)
2 × 6	1½ × 5¼	1¾
2 × 8	1½ × 7¼	2 13/32
2 × 10	1½ × 9¼	3 3/32
2 × 12	1½ × 11¼	3¾
2 × 14	1½ × 14¼	4¾

TABLE 6-2 NOTCH MAXIMUMS IN JOISTS		
Nominal (in.)	Actual (in.)	⅙ or 17% (in.)
2 × 6	1½ × 5¼	⅞
2 × 8	1½ × 7¼	1 7/32
2 × 10	1½ × 9¼	1 17/32
2 × 12	1½ × 11¼	1⅞
2 × 14	1½ × 14¼	2⅜

TABLE 6-3 NOTCH MAXIMUMS IN CEILING JOISTS OR RAFTERS		
Nominal (in.)	Actual (in.)	1/3 or 33% (in.)
2 × 6	1½ × 5¼	1¾
2 × 8	1½ × 7¼	2 13/32
2 × 10	1½ × 9¼	3 3/32
2 × 12	1½ × 11¼	3¾
2 × 14	1½ × 14¼	4¾

TABLE 6-4 END NOTCH MAXIMUMS IN CEILING JOISTS OR RAFTERS		
Nominal (in.)	Actual (in.)	¼ or 25% (in.)
2 × 6	1½ × 5¼	1 5/16
2 × 8	1½ × 7¼	1 13/16
2 × 10	1½ × 9¼	2 5/16
2 × 12	1½ × 11¼	2 13/16
2 × 14	1½ × 14¼	3 9/16

THINK SAFETY AT ALL TIMES

CHAPTER 7
RAFTER FRAMING

Rafters are configured and built several different ways. Some are "stick build," meaning that are built on the site. Others may be of engineered lumber built at the site, or a engineered truss system may be used. Trusses must have very specific design data accompanying them to the job site. Engineered rafter systems must be installed according to the manufacturer's instructions.

RAFTER SPANS

Refer to Chapter 4, "Reading Span Tables," for instructions for using span tables. Refer to Tables 7-1 through 7-36 for rafter span specifications.

TABLE 7-1 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	18-0	23-9	Note	Note
Douglas-fir–larch	#1	17-4	22-5	Note	Note
Douglas-fir–larch	#2	16-7	21-0	25-8	Note
Douglas-fir–larch	#3	12-6	15-10	19-5	22-6
Hemlock–fir	SS	17-0	22-5	Note	Note
Hemlock–fir	#1	16-8	21-10	Note	Note
Hemlock–fir	#2	15-11	20-8	25-3	Note
Hemlock–fir	#3	12-6	15-10	19-5	22-6
Southern pine	SS	17-8	23-4	Note	Note
Southern pine	#1	17-4	22-11	Note	Note
Southern pine	#2	17-0	22-5	Note	Note
Southern pine	#3	13-6	17-2	20-3	24-1
Spruce–pine–fir	SS	16-8	21-11	Note	Note
Spruce–pine–fir	#1	16-3	21-0	25-8	Note
Spruce–pine–fir	#2	16-3	21-0	25-8	Note
Spruce–pine–fir	#3	12-6	15-10	19-5	22-6

Note: Check availability of lumber over 20 ft.

TABLE 7-2 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	18-0	23-5	Note	Note
Douglas-fir–larch	#1	15-4	19-5	23-9	Note
Douglas-fir–larch	#2	14-4	18-2	22-3	25-9
Douglas-fir–larch	#3	10-10	13-9	16-9	19-6
Hemlock–fir	SS	17-0	22-5	Note	Note
Hemlock–fir	#1	14-11	18-11	23-2	Note
Hemlock–fir	#2	14-2	17-11	21-11	25-5
Hemlock–fir	#3	10-10	13-9	16-9	19-6
Southern pine	SS	17-8	23-4	Note	Note
Southern pine	#1	17-3	21-9	25-10	Note
Southern pine	#2	15-1	19-5	23-2	Note
Southern pine	#3	11-8	14-10	17-6	20-11
Spruce–pine–fir	SS	16-8	21-9	Note	Note
Spruce–pine–fir	#1	14-4	18-2	22-3	25-9
Spruce–pine–fir	#2	14-4	18-2	22-3	25-9
Spruce–pine–fir	#3	10-10	13-9	16-9	19-6

Note: Check availability of lumber over 20 ft.

TABLE 7-3 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	16-4	21-7	Note	Note
Douglas-fir–larch	#1	15-4	19-5	23-9	Note
Douglas-fir–larch	#2	14-4	18-2	22-3	25-9
Douglas-fir–larch	#3	10-10	13-9	16-9	19-6
Hemlock–fir	SS	15-6	20-5	Note	Note
Hemlock–fir	#1	14-11	18-11	23-2	Note
Hemlock–fir	#2	14-2	17-11	21-11	25-5
Hemlock–fir	#3	10-10	13-9	16-9	19-6
Southern pine	SS	16-1	21-2	Note	Note
Southern pine	#1	15-9	20-10	25-10	Note
Southern pine	#2	15-1	19-5	23-2	Note
Southern pine	#3	11-8	14-10	17-6	20-11
Spruce–pine–fir	SS	15-2	19-11	25-5	Note
Spruce–pine–fir	#1	14-4	18-2	22-3	25-9
Spruce–pine–fir	#2	14-4	18-2	22-3	25-9
Spruce–pine–fir	#3	10-10	13-9	16-9	19-6

Note: Check availability of lumber over 20 ft.

TABLE 7-4 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	16-0	20-3	24-9	Note
Douglas-fir–larch	#1	13-3	16-10	20-7	23-10
Douglas-fir–larch	#2	12-5	15-9	19-3	22-4
Douglas-fir–larch	#3	9-5	11-11	14-6	16-10
Hemlock–fir	SS	15-6	19-11	24-4	Note
Hemlock–fir	#1	12-11	16-5	20-0	23-3
Hemlock–fir	#2	12-3	15-6	18-11	22-0
Hemlock–fir	#3	9-5	11-11	14-6	16-10
Southern pine	SS	16-1	21-2	Note	Note
Southern pine	#1	15-0	18-10	22-4	Note
Southern pine	#2	13-0	16-10	20-1	23-7
Southern pine	#3	10-1	12-10	15-2	18-1
Spruce–pine–fir	SS	14-10	18-10	23-0	Note
Spruce–pine–fir	#1	12-5	15-9	19-3	22-4
Spruce–pine–fir	#2	12-5	15-9	19-3	22-4
Spruce–pine–fir	#3	9-5	11-11	14-6	16-10

Note: Check availability of lumber over 20 ft.

TABLE 7-5 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD = 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-4	18-10	23-4	23-4
Douglas-fir–larch	#1	12-6	15-10	19-5	19-5
Douglas-fir–larch	#2	11-9	14-10	18-2	18-2
Douglas-fir–larch	#3	8-10	11-3	13-8	13-8
Hemlock–fir	SS	13-6	17-10	22-9	22-9
Hemlock–fir	#1	12-3	15-6	18-11	18-11
Hemlock–fir	#2	11-7	14-8	17-10	17-10
Hemlock–fir	#3	8-10	11-3	13-8	13-8
Southern pine	SS	14-1	18-6	23-8	23-8
Southern pine	#1	13-9	17-9	21-1	21-1
Southern pine	#2	12-3	15-10	18-11	18-11
Southern pine	#3	9-6	12-1	14-4	14-4
Spruce–pine–fir	SS	13-3	17-5	21-8	21-8
Spruce–pine–fir	#1	11-9	14-10	18-2	18-2
Spruce–pine–fir	#2	11-9	14-10	18-2	18-2
Spruce–pine–fir	#3	8-10	11-3	13-8	13-8

Note: Check availability of lumber over 20 ft.

TABLE 7-6 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-1	16-7	20-3	23-5
Douglas-fir–larch	#1	10-10	13-9	16-9	19-6
Douglas-fir–larch	#2	10-2	12-10	15-8	18-3
Douglas-fir–larch	#3	7-8	9-9	11-10	13-9
Hemlock–fir	SS	12-10	16-3	19-10	23-0
Hemlock–fir	#1	10-7	13-5	16-4	19-0
Hemlock–fir	#2	10-0	12-8	15-6	17-11
Hemlock–fir	#3	7-8	9-9	11-10	13-9
Southern pine	SS	14-1	18-6	22-11	Note
Southern pine	#1	12-3	15-4	18-3	21-9
Southern pine	#2	10-8	13-9	16-5	19-3
Southern pine	#3	8-3	10-6	12-5	14-9
Spruce–pine–fir	SS	12-2	15-4	18-9	21-9
Spruce–pine–fir	#1	10-2	12-10	15-8	18-3
Spruce–pine–fir	#2	10-2	12-10	15-8	18-3
Spruce–pine–fir	#3	7-8	9-9	11-10	13-9

Note: Check availability of lumber over 20 ft.

TABLE 7-7 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	16-4	21-7	Note	Note
Douglas-fir–larch	#1	15-9	20-10	Note	Note
Douglas-fir–larch	#2	15-6	20-5	25-8	Note
Douglas-fir–larch	#3	12-6	15-10	19-5	22-6
Hemlock–fir	SS	15-6	20-5	Note	Note
Hemlock–fir	#1	15-2	19-11	25-5	Note
Hemlock–fir	#2	14-5	19-0	24-3	Note
Hemlock–fir	#3	12-6	15-10	19-5	22-6
Southern pine	SS	16-1	21-2	Note	Note
Southern pine	#1	15-9	20-10	Note	Note
Southern pine	#2	15-6	20-5	Note	Note
Southern pine	#3	13-6	17-2	20-3	24-1
Spruce–pine–fir	SS	15-2	19-11	25-5	Note
Spruce–pine–fir	#1	14-9	19-6	24-10	Note
Spruce–pine–fir	#2	14-9	19-6	24-10	Note
Spruce–pine–fir	#3	12-6	15-10	19-5	22-6

Note: Check availability of lumber over 20 ft.

TABLE 7-8 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	16-4	21-7	Note	Note
Douglas-fir–larch	#1	15-4	19-5	23-9	Note
Douglas-fir–larch	#2	14-4	18-2	22-3	25-9
Douglas-fir–larch	#3	10-10	13-9	16-9	19-6
Hemlock–fir	SS	15-6	20-5	Note	Note
Hemlock–fir	#1	14-11	18-11	23-2	Note
Hemlock–fir	#2	14-2	17-11	21-11	25-5
Hemlock–fir	#3	10-10	13-9	16-9	19-6
Southern pine	SS	16-1	21-2	Note	Note
Southern pine	#1	15-9	20-10	25-10	Note
Southern pine	#2	15-1	19-5	23-2	Note
Southern pine	#3	11-8	14-10	17-6	20-11
Spruce–pine–fir	SS	15-2	19-11	25-5	Note
Spruce–pine–fir	#1	14-4	18-2	22-3	25-9
Spruce–pine–fir	#2	14-4	18-2	22-3	25-9
Spruce–pine–fir	#3	10-10	13-9	16-9	19-6

Note: Check availability of lumber over 20 ft.

TABLE 7-9 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-11	19-7	25-0	Note
Douglas-fir–larch	#1	14-4	18-11	23-9	Note
Douglas-fir–larch	#2	14-1	18-2	22-3	25-9
Douglas-fir–larch	#3	10-10	13-9	16-9	19-6
Hemlock–fir	SS	14-1	18-6	23-8	Note
Hemlock–fir	#1	13-9	18-1	23-1	Note
Hemlock–fir	#2	13-1	17-3	21-11	25-5
Hemlock–fir	#3	10-10	13-9	16-9	19-6
Southern pine	SS	14-7	19-3	24-7	Note
Southern pine	#1	14-4	18-11	24-1	Note
Southern pine	#2	14-1	18-6	23-2	Note
Southern pine	#3	11-8	14-10	17-6	20-11
Spruce–pine–fir	SS	13-9	18-1	23-1	Note
Spruce–pine–fir	#1	13-5	17-9	22-3	25-9
Spruce–pine–fir	#2	13-5	17-9	22-3	25-9
Spruce–pine–fir	#3	10-10	13-9	16-9	19-6

Note: Check availability of lumber over 20 ft.

TABLE 7-10 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-11	19-7	24-9	Note
Douglas-fir–larch	#1	13-3	16-10	20-7	23-10
Douglas-fir–larch	#2	12-5	15-9	19-3	22-4
Douglas-fir–larch	#3	9-5	11-11	14-6	16-10
Hemlock–fir	SS	14-1	18-6	23-8	Note
Hemlock–fir	#1	12-11	16-5	20-0	23-3
Hemlock–fir	#2	12-3	15-6	18-11	22-0
Hemlock–fir	#3	9-5	11-11	14-6	16-10
Southern pine	SS	14-7	19-3	24-7	Note
Southern pine	#1	14-4	18-10	22-4	Note
Southern pine	#2	13-0	16-10	20-1	23-7
Southern pine	#3	10-1	12-10	15-2	18-1
Spruce–pine–fir	SS	13-9	18-1	23-0	Note
Spruce–pine–fir	#1	12-5	15-9	19-3	22-4
Spruce–pine–fir	#2	12-5	15-9	19-3	22-4
Spruce–pine–fir	#3	9-5	11-11	14-6	16-10

Note: Check availability of lumber over 20 ft.

TABLE 7-11 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-0	17-2	21-10	Note
Douglas-fir–larch	#1	12-6	15-10	19-5	22-6
Douglas-fir–larch	#2	11-9	14-10	18-2	21-0
Douglas-fir–larch	#3	8-10	11-3	13-8	15-11
Hemlock–fir	SS	12-3	16-2	20-8	25-1
Hemlock–fir	#1	12-0	15-6	18-11	21-11
Hemlock–fir	#2	11-5	14-8	17-10	20-9
Hemlock–fir	#3	8-10	11-3	13-8	15-11
Southern pine	SS	12-9	16-10	21-6	Note
Southern pine	#1	12-6	16-6	21-1	25-2
Southern pine	#2	12-3	15-10	18-11	22-2
Southern pine	#3	9-6	12-1	14-4	17-1
Spruce–pine–fir	SS	12-0	15-10	20-2	24-7
Spruce–pine–fir	#1	11-9	14-10	18-2	21-0
Spruce–pine–fir	#2	11-9	14-10	18-2	21-0
Spruce–pine–fir	#3	8-10	11-3	13-8	15-11

Note: Check availability of lumber over 20 ft.

TABLE 7-12 RAFTER SPANS FOR COMMON LUMBER SPECIES (ROOF LIVE LOAD 20 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-0	16-7	20-3	23-5
Douglas-fir–larch	#1	10-10	13-9	16-9	19-6
Douglas-fir–larch	#2	10-2	12-10	15-8	18-3
Douglas-fir–larch	#3	7-8	9-9	11-10	13-9
Hemlock–fir	SS	12-3	16-2	19-10	23-0
Hemlock–fir	#1	10-7	13-5	16-4	19-0
Hemlock–fir	#2	10-0	12-8	15-6	17-11
Hemlock–fir	#3	7-8	9-9	11-10	13-9
Southern pine	SS	12-9	16-10	21-6	Note
Southern pine	#1	12-3	15-4	18-3	21-9
Southern pine	#2	10-8	13-9	16-5	19-3
Southern pine	#3	8-3	10-6	12-5	14-9
Spruce–pine–fir	SS	12-0	15-4	18-9	21-9
Spruce–pine–fir	#1	10-2	12-10	15-8	18-3
Spruce–pine–fir	#2	10-2	12-10	15-8	18-3
Spruce–pine–fir	#3	7-8	9-9	11-10	13-9

Note: Check availability of lumber over 20 ft.

TABLE 7-13 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	15-9	20-9	Note	Note
Douglas-fir–larch	#1	14-9	18-8	22-9	24-8
Douglas-fir–larch	#2	13-9	17-5	21-4	18-8
Douglas-fir–larch	#3	10-5	13-2	16-1	Note
Hemlock–fir	SS	14-10	19-7	25-0	25-9
Hemlock–fir	#1	14-4	18-2	22-2	24-4
Hemlock–fir	#2	13-7	17-2	21-0	18-8
Hemlock–fir	#3	10-5	13-2	16-1	Note
Southern pine	SS	15-6	20-5	Note	Note
Southern pine	#1	15-2	20-0	24-9	Note
Southern pine	#2	14-5	18-8	22-3	20-0
Southern pine	#3	11-2	14-3	16-10	Note
Spruce–pine–fir	SS	14-7	19-2	24-6	24-8
Spruce–pine–fir	#1	13-9	17-5	21-4	24-8
Spruce–pine–fir	#2	13-9	17-5	21-4	18-8
Spruce–pine–fir	#3	10-5	13-2	16-1	Note

Note: Check availability of lumber over 20 ft.

