

# RESIDENTIAL WOOD FRAMING CONSTRUCTION

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BASED ON THE 2018 INTERNATIONAL RESIDENTIAL CODE (IRC)

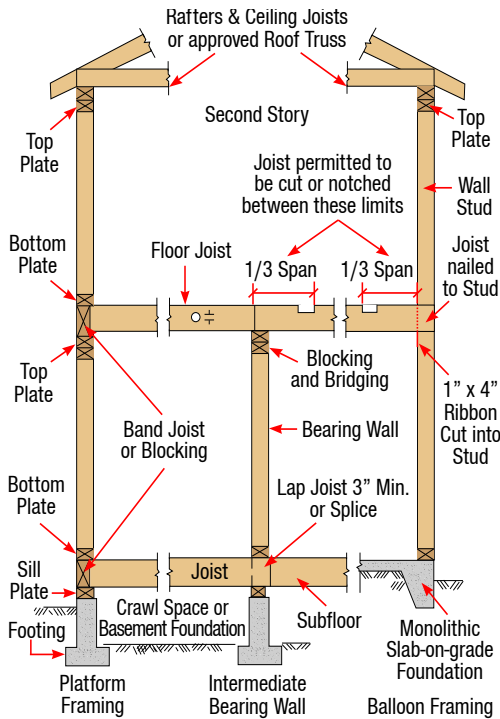
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## FOOTINGS & FOUNDATIONS

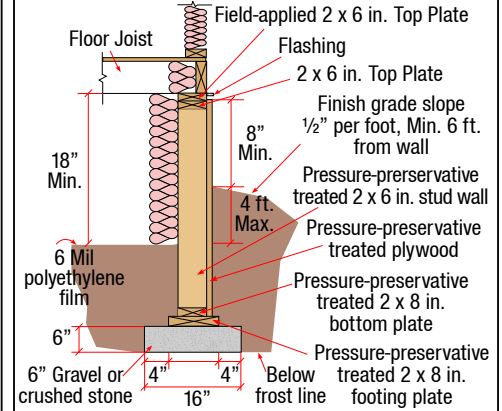
### WALL, FLOOR & ROOF FRAMING



### FOOTINGS (Based on IRC R403.1 - R403.1.5)

- All exterior walls must be supported on continuous solid or fully grouted masonry or concrete footings, crushed stone footings, wood foundations or other approved structural systems.
- Footing must be able to accommodate all loads and transmit the resulting loads to the soil within the limitations as determined from the character of the soil.
- Footings must be supported on undisturbed natural soils or engineered fill.
- The footing width must be based on the load-bearing value of soil.
- Footing Width (W) and Thickness (T): must comply with Tables R403.1(1) through R403.1(3) and Figure R403.1(1) or R403.1.3.
- Footing Depth: 12" Min. below the undisturbed ground surface.
- Footing Projections (P): 2" Min. and must not exceed the thickness of the footing.
- The top surface of footings must be level.
- The slope of the bottom surface of footings must not exceed 1 unit vertical in 10 units horizontal (1:10)(10% slope) Max. slope.
- Footings must be stepped where it is necessary to change the elevation of the top surface of the footings or where the slope of the bottom surface of the footings will exceed 1 unit vertical in 10 units horizontal (10% slope).
- Footings must be protected from frost.

### PERMANENT WOOD FOUNDATION CRAWL SPACE SECTION

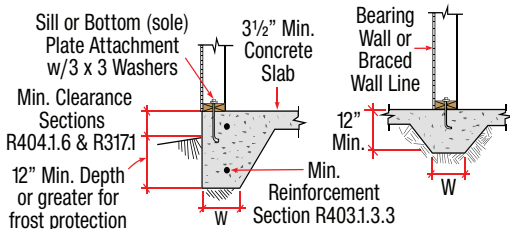


### FOOTINGS FOR WOOD FOUNDATIONS

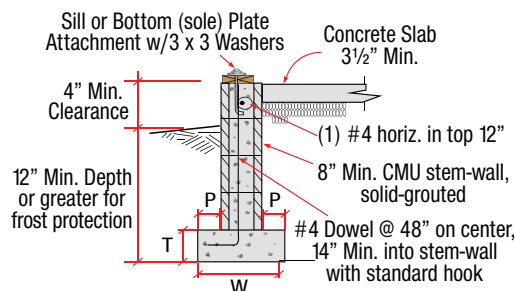
(Based on IRC R403.2)

- Footings for wood foundations must comply with Figures R403.1(2) and R403.1(3).
- Gravel must be washed and well graded.
- The max. size stone must not exceed 3/4".
- Gravel must be free from organic, clayey or silty soils.
- Sand must be coarse, not smaller than 1/16" grains and must be free from organic, clayey or silty soils.
- Crushed stone must have a max. size of 1/2".

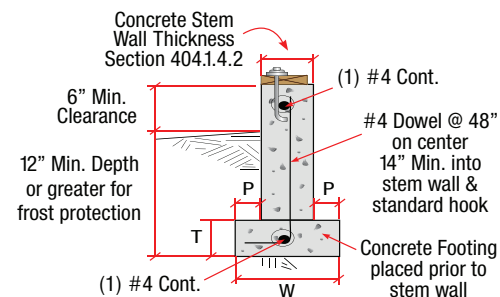
### REINFORCED CONCRETE FOOTINGS



### SLAB-ON-GROUND WITH MONOLITHIC TURNED-DOWN FOOTING



### SLAB-ON-GROUND WITH MASONRY STEM WALL & SPREAD FOOTING



### BASEMENT OR CRAWL SPACE CONCRETE STEM WALL & SPREAD FOOTING

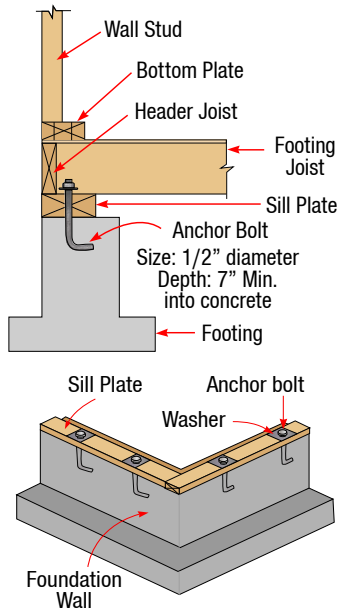
### MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION (inches) (Based on IRC Table R403.1(1))