TABLE 7-14 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	15-9	20-1	24-6	Note
Douglas-fir–larch	#1	13-2	16-8	20-4	23-7
Douglas-fir–larch	#2	12-4	15-7	19-1	22-1
Douglas-fir–larch	#3	9-4	11-9	14-5	16-8
Hemlock–fir	SS	14-10	19-7	24-1	Note
Hemlock–fir	#1	12-10	16-3	19-10	23-0
Hemlock–fir	#2	12-2	15-4	18-9	21-9
Hemlock–fir	#3	9-4	11-9	14-5	16-8
Southern pine	SS	15-6	20-5	Note	Note
Southern pine	#1	14-10	18-8	22-2	Note
Southern pine	#2	12-11	16-8	19-11	23-4
Southern pine	#3	10-0	12-9	15-1	17-11
Spruce–pine–fir	SS	14-7	18-8	22-9	Note
Spruce–pine–fir	#1	12-4	15-7	19-1	22-1
Spruce–pine–fir	#2	12-4	15-7	19-1	22-1
Spruce–pine–fir	#3	9-4	11-9	14-5	16-8

Note: Check availability of lumber over 20 ft.

TABLE 7-15 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-4	18-10	23-9	Note
Douglas-fir–larch	#1	12-9	16-2	19-9	22-10
Douglas-fir–larch	#2	11-11	15-1	18-5	21-5
Douglas-fir–larch	#3	9-0	11-5	13-11	16-2
Hemlock–fir	SS	13-6	17-10	22-9	Note
Hemlock–fir	#1	12-5	15-9	19-3	22-3
Hemlock–fir	#2	11-9	14-11	18-2	21-1
Hemlock–fir	#3	9-0	11-5	13-11	16-2
Southern pine	SS	14-1	18-6	23-8	Note
Southern pine	#1	13-9	18-1	21-5	25-7
Southern pine	#2	12-6	16-2	19-3	22-7
Southern pine	#3	9-8	12-4	14-7	17-4
Spruce–pine–fir	SS	13-3	17-5	22-1	25-7
Spruce–pine–fir	#1	11-11	15-1	18-5	21-5
Spruce–pine–fir	#2	11-11	15-1	18-5	21-5
Spruce–pine–fir	#3	9-0	11-5	13-11	16-2

Note: Check availability of lumber over 20 ft.

TABLE 7-16 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-9	17-5	21-3	24-8
Douglas-fir–larch	#1	11-5	14-5	17-8	20-5
Douglas-fir–larch	#2	10-8	13-6	16-6	19-2
Douglas-fir–larch	#3	8-1	10-3	12-6	14-6
Hemlock–fir	SS	13-6	17-1	20-10	24-2
Hemlock–fir	#1	11-1	14-1	17-2	19-11
Hemlock–fir	#2	10-6	13-4	16-3	18-10
Hemlock–fir	#3	8-1	10-3	12-6	14-6
Southern pine	SS	14-1	18-6	23-8	Note
Southern pine	#1	12-10	16-2	19-2	22-10
Southern pine	#2	11-2	14-5	17-3	20-2
Southern pine	#3	8-8	11-0	13-0	15-6
Spruce–pine–fir	SS	12-9	16-2	19-9	22-10
Spruce–pine–fir	#1	10-8	13-6	16-6	19-2
Spruce–pine–fir	#2	10-8	13-6	16-6	19-2
Spruce–pine–fir	#3	8-1	10-3	12-6	14-6

Note: Check availability of lumber over 20 ft.

TABLE 7-17 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	11-10	15-7	19-1	22-1
Hemlock–fir	#1	10-2	12-10	15-8	18-2
Hemlock–fir	#2	9-7	12-2	14-10	17-3
Hemlock–fir	#3	7-4	9-4	11-5	13-2
Southern pine	SS	12-3	16-2	20-8	25-1
Southern pine	#1	11-9	14-9	17-6	20-11
Southern pine	#2	10-2	13-2	15-9	18-5
Southern pine	#3	7-11	10-1	11-11	14-2
Spruce–pine–fir	SS	11-7	14-9	18-0	20-11
Spruce–pine–fir	#1	9-9	12-4	15-1	17-6
Spruce–pine–fir	#2	9-9	12-4	15-1	17-6
Spruce–pine–fir	#3	7-4	9-4	11-5	13-2

Note: Check availability of lumber over 20 ft.

TABLE 7-18 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	11-0	13-11	17-0	19-9
Hemlock–fir	#1	9-1	11-6	14-0	16-3
Hemlock–fir	#2	8-7	10-10	13-3	15-5
Hemlock–fir	#3	6-7	8-4	10-2	11-10
Southern pine	SS	12-3	16-2	19-8	23-0
Southern pine	#1	10-6	13-2	15-8	18-8
Southern pine	#2	9-2	11-9	14-1	16-6
Southern pine	#3	7-1	9-0	10-8	12-8
Spruce–pine–fir	SS	10-5	13-2	16-1	18-8
Spruce–pine–fir	#1	8-8	11-0	13-6	15-7
Spruce–pine–fir	#2	8-8	11-0	13-6	15-7
Spruce–pine–fir	#3	6-7	8-4	10-2	11-10

Note: Check availability of lumber over 20 ft.

TABLE 9-19 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-3	17-6	22-4	26-0
Douglas-fir–larch	#1	12-0	15-3	18-7	21-7
Douglas-fir–larch	#2	11-3	14-3	17-5	20-2
Douglas-fir–larch	#3	8-6	10-9	13-2	15-3
Hemlock–fir	SS	12-6	16-6	21-1	25-6
Hemlock–fir	#1	11-9	14-10	18-1	21-0
Hemlock–fir	#2	11-1	14-0	17-2	19-11
Hemlock–fir	#3	8-6	10-9	13-2	15-3
Southern pine	SS	13-0	17-2	21-11	Note
Southern pine	#1	12-10	16-10	20-3	24-1
Southern pine	#2	11-9	15-3	18-2	21-3
Southern pine	#3	9-2	11-8	13-9	16-4
Spruce–pine–fir	SS	12-3	16-2	20-8	24-1
Spruce–pine–fir	#1	11-3	14-3	17-5	20-2
Spruce–pine–fir	#2	11-3	14-3	17-5	20-2
Spruce–pine–fir	#3	8-6	10-9	13-2	15-3

Note: Check availability of lumber over 20 ft.

TABLE 7-20 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-3	17-0	20-9	24-0
Douglas-fir–larch	#1	11-2	14-1	17-3	20-0
Douglas-fir–larch	#2	10-5	13-2	16-1	18-8
Douglas-fir–larch	#3	7-10	10-0	12-2	14-1
Hemlock–fir	SS	12-6	16-6	20-4	23-7
Hemlock–fir	#1	10-10	13-9	16-9	19-5
Hemlock–fir	#2	10-3	13-0	15-10	18-5
Hemlock–fir	#3	7-10	10-0	12-2	14-1
Southern pine	SS	13-0	17-2	21-11	Note
Southern pine	#1	12-6	15-9	18-9	22-4
Southern pine	#2	10-11	14-1	16-10	19-9
Southern pine	#3	8-5	10-9	12-9	15-2
Spruce–pine–fir	SS	12-3	15-9	19-3	22-4
Spruce–pine–fir	#1	10-5	13-2	16-1	18-8
Spruce–pine–fir	#2	10-5	13-2	16-1	18-8
Spruce–pine–fir	#3	7-10	10-0	12-2	14-1

Note: Check availability of lumber over 20 ft.

TABLE 7-21 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	12-1	15-10	19-5	22-6
Douglas-fir–larch	#1	10-5	13-2	16-1	18-8
Douglas-fir–larch	#2	9-9	12-4	15-1	17-6
Douglas-fir–larch	#3	7-4	9-4	11-5	13-2
Hemlock–fir	SS	11-5	15-0	19-1	22-1
Hemlock–fir	#1	10-2	12-10	15-8	18-2
Hemlock–fir	#2	9-7	12-2	14-10	17-3
Hemlock–fir	#3	7-4	9-4	11-5	13-2
Southern pine	SS	11-10	15-7	19-11	24-3
Southern pine	#1	11-7	14-9	17-6	20-11
Southern pine	#2	10-2	13-2	15-9	18-5
Southern pine	#3	7-11	10-1	11-11	14-2
Spruce–pine–fir	SS	11-2	14-8	18-0	20-11
Spruce–pine–fir	#1	9-9	12-4	15-1	17-6
Spruce–pine–fir	#2	9-9	12-4	15-1	17-6
Spruce–pine–fir	#3	7-4	9-4	11-5	13-2

Note: Check availability of lumber over 20 ft.

TABLE 7-22 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	11-7	14-8	17-11	20-10
Douglas-fir–larch	#1	9-8	12-2	14-11	17-3
Douglas-fir–larch	#2	9-0	11-5	13-11	16-2
Douglas-fir–larch	#3	6-10	8-8	10-6	12-3
Hemlock–fir	SS	11-5	14-5	17-8	20-5
Hemlock–fir	#1	9-5	11-11	14-6	16-10
Hemlock–fir	#2	8-11	11-3	13-9	15-11
Hemlock–fir	#3	6-10	8-8	10-6	12-3
Southern pine	SS	11-10	15-7	19-11	23-10
Southern pine	#1	10-10	13-8	16-2	19-4
Southern pine	#2	9-5	12-2	14-7	17-1
Southern pine	#3	7-4	9-4	11-0	13-1
Spruce–pine–fir	SS	10-9	13-8	15-11	19-4
Spruce–pine–fir	#1	9-0	11-5	13-11	16-2
Spruce–pine–fir	#2	9-0	11-5	13-11	16-2
Spruce–pine–fir	#3	6-10	8-8	10-6	12-3

Note: Check availability of lumber over 20 ft.

TABLE 7-23 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	9-11	12-9	15-7	18-0
Hemlock–fir	#1	8-3	10-6	12-10	14-10
Hemlock–fir	#2	7-10	9-11	12-1	14-1
Hemlock–fir	#3	6-0	7-7	9-4	10-9
Southern pine	SS	10-4	13-8	17-5	21-0
Southern pine	#1	9-7	12-0	14-4	17-1
Southern pine	#2	8-4	10-9	12-10	15-1
Southern pine	#3	6-5	8-3	9-9	11-7
Spruce–pine–fir	SS	9-6	12-0	14-8	17-1
Spruce–pine–fir	#1	7-11	10-1	12-4	14-3
Spruce–pine–fir	#2	7-11	10-1	12-4	14-3
Spruce–pine–fir	#3	6-0	7-7	9-4	10-9

Note: Check availability of lumber over 20 ft.

TABLE 7-24 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING NOT ATTACHED TO RAFTERS, $L/\Delta = 180$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	9-4	11-9	14-5	16-8
Hemlock–fir	#1	7-8	9-9	11-10	13-9
Hemlock–fir	#2	7-3	9-2	11-3	13-0
Hemlock–fir	#3	5-7	7-1	8-7	10-0
Southern pine	SS	10-4	13-8	16-7	19-5
Southern pine	#1	8-10	11-2	13-3	15-9
Southern pine	#2	7-9	10-0	11-11	13-11
Southern pine	#3	6-0	7-7	9-0	10-8
Spruce–pine–fir	SS	8-10	11-2	13-7	15-9
Spruce–pine–fir	#1	7-4	9-4	11-5	13-2
Spruce–pine–fir	#2	7-4	9-4	11-5	13-2
Spruce–pine–fir	#3	5-7	7-1	8-7	10-0

Note: Check availability of lumber over 20 ft.

TABLE 7-25 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-4	18-10	24-1	Note
Douglas-fir–larch	#1	13-9	18-2	22-9	Note
Douglas-fir–larch	#2	13-6	17-5	21-4	24-8
Douglas-fir–larch	#3	10-5	13-2	16-1	18-8
Hemlock–fir	SS	13-6	17-10	22-9	Note
Hemlock–fir	#1	13-3	17-5	22-2	25-9
Hemlock–fir	#2	12-7	16-7	21-0	24-4
Hemlock–fir	#3	10-5	13-2	16-1	18-8
Southern pine	SS	14-1	18-6	23-8	Note
Southern pine	#1	13-9	18-2	23-2	Note
Southern pine	#2	13-6	17-10	22-3	Note
Southern pine	#3	11-2	14-3	16-10	20-0
Spruce–pine–fir	SS	13-3	17-5	22-3	Note
Spruce–pine–fir	#1	12-11	17-0	21-4	24-8
Spruce–pine–fir	#2	12-11	17-0	21-4	24-8
Spruce–pine–fir	#3	10-5	13-2	16-1	18-8

Note: Check availability of lumber over 20 ft.

TABLE 7-26 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	14-4	18-10	24-1	Note
Douglas-fir–larch	#1	13-2	16-8	20-4	23-7
Douglas-fir–larch	#2	12-4	15-7	19-1	22-1
Douglas-fir–larch	#3	9-4	11-9	14-5	16-8
Hemlock–fir	SS	13-6	17-10	22-9	Note
Hemlock–fir	#1	12-10	16-3	19-10	23-0
Hemlock–fir	#2	12-2	15-4	18-9	21-9
Hemlock–fir	#3	9-4	11-9	14-5	16-8
Southern pine	SS	14-1	18-6	23-8	Note
Southern pine	#1	13-9	18-2	22-2	Note
Southern pine	#2	12-11	16-8	19-11	23-4
Southern pine	#3	10-0	12-9	15-1	17-11
Spruce–pine–fir	SS	13-3	17-5	22-3	Note
Spruce–pine–fir	#1	12-4	15-7	19-1	22-1
Spruce–pine–fir	#2	12-4	15-7	19-1	22-1
Spruce–pine–fir	#3	9-4	11-9	14-5	16-8

Note: Check availability of lumber over 20 ft.

TABLE 7-27 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-0	17-2	21-10	Note
Douglas-fir–larch	#1	12-6	16-2	19-9	22-10
Douglas-fir–larch	#2	11-11	15-1	18-5	21-5
Douglas-fir–larch	#3	9-0	11-5	13-11	16-2
Hemlock–fir	SS	12-3	16-2	20-8	25-1
Hemlock–fir	#1	12-0	15-9	19-3	22-3
Hemlock–fir	#2	11-5	14-11	18-2	21-1
Hemlock–fir	#3	9-0	11-5	13-11	16-2
Southern pine	SS	12-9	16-10	21-6	Note
Southern pine	#1	12-6	16-6	21-1	25-7
Southern pine	#2	12-3	16-2	19-3	22-7
Southern pine	#3	9-8	12-4	14-7	17-4
Spruce–pine–fir	SS	12-0	15-10	20-2	24-7
Spruce–pine–fir	#1	11-9	15-1	18-5	21-5
Spruce–pine–fir	#2	11-9	15-1	18-5	21-5
Spruce–pine–fir	#3	9-0	11-5	13-11	16-2

Note: Check availability of lumber over 20 ft.

TABLE 7-28 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	13-0	17-2	21-3	24-8
Douglas-fir–larch	#1	11-5	14-5	17-8	20-5
Douglas-fir–larch	#2	10-8	13-6	16-6	19-2
Douglas-fir–larch	#3	8-1	10-3	12-6	14-6
Hemlock–fir	SS	12-3	16-2	20-8	24-2
Hemlock–fir	#1	11-1	14-1	17-2	19-11
Hemlock–fir	#2	10-6	13-4	16-3	18-10
Hemlock–fir	#3	8-1	10-3	12-6	14-6
Southern pine	SS	12-9	16-10	21-6	Note
Southern pine	#1	12-6	16-2	19-2	22-10
Southern pine	#2	11-2	14-5	17-3	20-2
Southern pine	#3	8-8	11-0	13-0	15-6
Spruce–pine–fir	SS	12-0	15-10	19-9	22-10
Spruce–pine–fir	#1	10-8	13-6	16-6	19-2
Spruce–pine–fir	#2	10-8	13-6	16-6	19-2
Spruce–pine–fir	#3	8-1	10-3	12-6	14-6

Note: Check availability of lumber over 20 ft.

TABLE 7-29 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	10-9	14-2	18-0	21-11
Hemlock–fir	#1	10-2	12-10	15-8	18-2
Hemlock–fir	#2	9-7	12-2	14-10	17-3
Hemlock–fir	#3	7-4	9-4	11-5	13-2
Southern pine	SS	11-2	14-8	18-9	22-10
Southern pine	#1	10-11	14-5	17-6	20-11
Southern pine	#2	10-2	13-2	15-9	18-5
Southern pine	#3	7-11	10-1	11-11	14-2
Spruce–pine–fir	SS	10-6	13-10	17-8	20-11
Spruce–pine–fir	#1	9-9	12-4	15-1	17-6
Spruce–pine–fir	#2	9-9	12-4	15-1	17-6
Spruce–pine–fir	#3	7-4	9-4	11-5	13-2

Note: Check availability of lumber over 20 ft.

TABLE 7-30 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 30 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	10-9	13-11	17-0	19-9
Hemlock–fir	#1	9-1	11-6	14-0	16-3
Hemlock–fir	#2	8-7	10-10	13-3	15-5
Hemlock–fir	#3	6-7	8-4	10-2	11-10
Southern pine	SS	11-2	14-8	18-9	22-10
Southern pine	#1	10-6	13-2	15-8	18-8
Southern pine	#2	9-2	11-9	14-1	16-6
Southern pine	#3	7-1	9-0	10-8	12-8
Spruce–pine–fir	SS	10-5	13-2	16-1	18-8
Spruce–pine–fir	#1	8-8	11-0	13-6	15-7
Spruce–pine–fir	#2	8-8	11-0	13-6	15-7
Spruce–pine–fir	#3	6-7	8-4	10-2	11-10

Note: Check availability of lumber over 20 ft.

TABLE 7-31 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 10 PSF)

Rafter spacing 12 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	12-1	15-11	20-3	24-8
Douglas-fir–larch	#1	11-7	15-3	18-7	21-7
Douglas-fir–larch	#2	11-3	14-3	17-5	20-2
Douglas-fir–larch	#3	8-6	10-9	13-2	15-3
Hemlock–fir	SS	11-5	15-0	19-2	23-4
Hemlock–fir	#1	11-2	14-8	18-1	21-0
Hemlock–fir	#2	10-8	14-0	17-2	19-11
Hemlock–fir	#3	8-6	10-9	13-2	15-3
Southern pine	SS	11-10	15-7	19-11	24-3
Southern pine	#1	11-7	15-4	19-7	23-9
Southern pine	#2	11-5	15-0	18-2	21-3
Southern pine	#3	9-2	11-8	13-9	16-4
Spruce–pine–fir	SS	11-2	14-8	18-9	22-10
Spruce–pine–fir	#1	10-11	14-3	17-5	20-2
Spruce–pine–fir	#2	10-11	14-3	17-5	20-2
Spruce–pine–fir	#3	8-6	10-9	13-2	15-3

Note: Check availability of lumber over 20 ft.

TABLE 7-32 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 12 IN., DEAD LOAD 20 PSF)

Rafter spacing 12 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	12-1	15-11	20-3	24-0
Douglas-fir–larch	#1	11-2	14-1	17-3	20-0
Douglas-fir–larch	#2	10-5	13-2	16-1	18-8
Douglas-fir–larch	#3	7-10	10-0	12-2	14-1
Hemlock–fir	SS	11-5	15-0	19-2	23-4
Hemlock–fir	#1	10-10	13-9	16-9	19-5
Hemlock–fir	#2	10-3	13-0	15-10	18-5
Hemlock–fir	#3	7-10	10-0	12-2	14-1
Southern pine	SS	11-10	15-7	19-11	24-3
Southern pine	#1	11-7	15-4	18-9	22-4
Southern pine	#2	10-11	14-1	16-10	19-9
Southern pine	#3	8-5	10-9	12-9	15-2
Spruce–pine–fir	SS	11-2	14-8	18-9	22-4
Spruce–pine–fir	#1	10-5	13-2	16-1	18-8
Spruce–pine–fir	#2	10-5	13-2	16-1	18-8
Spruce–pine–fir	#3	7-10	10-0	12-2	14-1

Note: Check availability of lumber over 20 ft.

TABLE 7-33 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 10 PSF)

Rafter spacing 16 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	11-0	14-5	18-5	22-5
Douglas-fir–larch	#1	10-5	13-2	16-1	18-8
Douglas-fir–larch	#2	9-9	12-4	15-1	17-6
Douglas-fir–larch	#3	7-4	9-4	11-5	13-2
Hemlock–fir	SS	10-4	13-8	17-5	21-2
Hemlock–fir	#1	10-2	12-10	15-8	18-2
Hemlock–fir	#2	9-7	12-2	14-10	17-3
Hemlock–fir	#3	7-4	9-4	11-5	13-2
Southern pine	SS	10-9	14-2	18-1	22-0
Southern pine	#1	10-7	13-11	17-6	20-11
Southern pine	#2	10-2	13-2	15-9	18-5
Southern pine	#3	7-11	10-1	11-11	14-2
Spruce–pine–fir	SS	10-2	13-4	17-0	20-9
Spruce–pine–fir	#1	9-9	12-4	15-1	17-6
Spruce–pine–fir	#2	9-9	12-4	15-1	17-6
Spruce–pine–fir	#3	7-4	9-4	11-5	13-2

Note: Check availability of lumber over 20 ft.

TABLE 7-34 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 16 IN., DEAD LOAD 20 PSF)

Rafter spacing 16 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Douglas-fir–larch	SS	11-0	14-5	17-11	20-10
Douglas-fir–larch	#1	9-8	12-2	14-11	17-3
Douglas-fir–larch	#2	9-0	11-5	13-11	16-2
Douglas-fir–larch	#3	6-10	8-8	10-6	12-3
Hemlock–fir	SS	10-4	13-8	17-5	20-5
Hemlock–fir	#1	9-5	11-11	14-6	16-10
Hemlock–fir	#2	8-11	11-3	13-9	15-11
Hemlock–fir	#3	6-10	8-8	10-6	12-3
Southern pine	SS	10-9	14-2	18-1	22-0
Southern pine	#1	10-7	13-8	16-2	19-4
Southern pine	#2	9-5	12-2	14-7	17-1
Southern pine	#3	7-4	9-4	11-0	13-1
Spruce–pine–fir	SS	10-2	13-4	16-8	19-4
Spruce–pine–fir	#1	9-0	11-5	13-11	16-2
Spruce–pine–fir	#2	9-0	11-5	13-11	16-2
Spruce–pine–fir	#3	6-10	8-8	10-6	12-3

Note: Check availability of lumber over 20 ft.

TABLE 7-35 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 10 PSF)

Rafter spacing 24 in.		*Dead load 10 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	9-1	11-11	15-2	18-0
Hemlock–fir	#1	8-3	10-6	12-10	14-10
Hemlock–fir	#2	7-10	9-11	12-1	14-1
Hemlock–fir	#3	6-0	7-7	9-4	10-9
Southern pine	SS	9-5	12-5	15-10	19-3
Southern pine	#1	9-3	12-0	14-4	17-1
Southern pine	#2	8-4	10-9	12-10	15-1
Southern pine	#3	6-5	8-3	9-9	11-7
Spruce–pine–fir	SS	8-10	11-8	14-8	17-1
Spruce–pine–fir	#1	7-11	10-1	12-4	14-3
Spruce–pine–fir	#2	7-11	10-1	12-4	14-3
Spruce–pine–fir	#3	6-0	7-7	9-4	10-9

Note: Check availability of lumber over 20 ft.

TABLE 7-36 RAFTER SPANS FOR COMMON LUMBER SPECIES (GROUND SNOW LOAD 50 PSF, CEILING ATTACHED TO RAFTERS, $L/\Delta = 240$, RAFTER SPACING 24 IN., DEAD LOAD 20 PSF)

Rafter spacing 24 in.		*Dead load 20 psf*			
		2 × 6	2 × 8	2 × 10	2 × 12
Species and grade		(ft-in.)	(ft-in.)	(ft-in.)	(ft-in.)
Hemlock–fir	SS	9-1	11-9	14-5	15-11
Hemlock–fir	#1	7-8	9-9	11-10	13-9
Hemlock–fir	#2	7-3	9-2	11-3	13-0
Hemlock–fir	#3	5-7	7-1	8-7	10-0
Southern pine	SS	9-5	12-5	15-10	19-3
Southern pine	#1	8-10	11-2	13-3	15-9
Southern pine	#2	7-9	10-0	11-11	13-11
Southern pine	#3	6-0	7-7	9-0	10-8
Spruce–pine–fir	SS	8-10	11-2	13-7	15-9
Spruce–pine–fir	#1	7-4	9-4	11-5	13-2
Spruce–pine–fir	#2	7-4	9-4	11-5	13-2
Spruce–pine–fir	#3	5-7	7-1	8-7	10-0

Note: Check availability of lumber over 20 ft.

RAFTER SPAN DEFLECTIONS AND ADJUSTMENT

Refer to Table 7-37 and Figure 4-15 for allowable rafter deflections.

TABLE 7-37 MAXIMUM ALLOWABLE RAFTER DEFLECTIONS

Span (ft)	*L*/180 (in.)	*L*/240 (in.)	*L*/360 (in.)
15	1	3/4	1/2
16	1 1/16	13/16	17/32
17	1 1/8	27/32	9/16
18	1 3/16	29/32	19/32
19	1 9/32	15/16	5/8
20	1 11/32	1	21/32
21	1 13/32	1 1/16	11/16
22	1 15/32	1 3/32	23/32
23	1 17/32	1 5/32	35/32
24	1 19/32	1 3/16	13/16
25	1 21/32	1 1/4	27/32
26	1 23/32	1 5/16	7/8
27	1 13/16	1 11/32	29/32
28	1 7/8	1 13/32	15/16
29	1 15/16	1 7/16	31/32
30	2	1 1/2	1
31	2 1/16	1 9/16	1 1/32
32	2 1/8	1 19/32	1 1/16

Note: Refer to Figure 6-15 for diagram.

Rafter spans should be adjusted when the ceiling joist or rafter tie is located higher in the attic space and not resting on the supporting wall. See Figure 7-1 and Table 7-38.

- Rafters and joists exceeding a depth-to-thickness ratio of 5-to-1 require lateral support.
- Rafters need bridging if the depth-to-thickness ratio exceeds 6-to-1 (i.e., a 2 × 12) at intervals of 10 ft or less.
- Headers need to be doubled if spanning more than 4 ft.
- Truss members cannot be cut or altered.

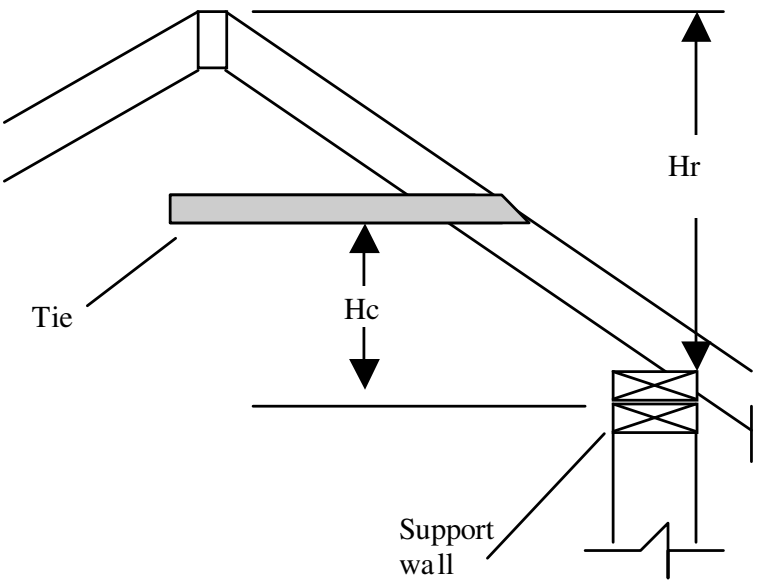


Figure 7-1 RAFTER TIES

TABLE 7-38 ADJUSTING SPANS FOR RAFTER TIES	
Hc/Hr	Span adjusted
⅔ or greater	0.50
½	0.58
⅓	0.67
¼	0.76
⅕	0.83
⅙	0.90
1/7.5 and less	1.0

Note: See Figure 9-1 for Hc and Hr.

CALCULATING RAFTERS

To calculate rafters, refer to Table 7-39 and the following definitions:

Common rafter run × secant = common rafter length

Common rafter run × hip factor = hip rafter length

Jack rafter spacing × secant = jack length difference

The following method to calculate rafters is illustrated with the example of a 10/12-pitch roof with a common rafter run of 180 in.

TABLE 7-39 CALCULATING RAFTERS			
Roof pitch (_ : 12 in.)	Angle	Secant	Hip rafter length factor
1	4.16	1.003	1.417
1½	7.13	1.008	1.420
2	9.46	1.014	1.424
2½	11.17	1.021	1.429
3	14.04	1.031	1.436
3½	16.26	1.042	1.444
4	18.43	1.054	1.453
4½	20.56	1.068	1.423
5	22.62	1.083	1.414
5½	24.62	1.100	1.487
6	26.57	1.118	1.500
6½	28.44	1.137	1.514
7	30.26	1.158	1.530
7½	32.01	1.179	1.546
8	33.69	1.202	1.563
8½	35.31	1.250	1.582
9	36.87	1.275	1.601
9½	38.37	1.302	1.621
10	39.81	1.329	1.641
10½	41.10	1.357	1.663
11	42.51	1.385	1.685
11½	43.18	1.414	1.708
12	45.00	1.444	1.732

Roof pitch (_ : 12 in.)	Angle	Secant	Hip rafter length factor
12½	48.17	1.474	1.756
13	47.29	1.505	1.781
13½	48.37	1.537	1.801
14	49.40	1.568	1.833
14½	50.39	1.601	1.860
15	51.34	1.634	1.887
15½	52.25	1.667	1.915
16	53.13	1.700	1.944
16½	53.97	1.734	1.972
17	54.78	1.166	2.002
17½	55.55	1.803	2.031
18	56.31	1.838	2.062
18½	57.03	1.813	2.092
19	57.72	1.908	2.123
19½	58.39	1.944	2.154
20	59.04	1.979	2.186
20½	59.66	2.016	2.218
21	60.26	2.052	2.250
21½	60.83	2.088	2.283
22	61.39	2.125	2.315
22½	81.93	2.162	2.349
23	62.45	2.199	2.382
23½	62.95	2.236	2.416

❑ **Step 1.** Find the common rafter length.

Common rafter run × secant = common rafter length

(180 in.) (1.329) (239 7/16 in.)

❑ **Step 2.** Find the hip rafter length.

Common rafter run × hip factor = hip rafter length

(180 in.) (1.663) (299 11/32 in.)

❑ **Step 3.** Find difference in length of jack rafters at 16 in. OC spacing.

Jack rafter spacing × secant = jack length difference

(16 in.) (1.329) (21¼ in.)

HEEL AND JOINT CONNECTIONS

Refer to Figure 7-2 and Tables 7-40 to 7-42.

- 40d box nails shall be permitted to be substituted for 16d common nails.
- Nailing requirements shall be permitted to be reduced 25% if nails are clinched.
- Heel joint connections are not required

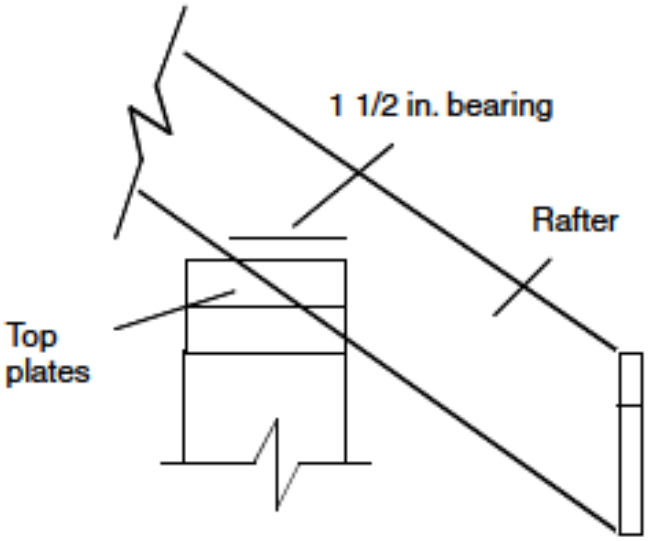


Figure 7-2 RAFTER–CEILING JOIST HEEL AND HEEL JOINT CONNECTIONS

when the ridge is supported by a load-bearing wall, header, or ridge beam.

- When intermediate support of the rafter is provided by vertical struts or purlins to a load-bearing wall, the tabulated heel joint connection requirements shall be permitted to be reduced proportionally to the reduction in span.
- Equivalent nailing patterns are required for ceiling joist to ceiling joist lap splices.
- When rafter ties are substituted for ceiling joists, the heel joint connection requirement shall be taken as the tabulated heel joint connection requirement for two-thirds of the actual rafter slope.