Snow Load or Roof Live Load	Story and Type of Structure with Light Frame	Load-Bearing Value of Soil (psf)					
		1500	2000	2500	3000	3500	4000
20 psf	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—with crawl space	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—plus basement	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	2 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	2 story—with crawl space	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	2 story—plus basement	22 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6
30 psf	3 story—slab-on-grade	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	3 story—with crawl space	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	3 story—plus basement	25 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—with crawl space	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—plus basement	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6
50 psf	2 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	2 story—with crawl space	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	2 story—plus basement	23 x 6	17 x 6	14 x 6	12 x 6	12 x 6	12 x 6
	3 story—slab-on-grade	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	3 story—with crawl space	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	3 story—plus basement	26 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—with crawl space	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—plus basement	21 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6
2 story—slab-on-grade	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	
2 story—with crawl space	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	
2 story—plus basement	25 x 7	19 x 6	15 x 6	12 x 6	12 x 6	12 x 6	
3 story—slab-on-grade	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6	
3 story—with crawl space	22 x 6	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	
3 story—plus basement	28 x 9	21 x 6	17 x 6	14 x 6	12 x 6	12 x 6	

Note: This is an abridged table. For complete table see 2018 International Residential Code Table R403.1(1)

# SILL PLATES & FOUNDATION ANCHORAGE

## SILL PLATE & ANCHOR BOLT



## FOUNDATION ANCHORAGE (Based on IRC R403.1.6)

- Wood sill plates and wood walls supported directly on continuous foundations must be anchored to the foundation.
- Wood sole plates at all exterior walls on monolithic slabs, wood sole plates of braced wall panels at building interiors on monolithic slabs and all wood sill plates must be anchored to the foundation with min. 1/2-inch-diameter anchor bolts spaced at a max. of 6 ft. on center or approved anchors or anchor straps spaced to provide equivalent anchorage to 1/2-inch diameter anchor bolts.
- Bolts must extend not less than 7" into concrete or grouted cells of concrete masonry units.
- The bolts must be located in the middle third of the width of the plate.
- A nut and washer must be tightened on each anchor bolt.
- There must be 2 bolts Min. per plate section with 1 bolt located not more than 12" or less than 7 bolt diameters from each end of the plate section.
- Interior bearing wall sole plates on monolithic slab foundation that are not part of a braced wall panel must be positively anchored with approved fasteners.
- Sill plates and sole plates must be protected against decay and termites.

## FOUNDATION ANCHORAGE IN SEISMIC DESIGN CATEGORIES C, D<sub>0</sub>, D<sub>1</sub> & D<sub>2</sub> (Based on IRC R403.1.6.1)

The following requirements apply to wood light-frame structures in SDC D<sub>0</sub>, D<sub>1</sub> and D<sub>2</sub> and wood light-frame townhouses in SDC C.

- Plate washers must be provided for all anchor bolts over the full length of required braced wall lines except where approved anchor straps are used. **Note:** Properly sized cut washers are permitted for anchor bolts in wall lines not containing braced wall panels.
- Interior braced wall plates must have anchor bolts spaced at not more than 6 ft. on center and located within 12" of the ends of each plate section when supported on a continuous foundation.
- Interior bearing wall sole plates must have anchor bolts spaced at not more than 6 ft. on center and located within 12" of the ends of each plate section where supported on a continuous foundation.
- Anchor bolt spacing for buildings over 2 stories in height: 4 ft. Max.
- Stepped cripple walls must conform to Section R602.11.2.
- Where continuous wood foundations are used, the force transfer must have a capacity equal to or greater than the connections required by Section R602.11.1 or the braced wall panel must be connected to the wood foundations in accordance with the braced wall panel-to-floor fastening requirements of Table R602.3(1).

## FOUNDATION WALL THICKNESS

(Based on IRC R404.1.5 & 404.1.6)

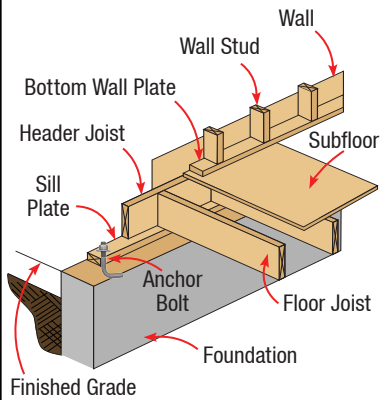
### Masonry Wall Thickness

- Masonry foundation walls must not be less than the thickness of the wall supported.
- Walls not less than 8" thick are permitted under brick veneered frame walls and under 10" wide cavity walls where total height of the wall supported, including gables, is not more than 20 ft., Section R404.1.1 must be met.

### Concrete Wall Thickness

- The thickness of concrete foundation walls must be equal to or greater than the thickness of the wall in the story above.
- Where a concrete foundation wall is reduced in thickness to provide a shelf for the support of masonry veneer, the reduced thickness must be equal to or greater than the thickness of the wall in the story above.
- Vertical reinforcement for foundation wall: See Table R404.1.2(8) and Section R404.1.3.3.7.2.
- Vertical reinforcement must be based on the thickness of the thinner portion of the wall.
- Concrete and masonry foundation walls must extend above the finished grade adjacent to the foundation at all points not less than 4" where masonry veneer is used and not less than 6" elsewhere.