TABLE 7-40 NUMBER OF 16D NAILS REQUIRED AT THE HEEL (GROUND SNOW LOAD 30 PSF)

Rafter slope	Rafter spacing (in.)	*Roof span (ft)*			
		12	20	28	36
3:12	12	4	6	8	11
	16	5	8	11	14
	24	7	11	16	21
4:12	12	3	5	6	8
	16	4	6	8	11
	24	5	9	12	16
5:12	12	3	4	5	7
	16	3	5	7	9
	24	4	7	10	13
7:12	12	3	3	4	5
	16	3	4	5	6
	24	3	5	7	9
9:12	12	3	3	3	4
	16	3	3	4	5
	24	3	4	6	7
12:12	12	3	3	3	3
	16	3	3	3	4
	24	3	3	4	6

TABLE 7-41 NUMBER OF 16D NAILS REQUIRED AT THE HEEL (GROUND SNOW LOAD 50 PSF)

Rafter slope	Rafter spacing (in.)	*Roof span (ft)*			
		12	20	28	36
3:12	12	5	8	12	15
	16	6	11	15	20
	24	9	16	23	30
4:12	12	4	6	9	11
	16	5	8	12	15
	24	7	12	17	22
5:12	12	3	5	7	9
	16	4	7	9	12
	24	6	10	14	18
7:12	12	3	4	5	7
	16	3	5	7	9
	24	4	7	10	13
9:12	12	3	3	4	5
	16	3	4	5	7
	24	3	6	8	10
12:12	12	3	3	3	4
	16	3	3	4	5
	24	3	4	6	8

TABLE 7-42 NUMBER OF 16D NAILS REQUIRED AT THE HEEL (GROUND SNOW LOAD 70 PSF)

Rafter slope	Rafter spacing (in.)	*Roof span (ft)*			
		12	20	28	36
3:12	12	6	11	15	20
	16	8	14	20	26
	24	12	21	30	39
4:12	12	5	8	12	15
	16	6	11	15	20
	24	19	16	23	29
5:12	12	4	7	9	12
	16	5	9	12	16
	24	7	13	18	23
7:12	12	3	5	7	9
	16	4	6	9	11
	24	5	9	13	17
9:12	12	3	4	5	7
	16	3	5	7	9
	24	4	7	10	13
12:12	12	3	3	4	5
	16	3	4	5	7
	24	3	6	8	10

ENGINEERED STRUCTURAL WOOD RAFTERS AND BEAMS

Glue-laminated beam spans are given in Tables 7-43 and 7-44.

TABLE 7-43 GLUE-LAMINATED BEAMS WITH *L*/180 DEFLECTIONS

Actual size (in)	*Clear span (ft)*						
	8	12	16	20	24	28	32
3 × 5.5	409	121	51	26			
3 × 6.9	679	237	100	51	30		
3 × 8.3	978	409	173	88	51	32	
3 × 9.6	1332	592	274	140	81	51	34
3 × 11.0	1641	773	409	210	121	76	51
3 × 12.4	1917	978	550	298	173	109	73
3 × 13.8	2216	1208	679	409	237	149	100
3 × 15.1	2540	1462	822	526	315	198	133
5 × 9.6	2220	986	457	234	135	85	57
5 × 11.0	2735	1288	682	349	202	127	85
5 × 12.4	3196	1631	917	497	288	181	121
5 × 13.8	3693	2013	1132	682	395	249	167
5 × 15.1	4233	2436	1370	863	525	331	222
5 × 16.5	4819	2735	1628	1019	682	429	288
5 × 17.9	5459	3038	1895	1186	809	546	366
5 × 19.3	6160	3357	2181	1365	931	674	457
6.75 × 12.4	4314	2201	1230	671	388	245	164
6.75 × 13.8	4986	2718	1503	921	533	336	225
6.75 × 15.1	5714	3289	1801	1127	709	447	299
6.75 × 16.5	6506	3692	2125	1330	907	580	388
6.75 × 17.9	7370	4102	2474	1549	1056	737	494
6.75 × 19.3	8316	4532	2848	1783	1216	879	617
6.75 × 20.6	9358	4986	3247	2032	1386	1003	757
6.75 × 22.0	10509	5465	3671	2298	1567	1133	856
6.75 × 23.4	11790	5971	3997	2578	1758	1272	961

TABLE 7-44 GLUE-LAMINATED BEAMS WITH L/360 DEFLECTIONS

Actual size (in)	Clear span (ft)						
	8	12	16	20	24	28	32
3 × 5.5	256	76	32				
3 × 6.9	500	148	62	32			
3 × 8.3	851	256	108	55	32		
3 × 9.6	1158	406	171	88	51	32	
3 × 11.0	1427	606	256	131	76	48	32
3 × 12.4	1667	851	364	186	108	68	46
3 × 13.8	1927	1050	500	256	148	93	62
3 × 15.1	2208	1271	665	340	197	124	83
5 × 9.6	1930	677	286	146	85	53	36
5 × 11.0	2378	1010	426	218	126	80	53
5 × 12.4	2779	1418	607	311	180	113	76
5 × 13.8	3212	1751	833	426	247	155	104
5 × 15.1	3681	2118	1108	567	328	207	139
5 × 16.5	4190	2378	1415	737	426	268	180
5 × 17.9	4747	2642	1648	936	542	341	229
5 × 19.3	5357	2919	1897	1170	677	426	286
6.75 × 12.4	3752	1914	818	419	243	153	102
6.75 × 13.8	4336	2363	1124	575	333	210	140
6.75 × 15.1	4969	2860	1496	766	443	279	187
6.75 × 16.5	5657	3211	1848	994	575	362	243
6.75 × 17.9	6408	3567	2151	1264	732	461	309
6.75 × 19.3	7231	3941	2477	1550	914	575	385
6.75 × 20.6	8137	4336	2824	1767	1124	708	474
6.75 × 22.0	9138	4752	3192	1998	1362	859	575
6.75 × 23.4	10252	5192	3476	2242	1529	1030	690

CHAPTER 8
ROOF FRAMING

- Rafter ties should be spaced no more than 4 ft on center (OC).
- The ridge board should be at least 1 in. and the same depth as the end cut of the rafter it supports.
- A hip and valley should have a hip rafter or valley rafter of not less than 2 in. and of same depth as the rafter it supports.
- If the roof pitch is less than 3 in. vertical in 12 in., then the rafters and joists need to be designed as beams.

PURLINS

Refer to Figure 8-1.

- Purlins must be the same size as the supported rafters.
- Purlins must be supported by struts at least 2×4 in.
- Supports cannot slope less than 45°.
- Supports must be spaced no more than 4 ft apart.
- Struts must be braced if over 8 ft long.

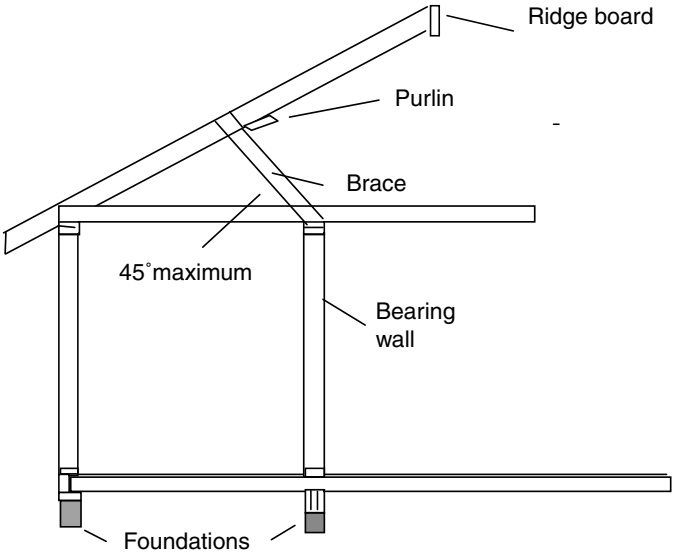


Figure 8-1 ROOF PURLINS

ROOF CURBS

Roof curbs must have 3/12 pitch or less and be at least 4 in. in height.

RAFTERS AND JOISTS

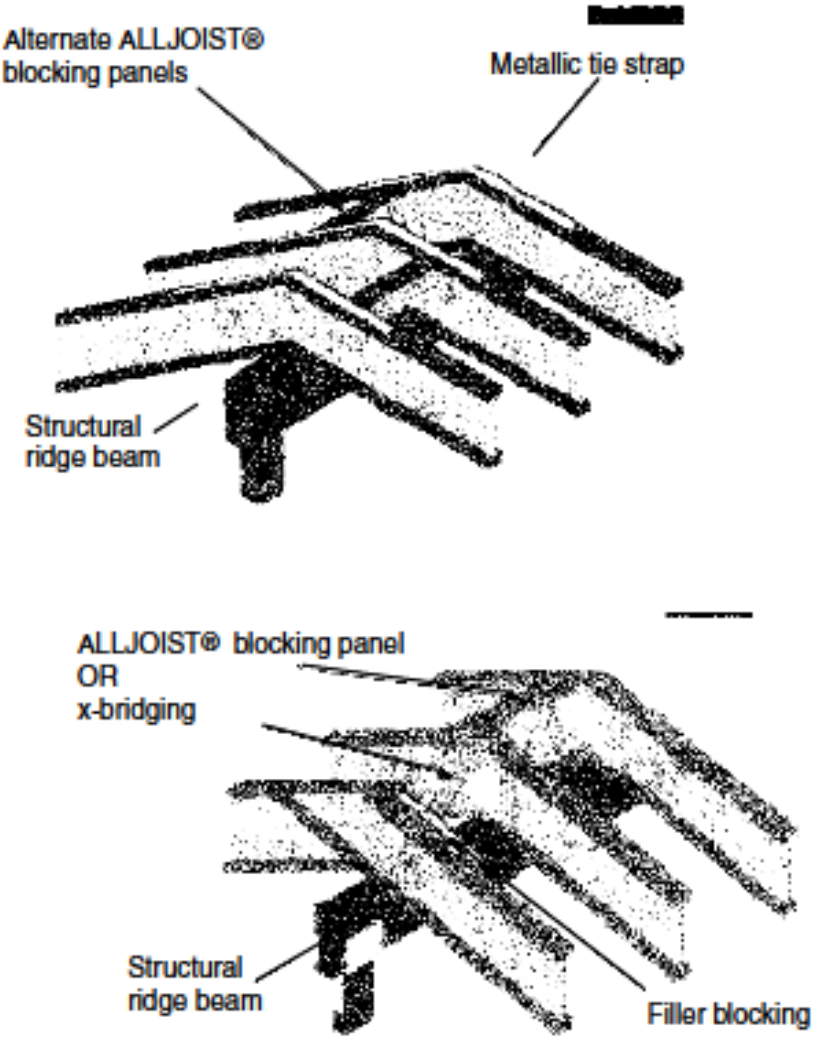
Rafters and joists must bear a minimum of 1½ in. on wood and 3 in. on masonry. The following guidelines cover cutting and drilling of joists and rafters:

- Cuts or notches must not exceed ¼ the depth at the ends.

- No cuts or notches should be located in middle third of the span.
- Cuts must not exceed ⅙ of depth at the top or bottom.
- Bored holes are not permitted within 2 in. of edges.
- Holes must not be more than ⅓ the depth.
- Holes cannot be closer than 2 in. to any notch.
- The tension side (bottom) of lumber must not be notched except at the ends.
- Cantilevered members cannot be notched! They may have holes drilled if they are no closer than 4 in. from the end.

ENGINEERED RAFTERS

Refer to Figure 8-2. Check to ensure that the manufacturer's installations are being used and strictly followed. As with engineered lumber used as joists, the manufacturer usually will void the warrantee if the product ever becomes wet.



Metallic tie strap is necessary for slopes exceeding 7/12.

Figure 8-2 SPECIAL CONSIDERATIONS WITH ENGINEERED RAFTERS (FROM ALLJOIST INSTALLATION GUIDE PROVIDED BY BOISE CASCADE CORPORATION)

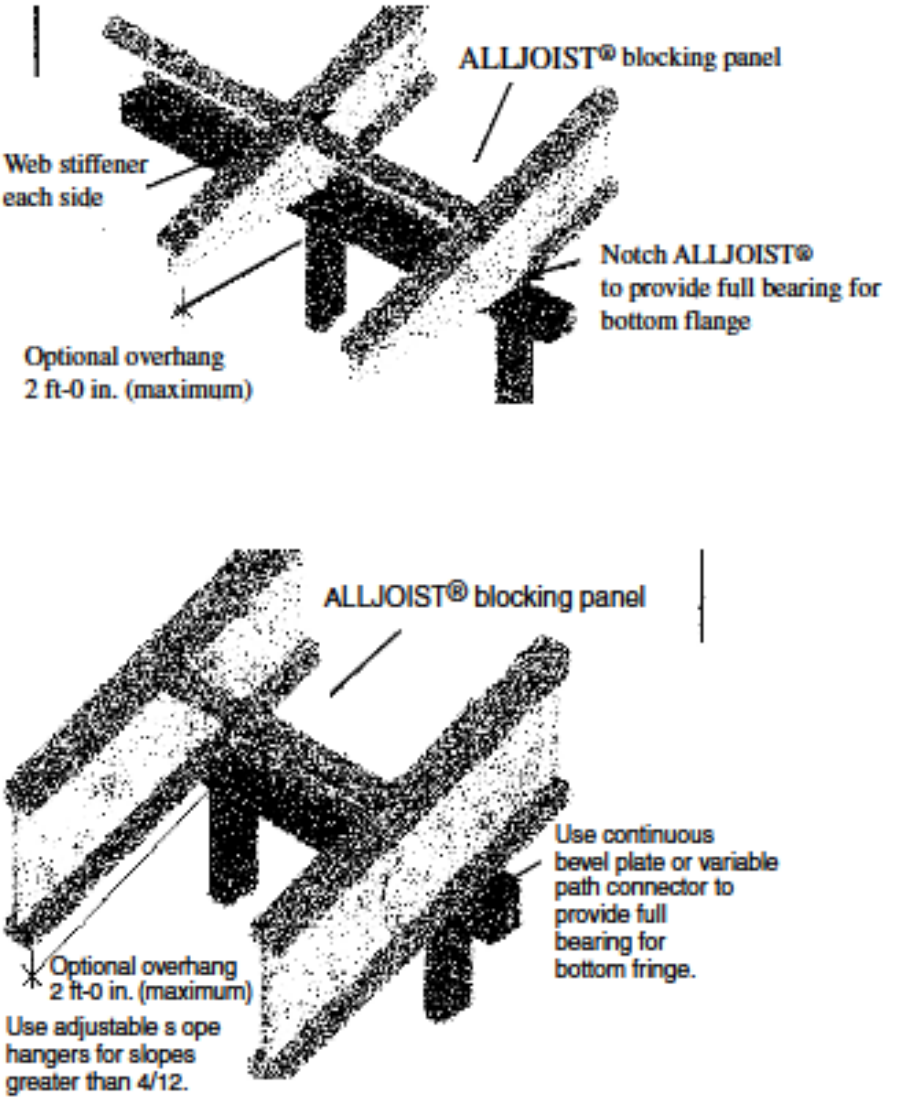


Figure 8-2 *(continued)*

ROOF VENTILATION

Refer to Figure 8-3.

- Ventilation requires as a minimum 1 to 150 of the area.
- Ventilation can be reduced from 1 to 300 under either of these conditions:
  (a) At least 50% but not more than 80% of venting is supplied by ventilators located in the upper space and at least 3 ft above cornice vents.
  (b) The attic has a vapor barrier on the warm side of the ceiling.
- Vents need corrosion-resistant mesh with openings less than ⅛ in.
- Insulation needs to be at least 1 in. away from all vents.

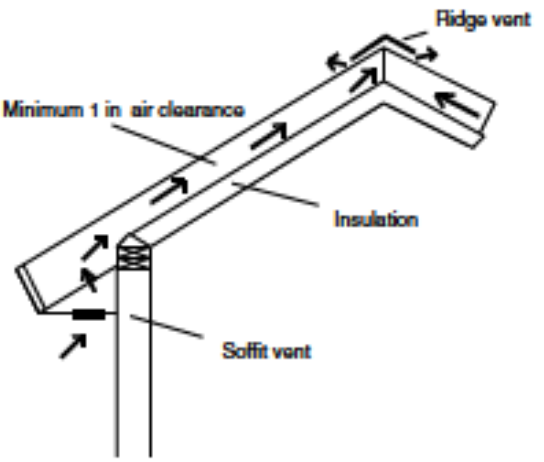


Figure 8-3 ROOF VENTILATION FOR A VAULTED CEILING

Ventilators

To establish the required number of ventilators needed for any area, first calculate the total number of cubic feet in the area to be ventilated. Then follow instructions below.