## FLOOR & WALL ANCHORAGE



## WOOD FOUNDATION WALL

(Based on IRC R404.2 & R404.3)

- Studs used in foundation walls: 2-inch x 6-inch
- Where spaced 16" on center, a wood species with an Fb value of not less than 1,250 psi must be used.
- Where spaced 12" on center, an Fb of not less than 875 psi is required.
- The height of backfill against a foundation wall must not exceed 4 ft. if wood foundations are not compliant with AWC PWF.
- Where the height of fill is more than 12" above the interior grade of a crawl space or floor of a basement, the thickness of the plywood sheathing must follow the requirements of Table R404.2.3.
- Wood sill plates must be 2" x 4" Min. nominal lumber.
- Sill plate anchorage must comply with Sections R403.1.6 and R602.11.

# WOOD FLOOR FRAMING

## DESIGN & CONSTRUCTION

(Based on IRC R502.2)

Floors must be designed and constructed according to IRC: Chapter 5: Floors; Figure R502.2 (Floor Construction) Section R317 (Protection of Wood); Section R318 (Protection Against Subterranean Termites) or ANSI AWC NDS.

## JOISTS UNDER BEARING PARTITIONS

(Based on IRC R502.4)

- Joists under parallel bearing partitions must be of adequate size to support the load.
- Double joists, sized to adequately support the load, that are separated to permit the installation of piping or vents must be full depth solid blocked with lumber 2" Min. in nominal thickness spaced not 4 ft. Max. on center.
- Bearing partitions perpendicular to joists must not be offset from supporting girders, walls or partitions more than the joist depth unless such joists are of sufficient size to carry the additional load.

## GIRDER & HEADERS

(Based on IRC R502.5)

Allowable spans of girders and headers fabricated of dimension lumber must not exceed the values in Tables R602.7(1), R602.7(2) and R602.7(3).

## BEARING

(Based on IRC R502.6)

- The ends of each joist, beam or girder must have a bearing of:
  - 1 1/2" Min. on wood or metal.
  - 3" Min. on masonry or concrete or be supported by approved joist hangers.
- Alternatively, the ends of joists must be supported on a 1-inch by 4-inch ribbon strip and must be nailed to the adjacent stud.
- The bearing on masonry or concrete must be direct, or a sill plate of 2" Min. nominal thickness must be provided under the joist, beam or girder.
- The sill plate must provide a min. nominal bearing area of 48 square inches.

## FLOOR SYSTEMS

(Based on IRC R502.6.1)

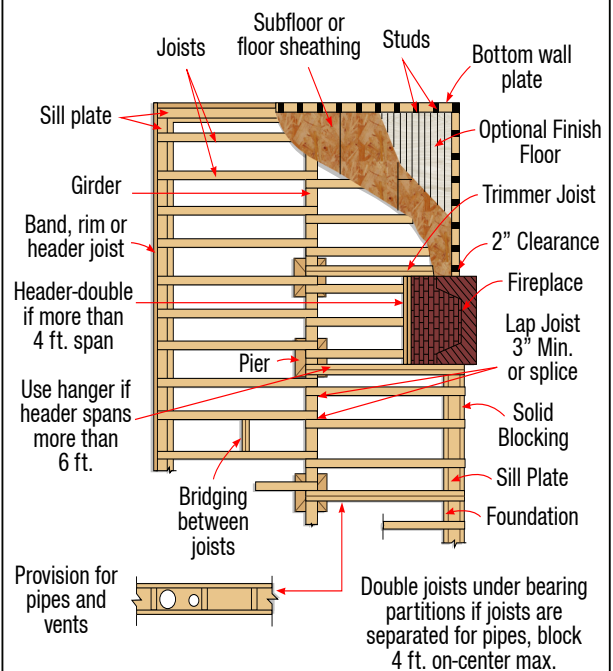
- Joists framing from opposite sides over a bearing support must lap 3" Min. and be nailed together with a min. of three 10d face nails.
- A wood or metal splice with strength equal to or greater than that provided by the nailed lap is permitted.

## JOIST FRAMING

(Based on IRC R502.6.2)

Joists framing into the side of a wood girder must be supported by approved framing anchors or on ledger strips not less than nominal 2" x 2".

## FLOOR CONSTRUCTION



# WOOD FLOOR FRAMING – JOISTS

## FRAMING AT BRACED WALL LINES

*(Based on IRC R502.2.1)*

A load path for lateral forces must be provided between floor framing and braced wall panels located above or below a floor, as specified in Section R602.10.8.

## BLOCKING & SUBFLOORING

*(Based on IRC R502.2.2)*

- Blocking for fastening panel edges or fixtures must not be less than utility grade lumber.
- Subflooring must not be less than utility grade lumber, No. 4 common grade boards or wood structural panels (Sec. R503.2).
- Fireblocking must be of any grade lumber.

## SLEEPING AREAS & ATTIC JOISTS

*(Based on R502.3.1)*

- Table R502.3.1(1) must be used to determine the max. allowable span of floor joists that support sleeping areas and attics that are accessed by means of a fixed stairway (Section R311.7) provided that the design live load does not exceed 30 lbs./sq. ft. and the design dead load does not exceed 20 lbs./sq. ft.
- For allowable span of ceiling joists that support attics used for limited storage or no storage, see Sec. R802.4.

## OTHER FLOOR JOISTS

*(Based on IRC R502.3.2)*

Table R502.3.1(2) must be used to determine the max. allowable span of floor joists that support other areas of the building, other than sleeping rooms and attics, provided that the design live load does not exceed 40 pounds per square foot and the design dead load does not exceed 20 pounds per square foot.