If you know the number of required air changes: Divide the total cubic feet by the number of air changes required per minute. This will give you the number of cubic feet per minute (CFM) required to reach the correct air changes. On the CFM ratings chart (Table 8-1), find the rotary ventilator (RV) that most closely reaches the correct CFM (use the lowest CFM rating so that this will be the minimum attained).

TABLE 8-1 SIZING OF ROTARY VENTILATORS

Wind speed (mph)	Cubic feet per minute (CFM)						
	Temperature difference	6 in.	8 in.	10 in.	12 in.	14 in.	18 in.
4	10	81	144	224	323	440	721
	20	83	149	232	334	455	752
	30	88	149	244	352	479	793
8	10	144	257	400	576	788	1299
	20	146	261	407	586	798	1320
	30	146	264	410	591	806	1333
10	10	178	317	494	711	970	1604
	20	182	325	506	729	994	1844
	30	188	332	517	748	1016	1678

If you know the size of the rotary requested: Divide the minimum CFM rating into total cubic feet. This will tell you how many ventilators are needed to totally ventilate the area each minute. (This number can then be used to calculate the number of minutes that you want a 100% air change to take place.)

ATTIC ACCESS

- Attic access requires a minimum opening of 22 × 30 in.
- A 30-in.-head clearance is needed between the rafters and the opening.
- Check sizes of any installed equipment such as HVAC units or water heaters. The access must be large enough to allow removal.

CORNICES

Refer to Figure 8-4 for features found in cornices.

TRUSSES

Verify all code-required design data. Refer to Figures 8-5 and 8-6 for components and types of trusses.

❑ Check slope, span, and spacing of trusses.
❑ Check joint locations.

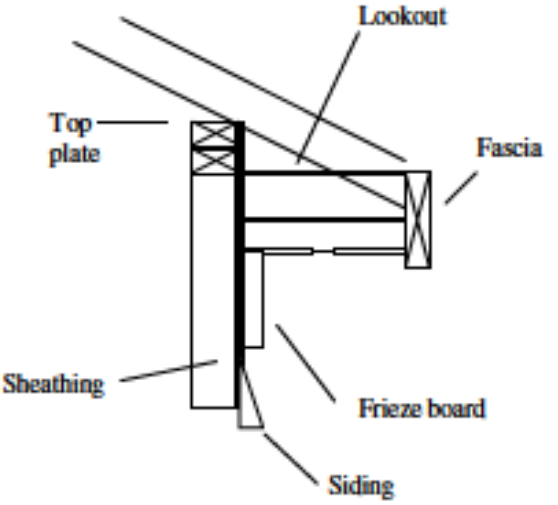


Figure 8-4 TYPICAL CORNICE DETAIL

- ❑ Check required bearings of trusses and locations.
- ❑ Check design loads as applicable:
  - Top chord live load (including snow loads)
  - Top chord dead load
  - Bottom chord live load
  - Bottom chord dead load

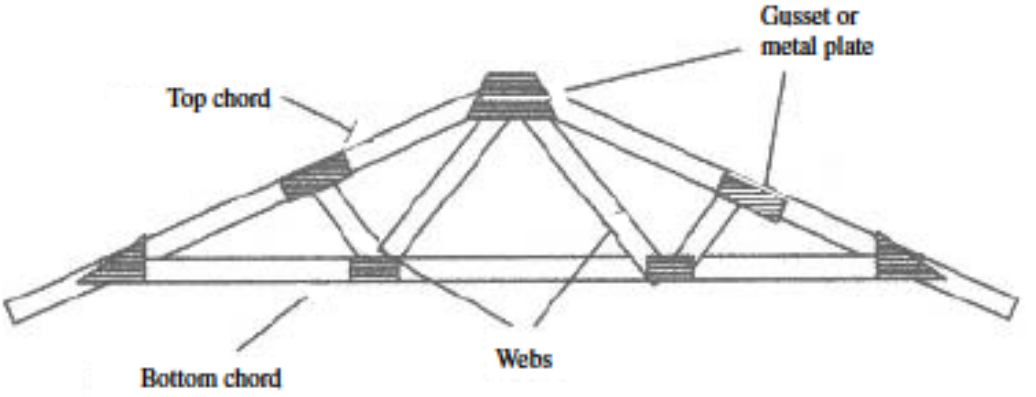


Figure 8-5 TRUSS COMPONENTS

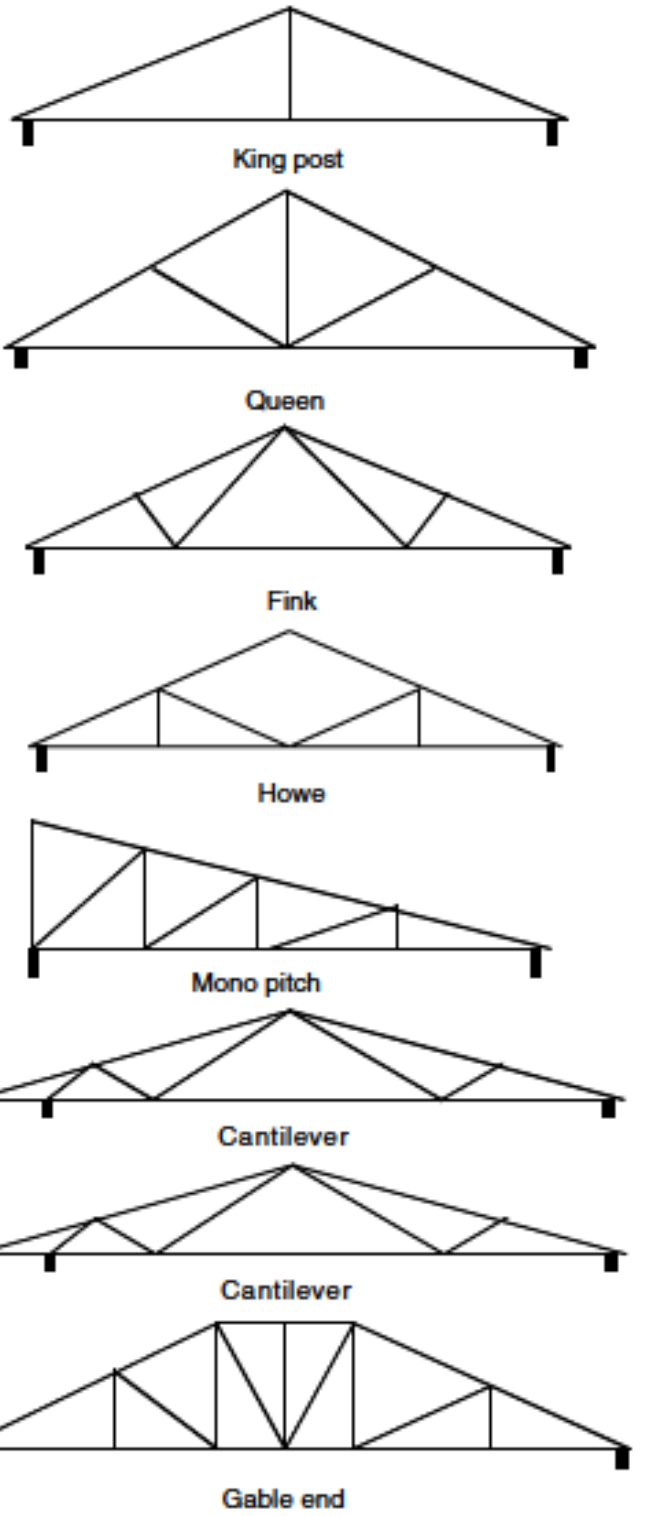


Figure 8-6 TYPICAL TRUSSES

- Concentrated loads and their points of application
- Controlling wind and earthquake loads

❏ Check adjustments to lumber and joint connector design values for conditions of use.

❏ Check each reaction force and direction.

❏ Check joint connector type and description (e.g., size, thickness, or gauge) and the dimensioned location of each joint connector except where symmetrically located relative to the joint interface.

❏ Check lumber size, species, and grade for each member.

❏ Check connection requirements for the following:

- Truss to truss girder
- Truss ply to ply
- Field splices
- Calculated deflection ratio and/or maximum description for live and total load

❏ Check maximum axial compression forces in the truss members to enable the building designer to design the size, connections, and anchorage of the permanent continuous lateral bracing. Forces should be shown on the truss design drawing or on supplemental documents.

❏ Check required permanent truss member bracing location.

The preceding information must be on the site and must accompany the delivery of the trusses.

TRUSS INSPECTIONS

Refer to Figures 8-7 through 8-11 and Tables 8-2 through 8-4.

Before Installation

- ❑ Verify sizes and design as per approved shop drawings, plans, and specifications.
- ❑ Verify correct wood type and grade.
- ❑ Check for correct metal plates, locations, and tolerances.
- ❑ Ensure that web placements are correct and within tolerances.
- ❑ Check that trusses are stored correctly.
- ❑ Do not allow the cutting of bands until ready to install.
- ❑ Use correct methods of lifting.

After Installation

- ❑ Ensure that appropriate ground bracing has been used to anchor the lateral bracing.
- ❑ Ensure that lateral bracing has been installed and spaced correctly.
- ❑ Check that lateral bracing has been lapped correctly.
- ❑ Check that diagonal braces are installed.
- ❑ Make sure trusses are spaced correctly.

BEARING LOCATION

FOR THIS AND ALL SIMILAR TRUSSES

Truss design requires that this truss be installed on a support at this location.

Truss Plate Institute

PLATE HERE

Bearing Location

TEMPORARY LATERAL BRACING REQUIRED

Truss design requires temporary continuous lateral bracing on this chord member and similar chord members of adjacent trusses. Refer to Truss Plate Institute's guidelines for location of temporary lateral bracing.

Truss Plate Institute

Figure 8-7 SAFETY TAGS FOR TRUSSES

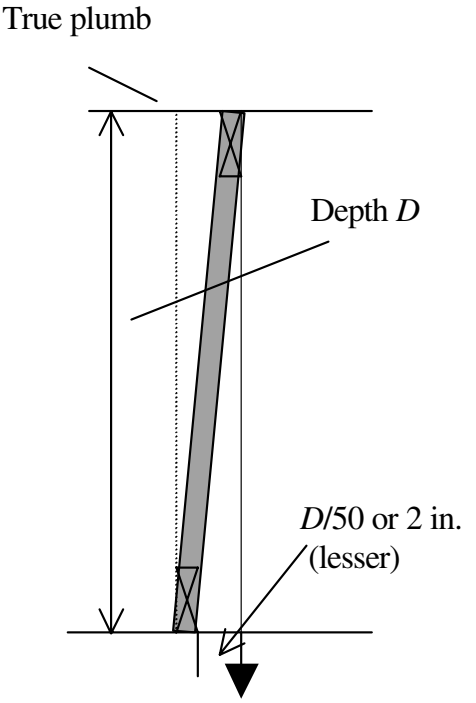


Figure 8-8 TRUSS PLUMB TOLERANCES

- ❏ Ensure that trusses are placed laterally and vertically within tolerances.
- ❏ Ensure that trusses have not been damaged during installation.

Truss Repairs

Any correction that involves cutting, drilling, or relocating any truss member or metal connector plate is considered to be a major correction, and it should never be done without the written approval of the truss designer and or the designer of record.

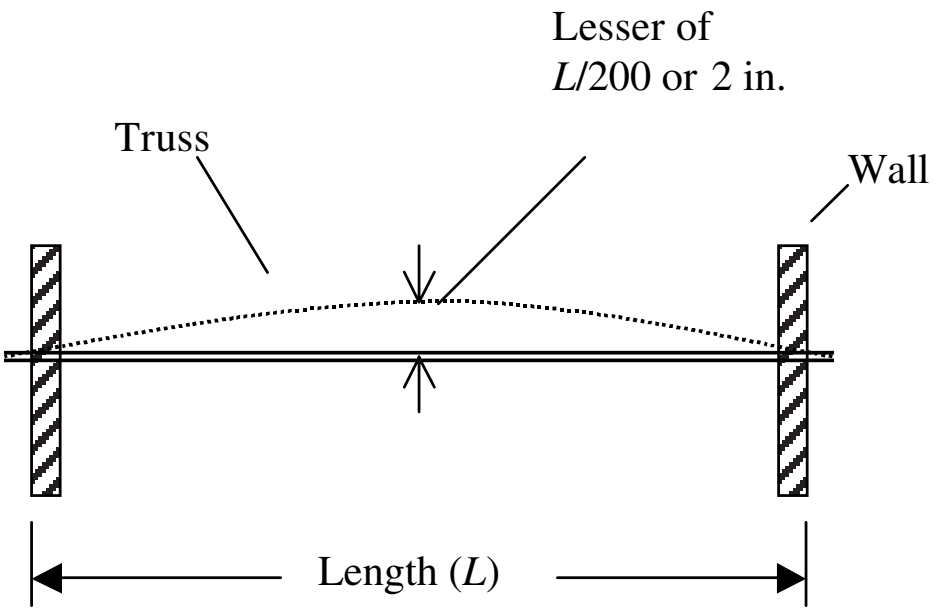


Figure 8-9 BOWING TOLERANCES OF TRUSSES

TABLE 8-2 TRUSS BOW ALLOWANCES

D (in.)	*D*/50 (in.)	D (ft)
12	¼	1
24	½	2
36	¾	3
48	1	4
60	1¼	5
72	1½	6
84	1¾	7
96	2	8
108	2	9

Note: Allowances are as per HIB-91 of Truss Plate Institute (TPI). Refer to Figure 8-8.

TABLE 8-3 COMPUTED BOWING TOLERANCES OF TRUSSES

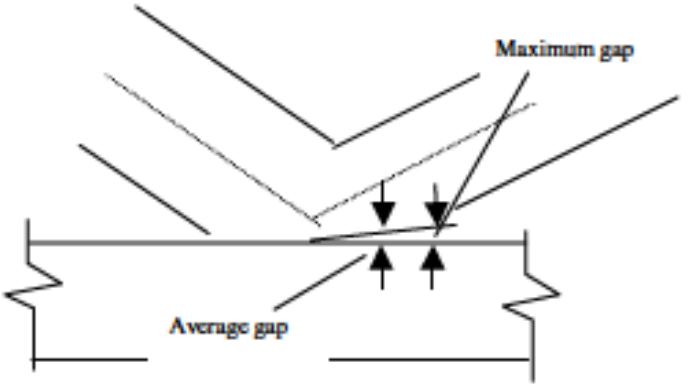
L (in.)	*L*/200 (in.)	*L* (ft)
25	1/8	2.1
50	1/4	4.2
75	3/8	6.3
100	1/2	8.3
125	5/8	10.4
150	3/4	12.5
175	7/8	14.6
200	1	16.7
225	1 1/8	18.8
250	1 1/4	20.8
275	1 3/8	22.9
300	1 1/2	25.0
350	1 3/4	29.2
400	2	33.3

Note: Refer to Figure 8-9.

TABLE 8-4 DESIGN VERSUS CONSTRUCTION TOLERANCES

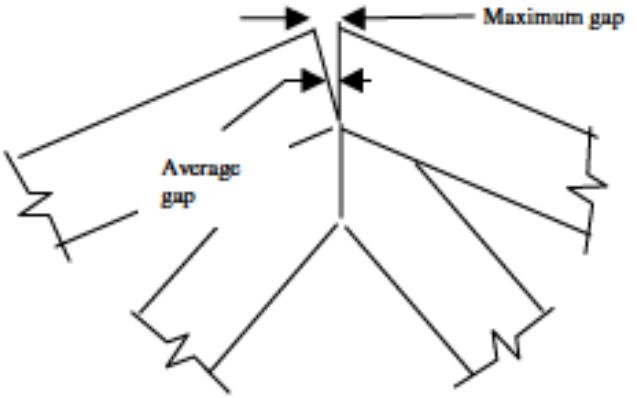
Dimension	Variance from design (in.)
Length of truss (ft)	
Up to 30	1/2
Over 30	3/4
Height of truss (ft)	
Up to 5	1/4 in.
Over 5	1/2 in.

Note: Truss length excludes overhangs and extensions.



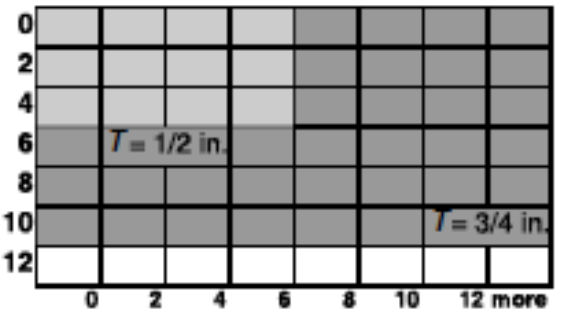
(a uniform gap is equal to an average gap).

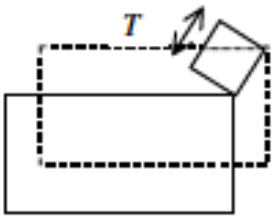
Maximum gap	1/4 in.
Average gap	1/8 in.



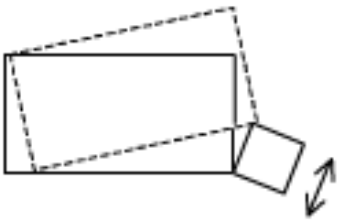
Maximum gap	1/8 in.
Average gap	1/16 in.

Figure 8-10 TRUSS PLATE TOLERANCES (A UNIFORM GAP IS EQUAL TO AN AVERAGE GAP)





Example:



Example: **Assuming a plate is 4 × 6 in., *T* measurement is 1/2 in. The codes allow a 1/2-in. deviation for the plate.**

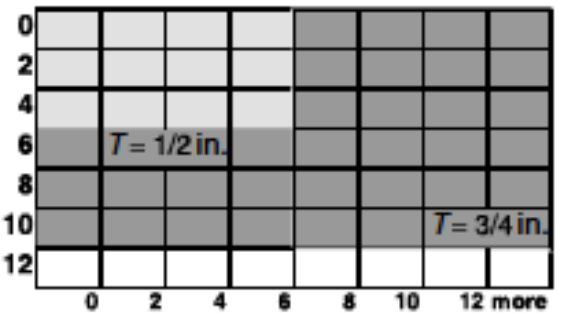


Figure 8-11 METAL PLATE TOLERANCES

ROOF SHEATHING

Refer to Figures 8-12 and 8-13 and Tables 8-5 to 8-8.

- A 1-in. gap is required between the panel and masonry.

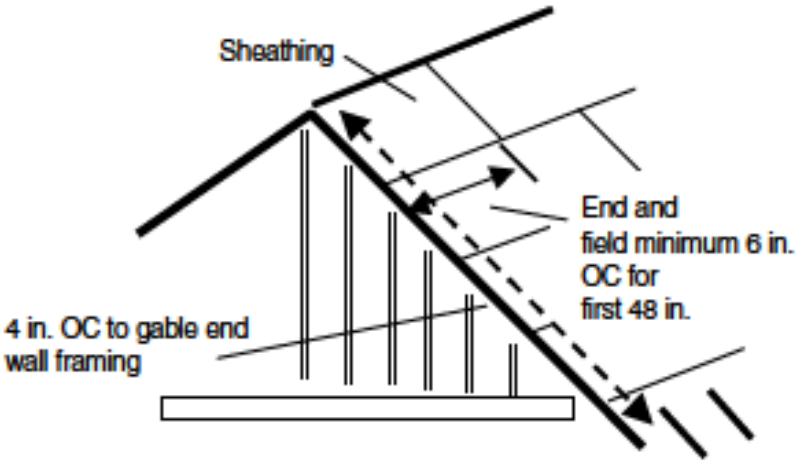


Figure 8-12 NAILING GABLE SHEATHING WHEN BASIC WIND SPEED IS GREATER THAN 80 MPH

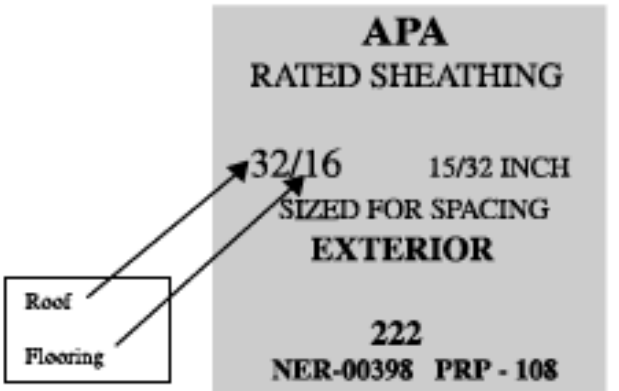


Figure 8-13 GRADED SPANS STAMPED ON SHEATHING MATERIALS

- All penetrations for the roof should be oversized.
- Sheathing must span two or more supports.
- Sheathing needs to have a 1/16-in. gap between panels and should be nailed no closer than 3/8 in. from the edges.
- The textured side of OSB sheathing must be installed up to receive the roofing material. Most oriented strand board (OSB) sheathing will be textured on one side and smooth on the opposite side.

TABLE 8-5 MINIMUM THICKNESS FOR LUMBER ROOF SHEATHING

Rafter or beam spacing (in. OC)	Minimum thickness (in.)
24	5/8
48 60 72	1 1/2

Note: The 1 1/2-in. boards must be tongue and groove.

TABLE 8-6 MINIMUM THICKNESS FOR PARTICLEBOARD SHEATHING

Rafter or beam spacing (in. OC)	Minimum thickness (in.)
16	3/8
24	7/16

Note: The 3/8-in. and 7/16-in. boards must be tongue and groove or have clips or blocking at the unsupported edges.

TABLE 8-7 NAILING OF ROOF SHEATHING (WOOD PANELS)

Thickness (in.)	Type of Nail	Edge spacing	Field spacing
5/16 to 1/2	8d common	6	12
19/32 to 1	8d common	6	12
1 1/8 to 1 1/4	10d common or 8d deformed	6	12

TABLE 8-8 CODE-ALLOWED SPANS FOR C-C AND C-D PLYWOOD

Rating	Nominal thickness (in.)	*Maximum span*	
		With edge support	Without edge support
16/0	5/16, 3/8	16	16
20/0	5/16, 3/8	20	20
24/0	3/8, 7/16, 1/2	24	20
24/16	7/16, 1/2	24	24
32/16	15/32, 1/2, 5/8	32	28
40/20	19/32, 5/8, 3/4, 7/8	40	32
48/24	23/32, 3/4, 7/8	48	36

Note: The maximum span for 1/2-in. 24/0 rated plywood is 24 in.

THINK SAFETY AT ALL TIMES

CHAPTER 9
CHIMNEY AND FIREPLACE FRAMING

Framers need to pay particular attention to the clearances allowed by the codes for combustible framing materials.

CRICKETS

Refer to Figures 9-1 and 9-2 and Table 9-1.

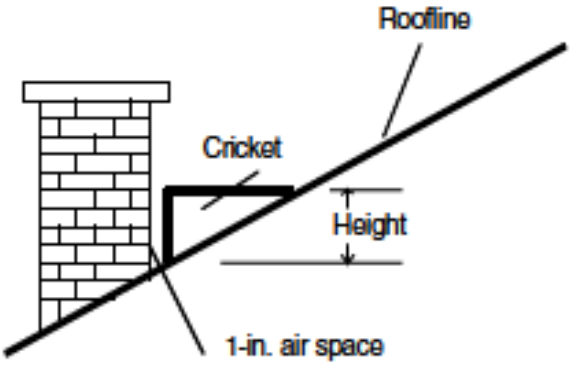


Figure 9-1 CRICKET HEIGHTS

TABLE 9-1 MINIMUM CRICKET HEIGHTS

Roof slope	Height of cricket
12 TO 12	½ OF WIDTH
8 TO 12	⅓ OF WIDTH
6 TO 12	¼ OF WIDTH
4 TO 12	⅙ OF WIDTH
3 TO 12	⅛ OF WIDTH

Note: Refer to Figures 9-1 and 9-2.

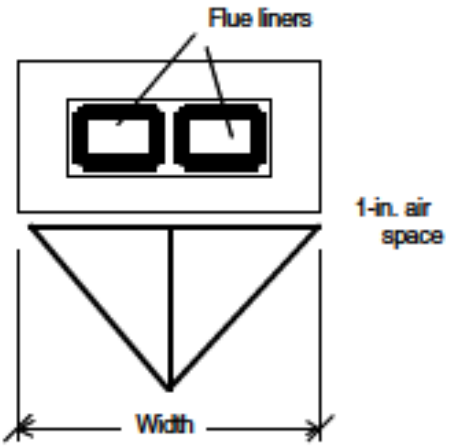


Figure 9-2 CRICKET HEIGHTS

CHIMNEY HEIGHTS

Refer to Figure 9-3.

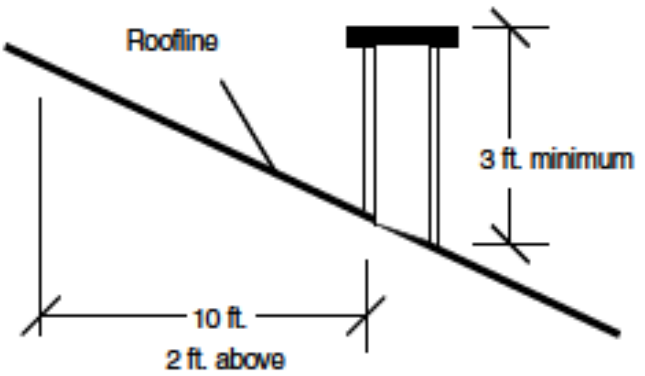


Figure 9-3 FIREPLACE CHIMNEY HEIGHTS

Chimney height must be at least 2′ above any point of the roof within 10′ of the chimney.

CHAPTER 10
MISCELLANEOUS FRAMING

INTERIOR FINISH

- ❑ Ensure that the correct quality of each piece of material is used.
- ❑ Check that grounds are provided to which to nail trim.
- ❑ Check that exposed surfaces are sanded smooth.
- ❑ Check that backs of trim, to be installed against wood or plaster, are hollow.
- ❑ Make sure that joints are tight, sawed and fitted accurately, and made to conceal shrinkage.
- ❑ Check that finish nails are used to secure trim set for puttying.
- ❑ Check that door and window trim, pilasters, newels, and posts are of single lengths.
- ❑ Ensure that bases are set in place after floor is laid.
- ❑ For wood finish flooring, ensure that shoe mold is nailed to base only.

MILLWORK

- ❑ Check millwork on arrival at the job site against specifications and details of shop drawings and/or contract drawings. Closely check workmanship.
- ❑ Check requirements for treated wood. Preservative treatment may be required for some components, especially those to be in contact with concrete or masonry.
- ❑ Check for water-repellent preservative requirements.
- ❑ Inspect condition of materials for warps, splits, and damages.
- ❑ Ensure that back-priming has been accomplished where specified.
- ❑ Check that anchors have been provided as specified or detailed.
- ❑ Ensure that fastenings are the type, size, and spacing specified, or shown.
- ❑ Verify the hardware.
- ❑ Ensure adequate protection of the installed items from construction damage.

INTERIOR TRIM AND FRAMING

Refer to Figures 10-1 to 10-3 for clearances around kitchen and bath fixtures.

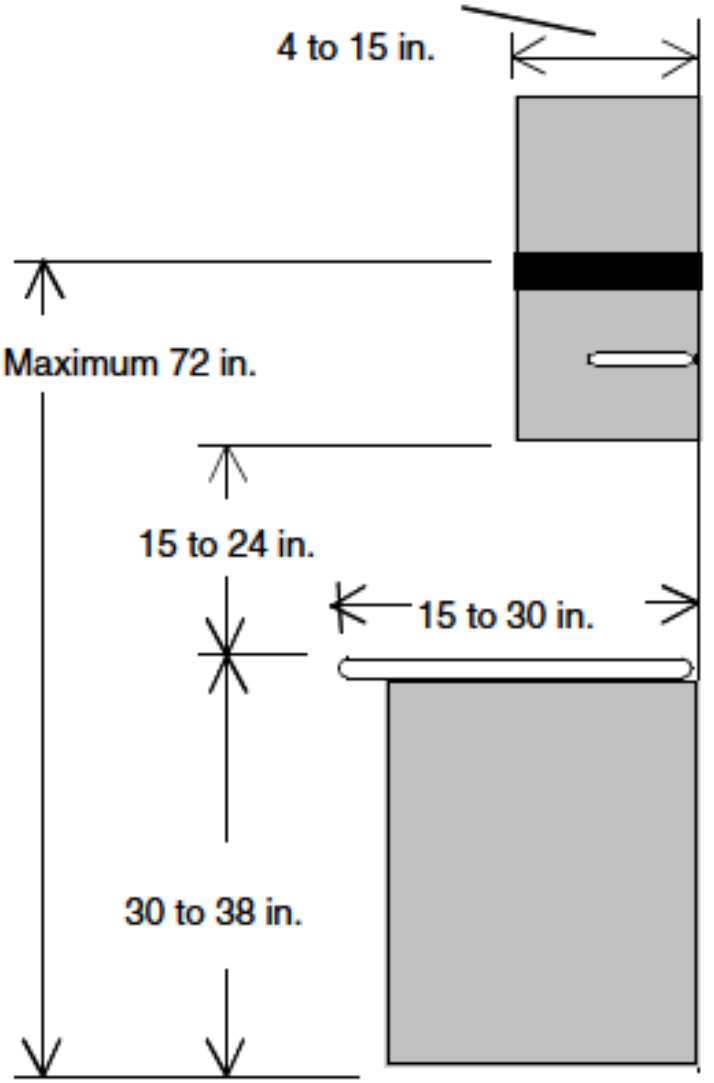


Figure 10-1 MINIMUM REQUIREMENTS FOR KITCHENS AND VANITIES

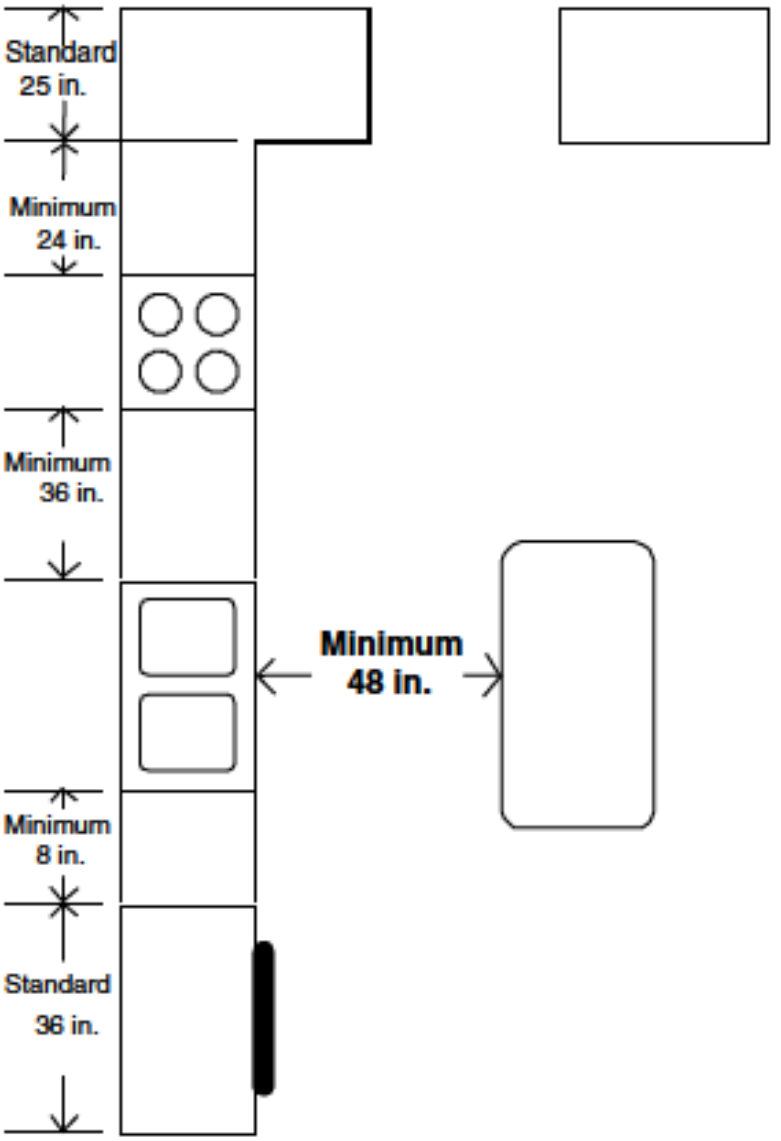


Figure 10-2 TYPICAL AND MINIMUM CLEARANCES FOR KITCHENS

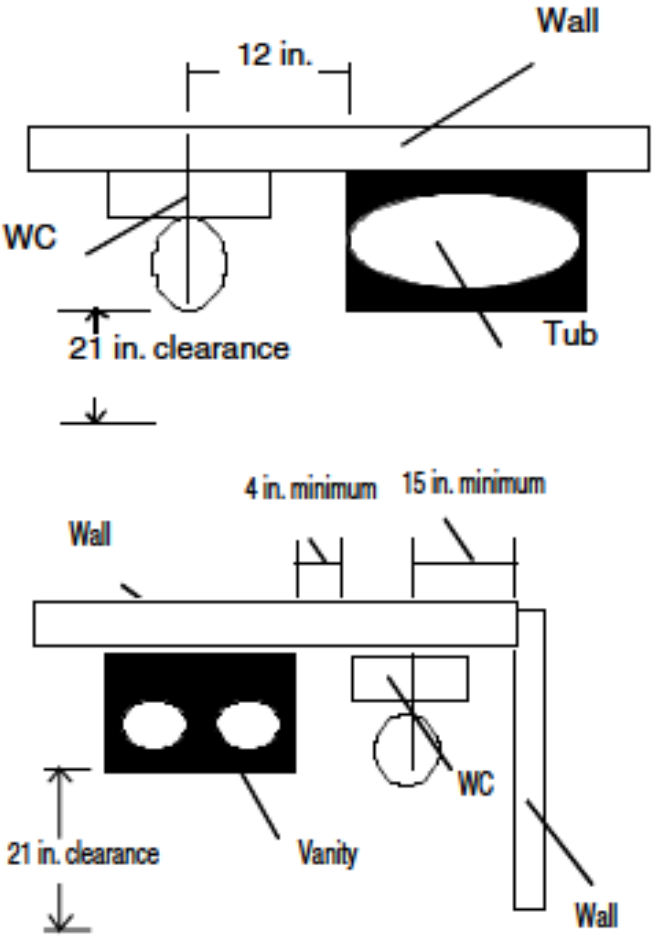


Figure 10-3 CODE-APPROVED MINIMUM CLEARANCES FOR BATH FIXTURES (NOT TO SCALE)

RAMPS

- Ramps should not exceed 1/12 pitch or 12.5% slope.
- Handrails are needed if greater than 1/12 pitch.
- Landings need to be 3 ft × 3 ft.