## FLOOR CANTILEVERS

*(Based on R502.3.3)*

- Floor cantilever spans must not exceed the nominal depth of the wood floor joist.
- Floor cantilevers constructed according with Table R502.3.3(1) are permitted where supporting a lightframe bearing wall and roof only.
- Floor cantilevers supporting an exterior balcony are permitted to be constructed in accordance with Table R502.3.3(2).

## LATERAL RESTRAINT AT SUPPORTS

*(Based on IRC R502.7)*

Joists must be supported laterally at the ends by any of the following:

- by full-depth solid blocking 2" Min. nominal thickness.
- by attachment to a full-depth header, band, rim joist or to an adjoining stud.
- by other lateral support that prevents rotation.

## BRIDGING

*(Based on IRC R502.7.1)*

Joists exceeding a nominal 2" x 12" must be supported laterally by any of the following:

- solid blocking
- diagonal bridging (wood or metal)
- a continuous 1" x 3" strip nailed across the bottom of joists perpendicular to joists at max. intervals of 8 ft.

## SHEATHING - END JOINTS

*(Based on IRC R503.1.1)*

- End joints in lumber used as subflooring must occur over supports unless end-matched lumber is used, in which case each piece must bear on at least 2 joists.
- Subflooring can be omitted where joist spacing does not exceed 16" and a 1" nominal tongue-and-groove wood strip flooring is applied perpendicular to the joists.

## SUBFLOOR & COMBINED SUBFLOOR UNDERLAYMENT

*(Based on IRC R503.2.1.1)*

- Where used as subflooring or combination subfloor underlayment, wood structural panels must comply with Table R503.2.1.1(1).
- Where sanded plywood is used as combination subfloor underlayment, the grade, bond classification and performance category must be as specified in Table R503.2.1.1(2).

## FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES

*(Residential sleeping areas, live load = 30 psf, L/Δ = 360) (Based on IRC Table R502.3.1(1))*

Joist Spacing (inches)	Species and Grade		Dead Load = 10 psf				Dead Load = 20 psf			
			2 × 6	2 × 8	2 × 10	2 × 12	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum floor joist spans							
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas fir-larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Hem-fir	SS	11-10	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Southern pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Spruce-pine-fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
16	Douglas fir-larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Hem-fir	#1	10-6	13-10	17-8	21-1	10-6	13-4	16-3	18-10
	Southern pine	#1	10-9	14-2	18-0	21-4	10-9	13-9	16-1	19-1
	Spruce-pine-fir	#1	10-3	13-6	17-2	19-11	9-11	12-7	15-5	17-10
19.2	Douglas fir-larch	#2	10-1	13-0	15-11	18-6	9-3	11-8	14-3	16-6
	Hem-fir	#2	9-5	12-5	15-6	17-1	8-11	11-4	13-10	16-1
	Southern pine	#2	9-6	12-1	14-4	16-10	8-6	10-10	12-10	15-1
	Spruce-pine-fir	#2	9-8	12-9	15-8	18-3	9-1	11-6	14-1	16-3
24	Douglas fir-larch	#3	7-0	8-11	10-11	12-7	6-3	8-0	9-9	11-3
	Hem-fir	#3	6-10	8-8	10-7	12-4	6-2	7-9	9-6	11-0
	Southern pine	#3	6-5	8-2	9-10	11-8	5-9	7-3	8-10	10-5
	Spruce-pine-fir	#3	6-10	8-8	10-7	12-4	6-2	7-9	9-6	11-0

**Note:** This is an abridged table. For complete table see 2018 International Residential Code Table R502.3.1(1)

## FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES

*(Residential living areas, live load = 40 psf, L/Δ = 360) (Based on IRC Table R502.3.1(2))*

Joist Spacing (inches)	Species and Grade		Dead Load = 10 psf				Dead Load = 20 psf			
			2 × 6	2 × 8	2 × 10	2 × 12	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum floor joist spans							
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-3
	Hem-fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11
	Southern pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Spruce-pine-fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6
16	Douglas fir-larch	#1	9-11	13-1	16-5	19-1	9-8	12-4	15-0	17-5
	Hem-fir	#1	9-6	12-7	16-0	18-10	9-6	12-2	14-10	17-2
	Southern pine	#1	9-9	12-10	16-1	19-1	9-9	12-7	14-8	17-5
	Spruce-pine-fir	#1	9-4	12-3	15-5	17-10	9-1	11-6	14-1	16-3
19.2	Douglas fir-larch	#2	9-2	11-8	14-3	16-6	8-5	10-8	13-0	15-1
	Hem-fir	#2	8-7	11-3	13-10	16-1	8-2	10-4	12-8	14-8
	Southern pine	#2	8-6	10-10	12-10	15-1	7-9	9-10	11-8	13-9
	Spruce-pine-fir	#2	8-9	11-6	14-1	16-3	8-3	10-6	12-10	14-10
24	Douglas fir-larch	#3	6-3	8-0	9-9	11-3	5-9	7-3	8-11	10-4
	Hem-fir	#3	6-2	7-9	9-6	11-0	5-7	7-1	8-8	10-1
	Southern pine	#3	5-9	7-3	8-10	10-5	5-3	6-8	8-1	9-6
	Spruce-pine-fir	#3	6-2	7-9	9-6	11-0	5-7	7-1	8-8	10-1

**Note:** This is an abridged table. For complete table see 2018 International Residential Code Table R502.3.1(2)

## LUMBER FLOOR SHEATHING

*(Based on IRC Table R503.1)*

Joist or Beam Spacing (inches)	Min. Net Thickness	
	Perpendicular to joist	Diagonal to joist
24	1 1/16	3/4
16	5/8	5/8
48	1 1/2 T & G	N/A
54		
60		