- When the slope of a sidewalk that is an ADA accessible route becomes steeper than 1 to 20, railings and edge protection are required for safe use.

STAIRS

Refer to Figures 10-4 to 10-7.

- Stairs should be at least 36 in. in width.
- With one handrail stair width may be reduced but must be at least 32 in. With two handrails, 28 in. is needed.

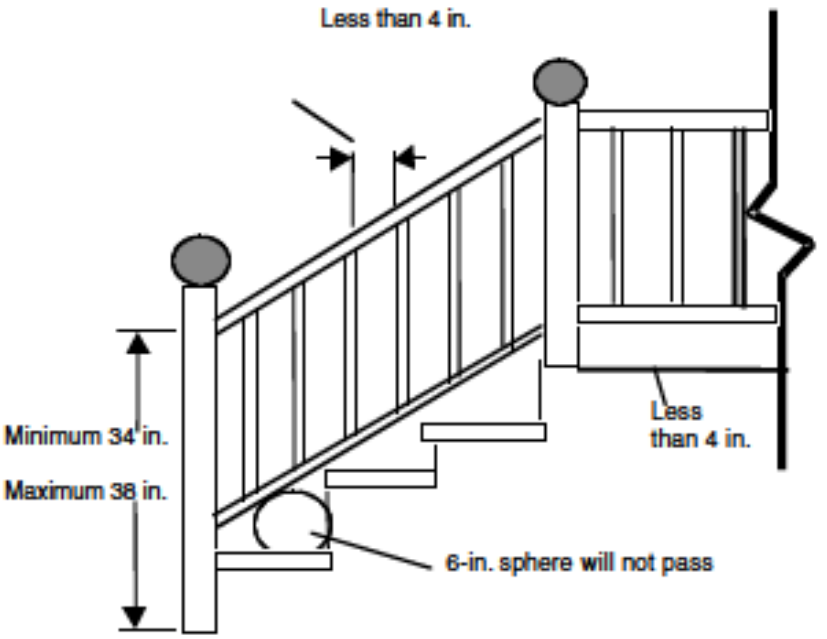


Figure 10-4 CODE REQUIREMENTS FOR STAIRS

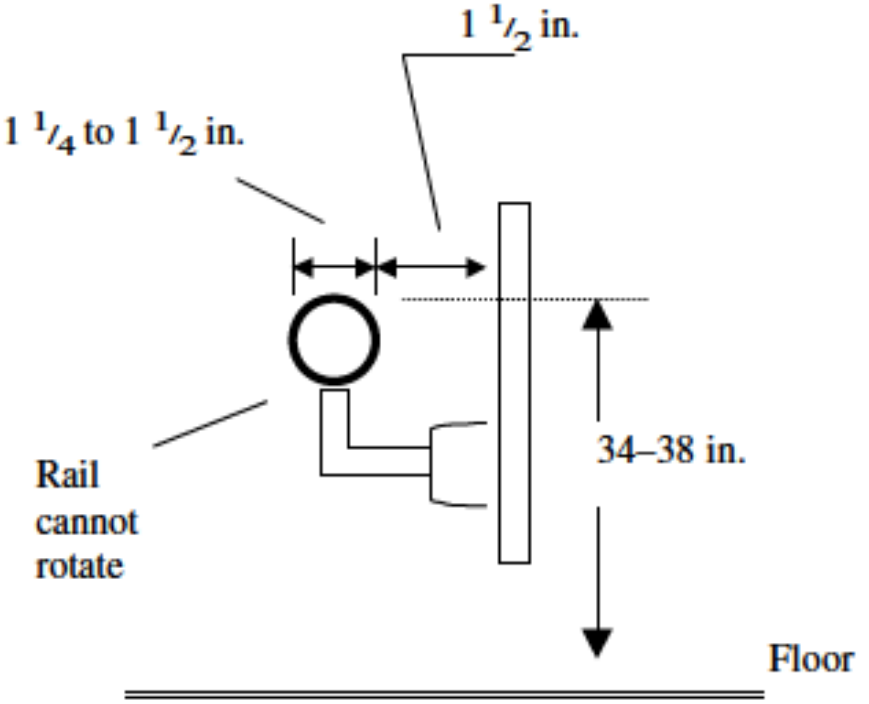


Figure 10-5 HANDRAILS

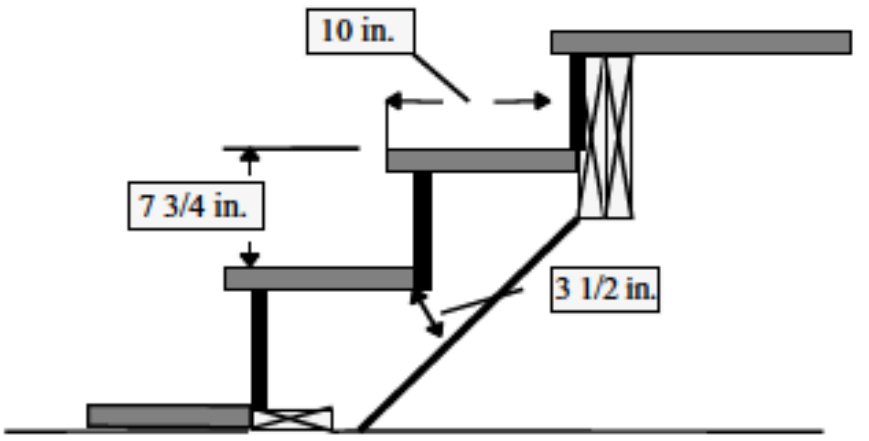


Figure 10-6 STAIR TREADS AND RISERS

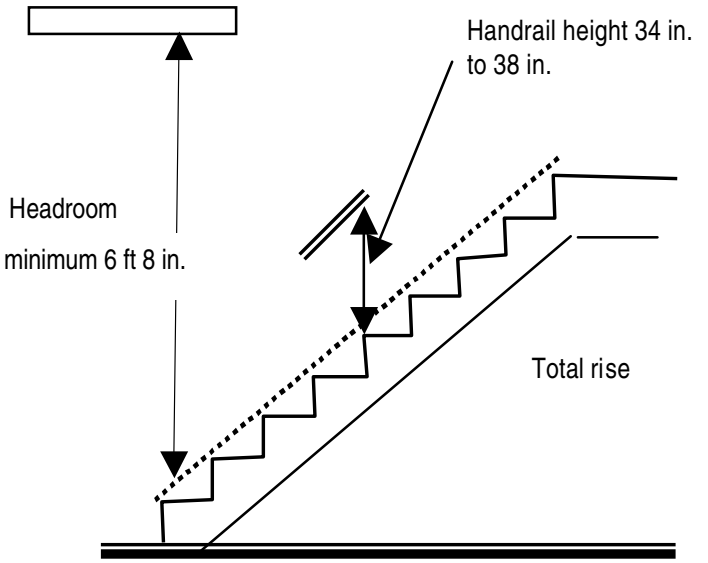


Figure 10-7 STAIR HEADROOM AND HANDRAIL HEIGHTS

- Risers must be not more than 7¾ in. in height.
- Treads must be not less than 10 in. in depth, and the greatest must vary from the lesser by no more than ⅜ in.
- Nosing should be ¾ to 1¼ in. except when the depth of tread is at least 11 in.
- Headroom must be at least 6 ft 8 in.

Spiral Stairs

- Spiral stairs must be at least 26 in. in width on 7½ in. in depth at 12 in. from the narrow end (Figure 10-8).

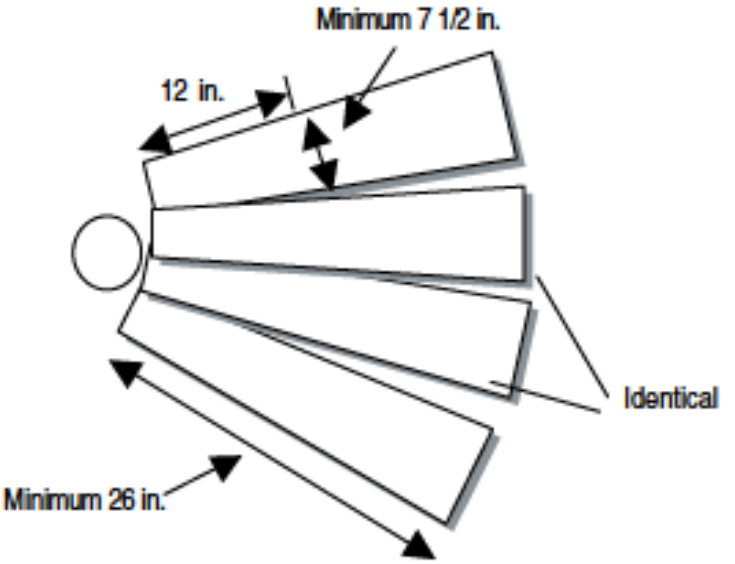


Figure 10-8 SPIRAL STAIRS

- Spiral staircases need a handrail on the outside on the steps.
- Treads must be identical but no more than 9½ in. deep.
- Headroom must be at least 6 ft 6 in.

Circular Stairs

- Circular stairs should have a minimum depth of tread of 6 in.
- The smaller radius should not be less than twice the width of the stairway measured 12 in. from the narrow end.
- The minimum tread depth should be 10 in.

Handrails

- Handrails should be 34 to 38 in. in height.
- The space next to the wall must not be less than 1½ in.
- The gripable size should be 1¼ to 2 in.
- Openings must be less than 4 in. apart.
- Handrails need to withstand 200 pounds of force.
- Handrails are required if stairs are more than 30 in. above grade.

Calculating Treads and Risers

Refer to Figure 10-9.

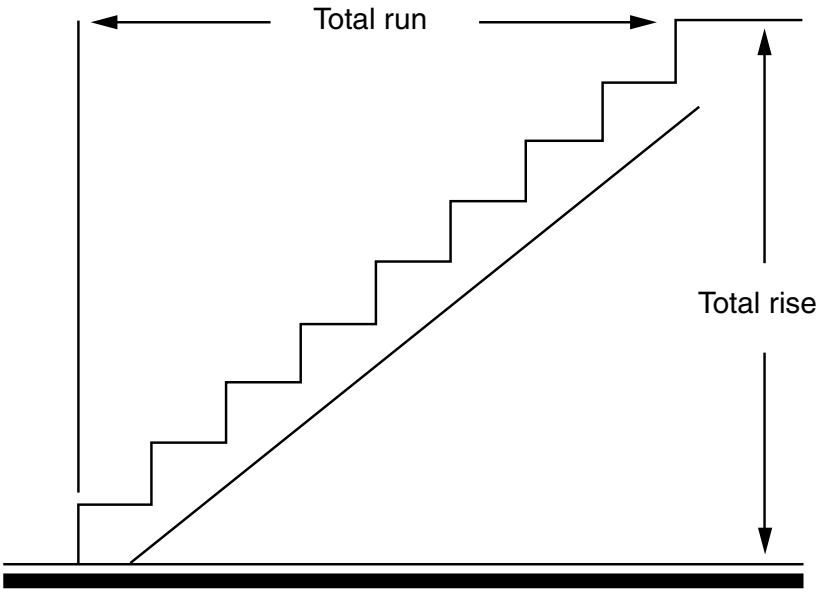


Figure 10-9 RISE AND RUN IN STAIRS

- ❏ Step 1. Divide total floor-to-floor rise (in inches) by 7.
- ❏ Step 2. Raise or lower fraction to nearest whole number. This is the number of risers.
- ❏ Step 3. Divide total rise by number of risers to determine height of riser.
- ❏ Step 4. Number of treads is one less than the number of risers.

For example, for a total rise of 10 ft,

120 in./7 in. = 17.14 ≈ 17 risers (=16 treads)

120 in./17 = 7 1/16 in. per riser

EXTERIOR FINISH

- ❏ Determine material type, grade, and length of boards to be used, and condition of material.
- ❏ Ensure that the correct nails, staples, or other fasteners are being used.
- ❏ Ensure that the manufacturer's instructions are strictly followed! Make sure that they are on the site.
- ❏ Make sure that prefinished siding is sealed and finished exactly as specified.
- ❏ Check that fastening of finished siding is exactly as directed by the siding manufacturer.

- ❑ Inspect for excessive bowing, warping, or damages of such items as trim and siding.
- ❑ Check for workmanship such as sawing, fitting, appearance and location of splicing, coping, shouldering, mitering, and excess splices.
- ❑ Ensure that end joints of siding are made at supports. Check clearances.
- ❑ Check trim installation for specified nailing, joining, fitting, and caulking for water resistance.
- ❑ Check that preservative treatment has been provided as specified. All new cuts must be retreated!
- ❑ Make sure that door and window trim and moldings are in single lengths. Machine finger-jointing is permitted.
- ❑ Ensure that all flashing has been correctly installed.
- ❑ Check that joints of built-up members are staggered.
- ❑ Ensure that joints in exterior millwork are constructed so as to be weather tight.
- ❑ For wood shingles installed on walls, check to ensure the following:
  - Correct grade for shingles
  - Starter courses doubled

- Weather exposure, as specified (see "Up to Code" Thermal and Moisture Protections book for more information)
- Nailing 1 in. above butt line of the next course
- Joints kept offset from the previous course

❑ Check for priming of all sides and edges of exterior wood work. This applies especially to the backside of fascia, soffits, frieze boards, and trim.

THINK SAFETY AT ALL TIMES

CHAPTER 11
DECKS AND BALCONIES

Refer to Table 11-1 for general load requirements.

TABLE 11-1 MINIMUM CODE-APPROVED LOADS FOR DECKS AND BALCONIES

Use	Minimum live load (pounds per square foot)
Decks	40
Exterior balcony	60
Fire escape	40
Stairs	40
Guardrail or handrails	200

LEDGERS AND LEDGER BOLTS

Refer to Figure 11-1 and Table 11-2. If ledger bolts are inserted in a load-bearing CMU, the block must be solid (75%) or grouted full! Brick veneer cannot be used to support ledgers supporting a deck or any other load.

TABLE 11-2 LEDGER BOLTS

Joist span (ft)	*Bolt size and proper spacing*	
	Roof	Floor
10	½ at 2 ft 6 in. ⅞ at 3 ft 6 in.	½ at 2 ft 0 in. ⅞ at 2 ft 9 in.
10–15	½ at 1 ft 9 in. ⅞ at 2 ft 6 in.	½ at 1 ft 4 in. ⅞ at 2 ft 0 in.
15–20	½ at 1 ft 3 in. ⅞ at 2 ft 0 in.	½ at 1 ft 0 in. ⅞ at 1 ft 6 in.