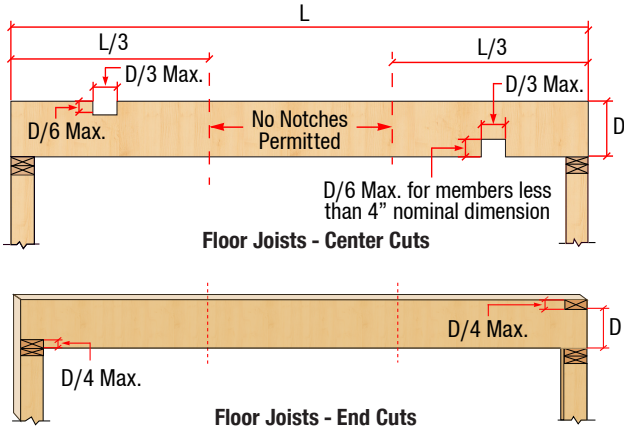
## SPANS FOR SANDED PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT

*(Based on IRC Table R503.2.11(2))*

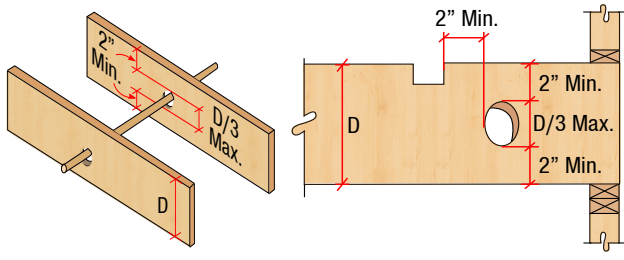
Identification	Spacing of Joists (inches)		
	16	20	24
Species Group	—	—	—
1	1/2	5/8	3/4
2, 3	5/8	3/4	7/8
4	3/4	7/8	1

# CUTTING, DRILLING , NOTCHING & FASTENING SCHEDULE

## NOTCHES IN FLOOR MEMBERS



## HOLES IN FLOOR MEMBERS



## CUTTING, DRILLING & NOTCHING (Based on IRC R502.8)

- Structural floor members must not be cut, bored or notched in excess of the limitations specified in this section.
- Engineered wood can only be cut, notched and drilled where permitted by the manufacturer.

## NOTCHES IN SAWN LUMBER (Based on IRC R502.8.1)

- Notches in solid lumber joists, rafters and beams:
  - must not exceed 1/6 of the depth of the member.
  - must not be longer than 1/3 of the depth of the member.
  - must not be located in the middle 1/3 of the span.
- Notches at the ends of the member must not exceed 1/4 the depth of the member.
- Tension side of members 4" or greater in nominal thickness must not be notched except at the ends of the members.

## HOLES IN SAWN LUMBER (Based on IRC R502.8.1)

- The diameter of holes bored or cut into members must not exceed 1/3 the depth of the member.
- Holes must not be closer than 2" to the top or bottom of the member, or to any other hole located in the member.
- Where the member is also notched, the hole must not be closer than 2" to the notch.

## FASTENING (Based on IRC R502.9)

- Floor framing must be nailed in accordance with Table R602.3(1).
- Where posts and beam or girder construction is used to support floor framing, positive connections must be provided to ensure against uplift and lateral displacement.

## FRAMING OF OPENINGS (Based on IRC R502.10)

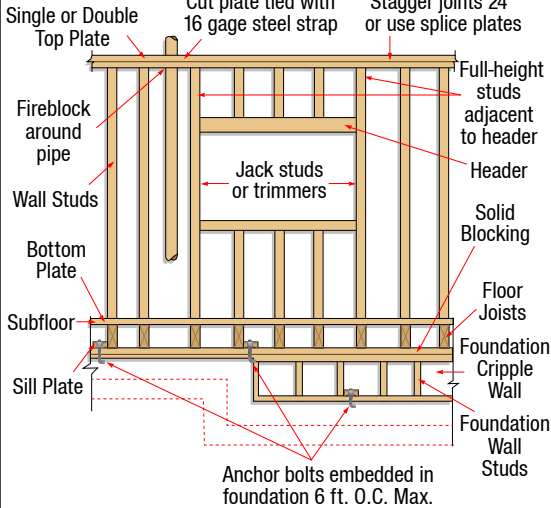
- Openings in floor framing must be framed with a header and trimmer joists.
- Where the header joist span does not exceed 4 ft., the header joist must be a single member the same size as the floor joist.
- Single trimmer joists must be used to carry a single header joist that is located within 3 ft. of the trimmer joist bearing.
- Where the header joist span exceeds 4 ft., the trimmer joists and the header joist must be doubled and of sufficient cross section to support the floor joists framing into the header.

## FASTENING SCHEDULE (Based on IRC Table R602.3(1))

Roof			
Description of Building Elements	Number and Type of Fastener	Spacing and Location	
Blocking between ceiling joists or rafters to top plate	4-8d box (2½" × 0.113") or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail	
Ceiling joists to top plate	4-8d box (2½" × 0.113"); or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Per joist, toe nail	
Rafter or roof truss to plate	3-16d box nails (3½" × 0.135"); or 3-10d common nails (3" × 0.148"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	2 toe nails on one side and 1 toe nail on opposite side of each rafter or truss	
Wall			
Description of Building Elements	Number and Type of Fastener	Spacing and Location	
Stud to stud (not at braced wall panels)	16d common (3½" × 0.162")	24" o.c. face nail	
	10d box (3" × 0.128"); or 3" × 0.131" nails	16" o.c. face nail	
Stud to stud and abutting studs at intersecting wall corners (at braced wall panels)	16d box (3½" × 0.135"); or 3" × 0.131" nails	12" o.c. face nail	
	16d common (3½" × 0.162")	16" o.c. face nail	
Continuous header to stud	5-8d box (2½" × 0.113"); or 4-8d common (2½" × 0.131"); or 4-10d box (3" × 0.128")	Toe nail	
Top plate to top plate	16d common (3½" × 0.162")	16" o.c. face nail	
	10d box (3" × 0.128"); or 3" × 0.131" nails	12" o.c. face nail	
Top plates, laps at corners and intersections	3-10d box (3" × 0.128"); or 2-16d common (3½" × 0.162"); or 3-3" × 0.131" nails	Face nail	
Floor			
Description of Building Elements	Number and Type of Fastener	Spacing and Location	
Joist to sill, top plate or girder	4-8d box (2½" × 0.113"); or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail	
Rim joist, band joist or blocking to sill or top plate (roof applications also)	8d box (2½" × 0.113")	4" o.c. toe nail	
	8d common (2½" × 0.131"); or 10d box (3" × 0.128"); or 3" × 0.131" nails	6" o.c. toe nail	
Band or rim joist to joist	3-16d common (3½" × 0.162") 4-10 box (3" × 0.128"), or 4-3" × 0.131" nails; or 4-3" × 14 ga. staples, 7/16" crown	End nail	
Wood structural panels, subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing			
Description of Building Elements	Number and Type of Fastener	Spacing of Fasteners	
		Edges (inches)	Intermediate Supports (inches)
3/8" - 1/2"	6d common (2" × 0.113") nail (subfloor, wall) 8d common (2½" × 0.131") nail (roof); or RSRS-01 (2³/₈" × 0.113") nail (roof)	6	12
19/32" - 1"	8d common nail (2½" × 0.131"); or RSRS-01; (2³/₈" × 0.113") nail (roof)	6	12
1 1/8" - 1 1/4"	10d common (3" × 0.148") nail; or 8d (2½" × 0.131") deformed nail	6	12
Wood structural panels, combination subfloor underlayment to framing			
Description of Building Elements	Number and Type of Fastener	Spacing of Fasteners	
		Edges (inches)	Intermediate Supports (inches)
3/4" and less	6d deformed (2" × 0.120") nail; or 8d common (2½" × 0.131") nail	6	12
7/8" - 1"	8d common (2½" × 0.131") nail; or 8d deformed (2½" × 0.120") nail	6	12
1 1/8" - 1 1/4"	10d common (3" × 0.148") nail; or 8d deformed (2½" × 0.120") nail	6	12
<b>Note:</b> This is an abridged table. For complete table see 2018 IRC Table R602.3(1).			

# WALL FRAMING

## WALL FRAMING



**Note:** Apply approved sheathing or brace exterior walls with 1" x 4" braces let into studs and plates extending from bottom plate to top plate or other approved metal strap devices.



## STUD SIZE, HEIGHT & SPACING (Based on IRC R602.3.1)

For size, height and spacing of studs see Table R602.3.(5).

### TOP PLATE (Based on IRC R602.3.2)

- Wood stud walls must be capped with a double top plate installed to provide overlapping at corners and intersections with bearing partitions.
- End joints in top plates must be offset not less than 24".
- Joints in plates don't need to occur over studs.
- Top plate thickness: 2" min. nominal thickness.
- Top plate width: at least as wide as the width size of the studs.

### BEARING STUDS (Based on IRC R602.3.3)

Where joists, trusses or rafters are spaced more than 16" on center and the bearing studs below are spaced 24" on center, such members must bear within 5" of the studs beneath.

### BOTTOM (SOLE) PLATE (Based on IRC R602.3.4)

Studs must have full bearing on a nominal 2-by or larger plate or sill having a width not less than to the width of the studs.

### SINGLE MEMBER HEADERS (Based on IRC R602.7.1)

Single headers must be framed with a single flat 2" nominal member or wall plate not less in width than the wall studs on the top and bottom of the header and face nailed to the top and bottom of the header with 10d box nails (3" x 0.128") spaced 12" on center.

### RIM BOARD HEADERS (Based on IRC R602.7.2)

- For rim board header size, material and span see Table R602.7(1).
- Rim board headers must be supported at each end by full-height studs.
- The number of full-height studs at each end must not be less than the number of studs displaced by half of the header span based on the maximum stud spacing stated in Table R602.3(5).

### HEADERS FOR NONBEARING WALLS (Based on IRC R602.7.4)

- Load-bearing headers are not required in interior or exterior nonbearing walls.
- A single flat 2" x 4" member must be permitted to be used as a header in interior or exterior nonbearing walls for openings up to 8 ft. in width if the vertical distance to the parallel nailing surface above is not more than 24".

### SUPPORTS FOR HEADERS (Based on IRC R602.7.5)

- Headers must be supported on each end with one or more jack studs or with approved framing anchors.
- The full-height stud adjacent to each end of the header must be end nailed to each end of the header with four-16d nails (3.5" x 0.135").
- For the min. number of full-height studs at each end of a header, see Table R602.7.5

## INFO YOU MUST KNOW!

Ceiling height requirements to keep in mind during wall construction:

- Ceiling height of habitable space, hallways and portions of basements containing these spaces: 7' min.
- Ceiling height of bathrooms, toilet rooms and laundry rooms: 6'8" min.

## NOTCHING OF WALL STUDS (Based on IRC R602.6)

- Stud in an exterior wall or bearing partition is permitted to be cut or notched to a depth not exceeding 25% of its width.
- Studs in nonbearing partitions are permitted to be notched to a depth not exceeding 40% of a single stud width.