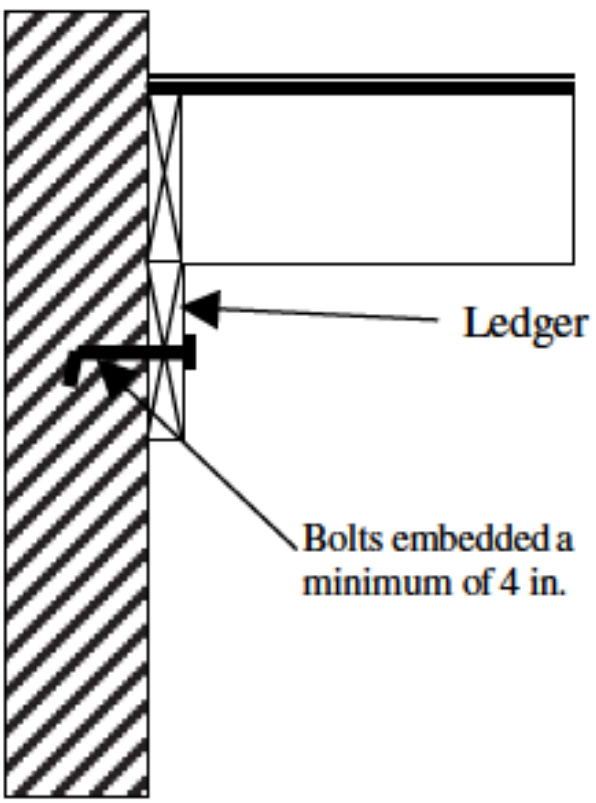


Figure 11-1 LEDGER BOLTS IN DECK CONSTRUCTION

DECK JOISTS

Span tables for deck joists are given as Tables 11-3 and 11-4.

TABLE 11-3 DECK JOIST SPANS FOR 10 PSF DEAD LOAD, 40 PSF LIVE LOAD

Species, grade 2 or better L/360	Joist size	*Joist spacing (in. OC)*		
		12	16	24
Douglas-fir, southern pine	2×6	10 ft 4 in.	9 ft 5 in.	7 ft 10 in.
	2×8	13 ft 8 in.	12 ft 5 in.	10 ft 2 in.
	2×10	17 ft 5 in.	15 ft 5 in.	12 ft 7 in.
	2×12	20 ft 0 in.	17 ft 10 in.	14 ft 7 in.
Hemlock-fir, spruce-pine-fir	2×6	9 ft 2 in.	8 ft 4 in.	7 ft 3 in.
	2×8	12 ft 1 in.	10 ft 11 in.	9 ft 6 in.
	2×10	15 ft 4 in.	14 ft 0 in.	11 ft 7 in.
	2×12	18 ft 8 in.	16 ft 6 in.	13 ft 6 in.
Ponderosa pine, redwood, western cedar	2×6	8 ft 10 in.	8 ft 0 in.	7 ft 0 in.
	2×8	11 ft 8 in.	10 ft 7 in.	8 ft 10 in.
	2×10	14 ft 10 in.	13 ft 3 in.	10 ft 10 in.
	2×12	17 ft 9 in.	15 ft 4 in.	12 ft 7 in.

TABLE 11-4 DECK JOIST SPANS FOR 10 PSF DEAD LOAD, 60 PSF LIVE LOAD

Species, grade 2 or better L/360	Joist size	*Joist spacing (in. OC)*		
		12	16	24
Douglas-fir, southern pine	2×6	9 ft 0 in.	8 ft 2 in.	6 ft 8 in.
	2×8	11 ft 11 in.	10 ft 6 in.	8 ft 7 in.
	2×10	15 ft 0 in.	13 ft 0 in.	10 ft 7 in.
	2×12	17 ft 5 in.	15 ft 1 in.	12 ft 4 in.
Hemlock-fir, spruce-pine-fir	2×6	8 ft 0 in.	7 ft 3 in.	6 ft 3 in.
	2×8	10 ft 6 in.	9 ft 6 in.	8 ft 0 in.
	2×10	13 ft 5 in.	12 ft 0 in.	9 ft 10 in.
	2×12	16 ft 1 in.	14 ft 0 in.	10 ft 10 in.
Ponderosa pine, redwood, western cedar	2×6	7 ft 9 in.	7 ft 0 in.	5 ft 11 in.
	2×8	10 ft 2 in.	9 ft 2 in.	7 ft 6 in.
	2×10	12 ft 11 in.	11 ft 2 in.	9 ft 2 in.
	2×12	15 ft 0 in.	13 ft 0 in.	10 ft 7 in.

POST LOADS

Refer to Figure 11-2 and Tables 11-5 through 11-10 for post loading.

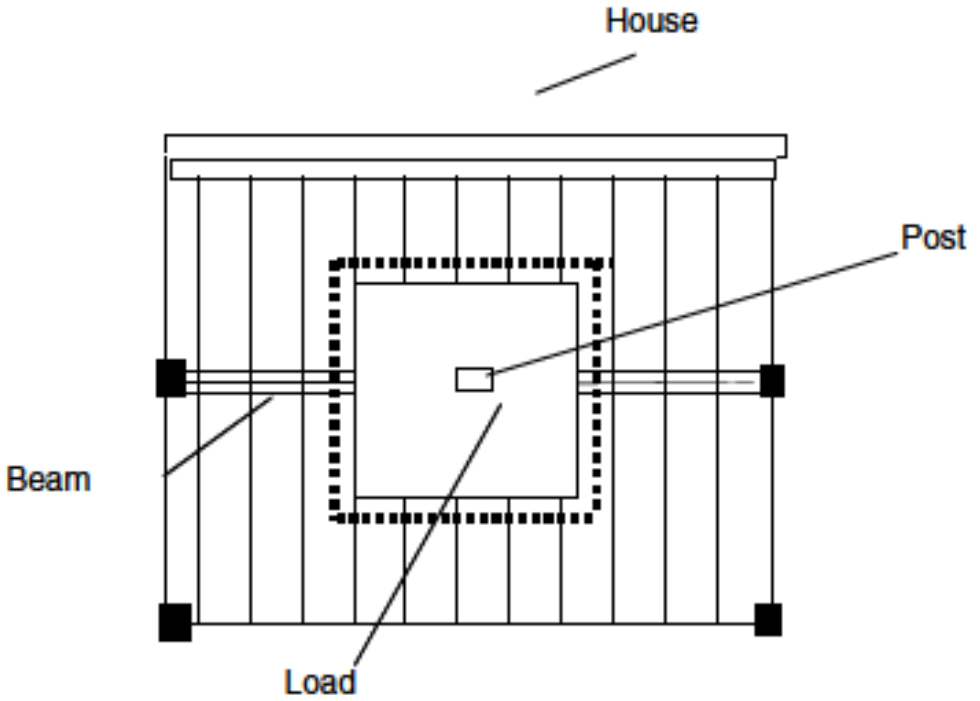


Figure 11-2 EXAMPLE OF TRIBUTARY LOADING ON POSTS OR JOISTS

TABLE 11-5 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR SOUTHERN PINE OR DOUGLAS-FIR POSTS (40 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	14	17
48	10	14	17
60	10	13	17
72	9	12	17
84	9	11	17
96	8	10	17
108	8	10	17
120	7	9	17
132	7	8	17
144	6	8	17
156	6	8	17
168	6	8	17
180	6	7	16
192	5	7	16
204	5	7	15
216	5	7	15
228	4	6	14
240	4	6	14

Note: No. 1 grade is for 6 × 6 posts.

TABLE 11-6 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR HEMLOCK–FIR OR SPRUCE–PINE–FIR (40 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	14	17
48	10	14	17
60	10	13	17
72	9	12	17
84	9	11	17
96	8	11	17
108	8	10	17
120	7	9	17
132	7	9	17
144	6	9	17
156	6	8	17
168	6	8	16
180	6	8	16
192	5	7	15
204	5	7	15
216	5	7	14
228	4	7	13
240	4	6	13
256	4	6	12

Note: No. 1 grade is required for 6 × 6 posts.

TABLE 11-7 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR PONDEROSA PINE, REDWOOD, WESTERN CEDAR, OR SPRUCE–SOUTHERN PINE–FIR POSTS (40 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	14	17
48	10	13	17
60	9	12	17
72	8	11	17
84	7	10	17
96	7	9	17
108	6	8	17
120	6	8	17
132	5	7	16
144	4	7	15
156		7	15
168		6	14
180		6	14
192		5	13
204		5	13
216		4	12
228		4	12
240			11

Note: No. 1 grade

TABLE 11-8 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR SOUTHERN PINE OR DOUGLAS-FIR POSTS (60 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	14	17
48	10	12	17
60	9	11	17
72	8	10	17
84	7	9	17
96	7	9	16
108	6	8	15
120	6	8	14
132	5	7	13
144	5	7	12
156	5	7	11
168		6	9
180		6	6
192		6	
204		5	
216		5	
228		5	
240		5	
256			

Note: No. 1 grade

TABLE 11-9 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR HEMLOCK–FIR OR SPRUCE–PINE–FIR POSTS (60 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	14	17
48	10	13	17
60	9	11	17
72	8	10	17
84	7	9	17
96	7	9	16
108	6	8	14
120	6	8	12
132	6	7	10
144	5	7	
156	5	7	
168		6	
180		6	
192		6	
204		5	
216		5	
228			
240			
256			

Note: No. 1 grade

TABLE 11-10 MAXIMUM ALLOWED TRIBUTARY LOAD AREA FOR PONDEROSA PINE, REDWOOD, WESTERN CEDAR, OR SPRUCE–SOUTHERN PINE–FIR POSTS (60 PSF LIVE LOAD, 10 PSF DEAD LOAD)

Load area (sq ft)	Maximum post height (ft)		
	4 × 4	4 × 6	6 × 6
36	10	13	17
48	9	11	17
60	7	10	17
72	7	9	17
84	6	8	17
96	5	7	16
108		7	15
120		6	14
132		5	13
144		5	13
156			12
168			11
180			11
192			10
204			10
216			9
228			9
240			8

Note: No. 1 grade

FASTENERS

Refer to Table 11-11. Bolting in post limits (Figure 11-3) is the least desirable type of fastening. The load is limited to the strength of the bolts, which greatly lessens the amount of tributary loading allowed. See Tables 11-12 and 11-13. Loads on post and columns are reduced depending on the size and number of fasteners used.

TABLE 11-11 DECK REQUIRED FASTENERS (BOLTING ONLY)

Size of joist bolted to post	*Bolt diameter*	
	½ in.	⅝ in.
2×6	2	—
2×8	2	2
2×10	3	2
2×12	3	3

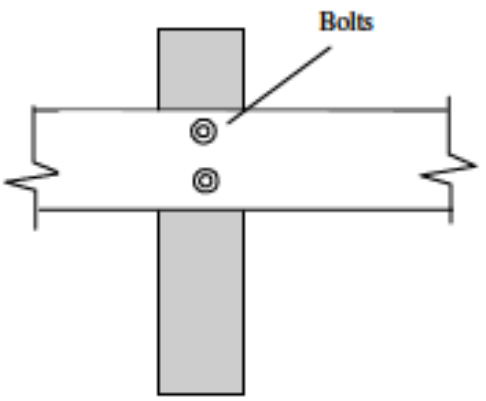


Figure 11-3 BOLTS IN POST LIMITS

TABLE 11-12 CONNECTIONS WITH 6 × 6 OR 4 × 4 POSTS AND ½-IN.-DIAMETER BOLTS

Live load (psf)	*Tributary load area (sq ft)*		
	Douglas-fir, southern pine	Hemlock–fir, spruce–pine–fir, spruce–southern pine–fir	Ponderosa pine, redwood, western cedar
Two-bolt connection (2 × 6, 2 × 8)			
40	30	26	23
60	20	19	16
Three-bolt connection (2 × 10, 2 × 12)			
40	44	39	34
60	32	28	24

TABLE 11-13 CONNECTIONS WITH 6 × 6 POSTS AND ⅝-IN.-DIAMETER BOLTS

Live load (psf)	*Tributary load area (sq ft)*		
	Douglas-fir, southern pine	Hemlock–fir, spruce–pine–fir	Ponderosa pine, redwood, western cedar
Two-bolt connection (2 × 8, 2 × 10)			
40	42	34	27
60	30	24	19
Three-bolt connection (2 × 12)			
40	63	51	40
60	45	37	29

DECK FLASHING

Many leaks are caused by flashing not being installed properly, especially at the junction of decks. Refer to Figure 11-4.

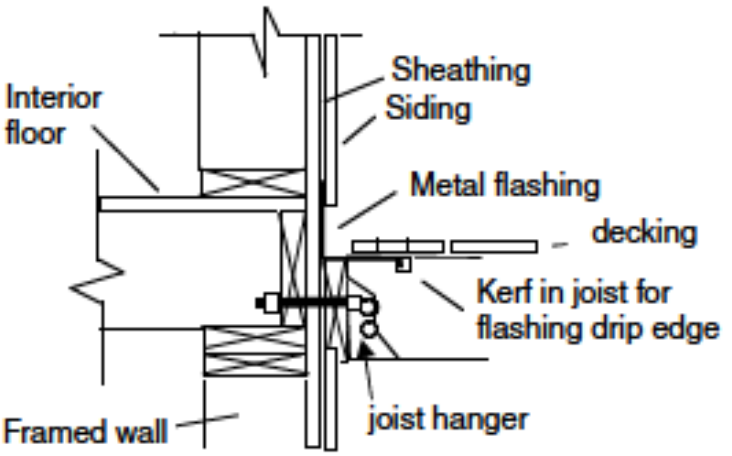


Figure 11-4 EXTERIOR DECK FLASHING

PEOPLE LOADS FOR DECKS AND BALCONIES

Refer to Tables 11-14 and 11-15.

TABLE 11-14 ESTIMATED NUMBER OF PEOPLE PERMISSIBLE ON DECKS (40 PSF LIVE LOAD, 160 POUNDS/PERSON)

Width (ft)	*Deck length (ft)*								
	7	8	9	10	11	12	13	14	16
7	12	14	16	18	19	21	23	25	28
8	14	16	23	20	22	24	26	32	32
9	16	18	20	23	25	27	29	32	36
10	18	20	23	25	28	30	33	35	40
11	19	22	25	28	30	33	36	39	44
12	21	24	27	30	33	36	39	42	48
13	23	26	29	33	36	39	42	46	52
14	25	28	32	35	39	42	46	49	56

TABLE 11-15 ESTIMATED NUMBER OF PEOPLE PERMISSIBLE ON DECKS (50 PSF LIVE LOAD, 160 POUNDS/PERSON)

Width (ft)	*Deck length (ft)*								
	7	8	9	10	11	12	13	14	16
7	15	18	20	22	24	26	28	31	35
8	18	20	23	25	28	30	33	40	40
9	20	23	25	28	31	34	37	39	45
10	22	25	28	31	34	38	41	44	50
11	24	28	31	34	38	41	45	48	55
12	26	30	34	38	41	45	49	53	60
13	28	33	37	41	45	49	53	57	65
14	31	35	39	44	48	53	57	61	70

The code describes balconies as structures supported only on one side; thus, they are cantilevered. Cantilevered joists must have a 3:1 ratio of support and are required to be designed to support 60 pounds per square foot live load.

THINK SAFETY AT ALL TIMES

- ❑ Review and study all plans and specifications—not just the carpentry and framing set.
- ❑ Inspect incoming materials against approved shop drawings.
- ❑ Inspect for proper storage of materials.
- ❑ Verify all lumber grades and metal gauges.
- ❑ Verify approved fasteners and mounting ware, such as joist hangers.
- ❑ Check for pressure-treated members and engineered lumber as required.
- ❑ Check moisture content of all wood members before covering.
- ❑ Do not allow installation of damaged or dirty materials.
- ❑ Inspect all installed equipment for protection against damage during construction.
- ❑ Ensure that all fire clearances are maintained throughout construction.
- ❑ Ensure that all ADA (Americans with Disabilities Act) clearance requirements have been met.
- ❑ Review contractor's safety plan when applicable.
- ❑ Ensure that equipment manufacturer's instructions are strictly followed for each component—especially for trusses and engineered products.
- ❑ Enforce all project, OSHA, State, and safety standards.
- ❑ Do not allow concentrated loads during construction.
- ❑ Review all Change Orders and verify that Record Set Drawings are being maintained.
- ❑ Make safety your first priority at all times.

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