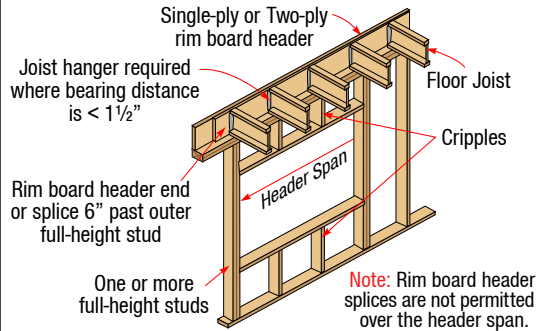
## DRILLING OF WALL STUDS (Based on IRC R602.6)

- Any stud is permitted to be bored or drilled, so long as the:
  - diameter of the resulting hole is not more than 60% the stud width.
  - edge of the hole is not more than 5/8" to the edge of the stud.
  - hole is not located in the same section as a cut or notch.
- Studs located in exterior walls or bearing partitions drilled over 40% and up to 60% must be doubled with a max. of 2 successive doubled studs bored.

## DRILLING & NOTCHING OF TOP PLATE (Based on IRC R602.6.1)

- When piping or ductwork is placed in or partly in an exterior wall or interior load-bearing wall, and the top plate needs to be cut, drilled or notched by more than 50% of its width, a galvanized metal tie a min. of 0.054" thick (16 ga) and 1 1/2" wide must be fastened across and to the plate at each side of the opening with not less than eight 10d (0.148" diameter) nails having a min. length of 1-1/2" at each side or equivalent.
- The metal tie must extend a min. of 6" past the opening.

## RIM BOARD HEADERS



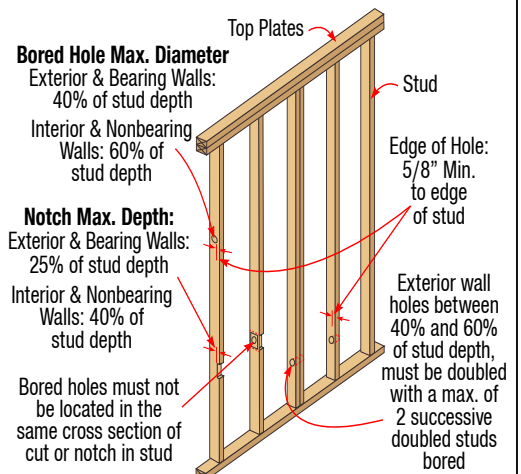
## MAX. SPANS FOR WOOD STRUCTURAL PANEL BOX HEADERS (Based on IRC Table R602.7.3)

Header Construction	Header Depth (inches)	House Depth (feet)				
		24	26	28	30	32
Wood structural panel - one side	9	4	4	3	3	—
	15	5	5	4	3	3
Wood structural panel - both sides	9	7	5	5	4	3
	15	8	8	7	7	6

## SIZE, HEIGHT & SPACING OF WOOD STUDS (Based on IRC Table R602.3(5))

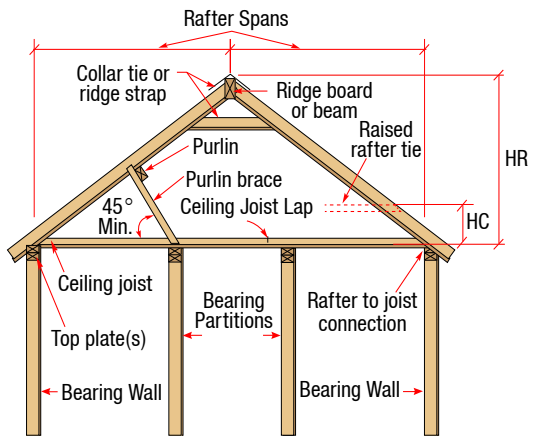
Stud Size (inches)	Bearing Walls					NonBearing Walls	
	Laterally unsupported stud height (feet)	Max. spacing where supporting a roof-ceiling assembly or a habitable attic assembly, only (inches)	Max. spacing where supporting one floor, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Max. spacing where supporting two floors, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Max. spacing where supporting one floor height (inches)	Laterally unsupported stud height (feet)	Max. spacing (inches)
2 x 3	—	—	—	—	—	10	16
2 x 4	10	24	16	—	24	14	24
3 x 4	10	24	24	16	24	14	24
2 x 5	10	24	24	—	24	16	24
2 x 6	10	24	24	16	24	20	24

## WALL FRAMING - NOTCHES



# ROOF FRAMING

## FRAMING - BRACED RAFTER CONSTRUCTION



## FRAMING OF OPENINGS (Based on IRC R802.9)

- Roof and ceiling openings must be framed with header and trimmer joists.
- Where the header joist span does not exceed 4 ft., the header joist can be a single member the same size as the ceiling joist or rafter.
- Single trimmer joists can be used to carry a single header joist that is located within 3 ft. of the trimmer joist bearing.
- Where header joist span exceeds 4 ft., the trimmer joists and the header joist must be doubled and of sufficient cross section to support the ceiling joists or rafter framing into the header.
- Approved hangers must be used for the header joist to trimmer joist connections where the header joist span exceeds 6 ft.
- Tail joists over 12 ft. long must be supported at the header by framing anchors or on ledger strips a min. of 2" x 2".

## BEARING (Based on IRC R802.6)

- The ends of each rafter or ceiling joist must have a min. of 1 1/2" of bearing on wood or metal.
- The ends of each rafter or ceiling joist must have a min. of 3" of bearing on masonry or concrete.
- The bearing on masonry or concrete must be direct, or a sill plate of 2" min. nominal thickness must be provided under the rafter or ceiling joist.
- Sill plate must provide a min. nominal bearing area of 48 square inches.

## ROOFING FRAMING (Based on IRC R802.3 & 802.4)

### Ridge

- A ridge board used to connect opposing rafters must be 1" Min. thick and not less in depth than the cut end of the rafter.
- Where ceiling joist or rafter ties do not provide continuous ties across the structure, a ridge beam must be provided and supported on each end by a wall or girder.

### Rafters

- Rafter Size: Tables R802.4.1(1) through R802.4.1(8).
- Rafter spans must be measured along the horizontal projection of the rafter.
- Rafters must be framed with a 1/2" Max. offset from each other to a ridge board or directly opposite from each other with a collar tie, gusset plate or ridge strap in accordance with Table R602.3(1).
- Rafters must be nailed to the top wall plates (see Table R602.3(1)) unless the roof assembly is required to comply with uplift requirements in R802.11.

### Hips and Valleys

- Hip and valley rafters must 2" Min. nominal thick and not less in depth than the cut end of the rafter.
- Hip and valley rafters must be supported at the ridge by a brace to a bearing partition or be designed to carry and distribute the specific load at that point.

### Rafter Supports

- Where the roof pitch is less than 3:12 (25%), structural members that support rafters, such as ridges, hips and valleys, must be designed as beams and bearing must be provided for rafters (see Section R802.6).

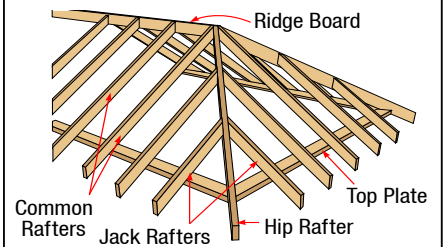
### Purlins

- Purlins can be used to reduce the span of rafters.
- Purlins must be sized not less than the required size of the rafters that they support.
- Purlins must be continuous and must be supported by 2" x 4" braces installed to bearing walls at a slope not less than 45° (0.79 rad) from the horizontal.
- The braces must be spaced not more than 4 ft. o.c. and the unbraced length of braces must not exceed 8 ft.

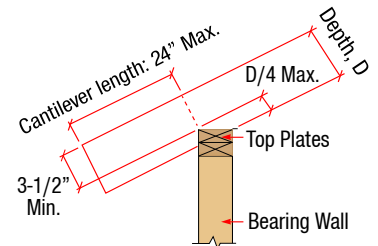
### Collar Ties

- Where collar ties are used to connect opposing rafters, they must be located in the upper third of the attic space and fastened in accordance with Table R602.3(1).
- Collar ties must be not less than 1" x 4" nominal, spaced not more than 4 ft. on center.
- Ridge straps in accordance with Table R602.3(1) must be permitted to replace collar ties.

## RAFTERS



## ROOF RAFTER NOTCH



## CUTTING, DRILLING & NOTCHING

(Based on IRC R802.7)

- See the floor framing section of this quick-card for cutting, drilling and notching requirements.
- Notches on cantilevered portions of rafters are permitted provided the dimension of the remaining portion of the rafter is not less than 3 1/2" and the length of the cantilever does not exceed 24".
- Taper cuts at the ends of the ceiling joist must not exceed 1/4 the depth of the member.

## BRIDGING (Based on IRC R802.8.1)

Rafters and ceiling joists having a depth-to-thickness ratio exceeding 6 to 1 based on nominal dimensions must be supported laterally by one of the following:

- solid blocking
- diagonal bridging (wood or metal)
- a continuous 1" x 3" wood strip nailed across the rafters or ceiling joists at max. intervals of 8 ft.

## CEILING JOISTS (Based on IRC 802.5)

- Ceiling joists must be continuous across the structure or securely joined where they meet over interior partitions see Table R802.5.2.
- Ceiling joists must be sized based on the joist spans in Tables R802.5.1(1) and R802.5.1(2).
- Where ceiling joists run parallel to rafters, they must be connected to rafters at the top wall plate in accordance with Table R802.5.2.
- Where ceiling joists are not connected to the rafters at the top wall plate, they must be installed in the bottom third of the rafter height see Table R802.5.2.
- Where the ceiling joists are installed above the bottom third of the rafter height, the ridge must be designed as a beam.
- Where ceiling joists do not run parallel to rafters, the ceiling joists must be connected to top plates in accordance with Table R602.3(1).
- Each rafter must be tied across the structure with a rafter tie or a 2" x 4" kicker connected to the ceiling diaphragm with nails equivalent in capacity to Table R802.5.2.

## RAFTER/CEILING JOIST HEEL JOINT CONNECTIONS (Based on IRC Table R802.5.2)

Rafter Slope	Rafter Spacing (inches)	Ground Snow Load (psf)															
		20				30				50				70			
		Roof Span (feet)															
		12	20	28	36	12	20	28	36	12	20	28	36	12	20	28	36
Required number of 16d common nails per heel joint splices																	
3:12	12	4	6	8	10	4	6	8	11	5	8	12	15	6	11	15	20
	16	5	8	10	13	5	8	11	14	6	11	15	20	8	14	20	26
	24	7	11	15	19	7	11	16	21	9	16	23	30	12	21	30	39
4:12	12	3	5	6	8	3	5	6	8	4	6	9	11	5	8	12	15
	16	4	6	8	10	4	6	8	11	5	8	12	15	6	11	15	20
	24	5	8	12	15	5	9	12	16	7	12	17	22	9	16	23	29
5:12	12	3	4	5	6	3	4	5	7	3	5	7	9	4	7	9	12
	16	3	5	6	8	3	5	7	9	4	7	9	12	5	9	12	16
	24	4	7	9	12	4	7	10	13	6	10	14	18	7	13	18	23

Note: This is an abridged table. For complete table see 2018 IRC Table R802.5.2



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