RICHMOND
INTERNATIONAL CODE COUNCIL 2018

Welcome to the

2018 Annual Conference Educational Sessions

Session: 2018 IRC Essentials - Design Criteria, Foundations, Framing and Finishes

Sponsored by ORACLE

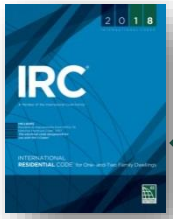
2018 IRC® Essentials

Based on the 2018 International Residential Code® (IRC®)

Apply the critical concepts provisions of the 2018 *International Residential Code*®.

OBJECTIVES

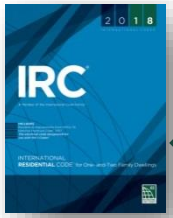
- Explain the fundamental provisions of the 2018 IRC.
- Locate general topics and applicable tables in the 2018 IRC.
- Define terms essential for correct code interpretation.
- Identify the code that relates to the design, construction or inspection of residential building.



Tips

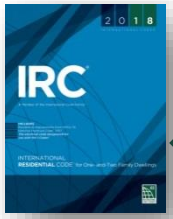
Guide to a successful class:

- Slides contain some text and iconic images to help you learn.
- Text and commentary is in the handout.
- Follow along in the course handout.
- Ask Questions, ask questions, ASK QUESTIONS!!!!



Outline

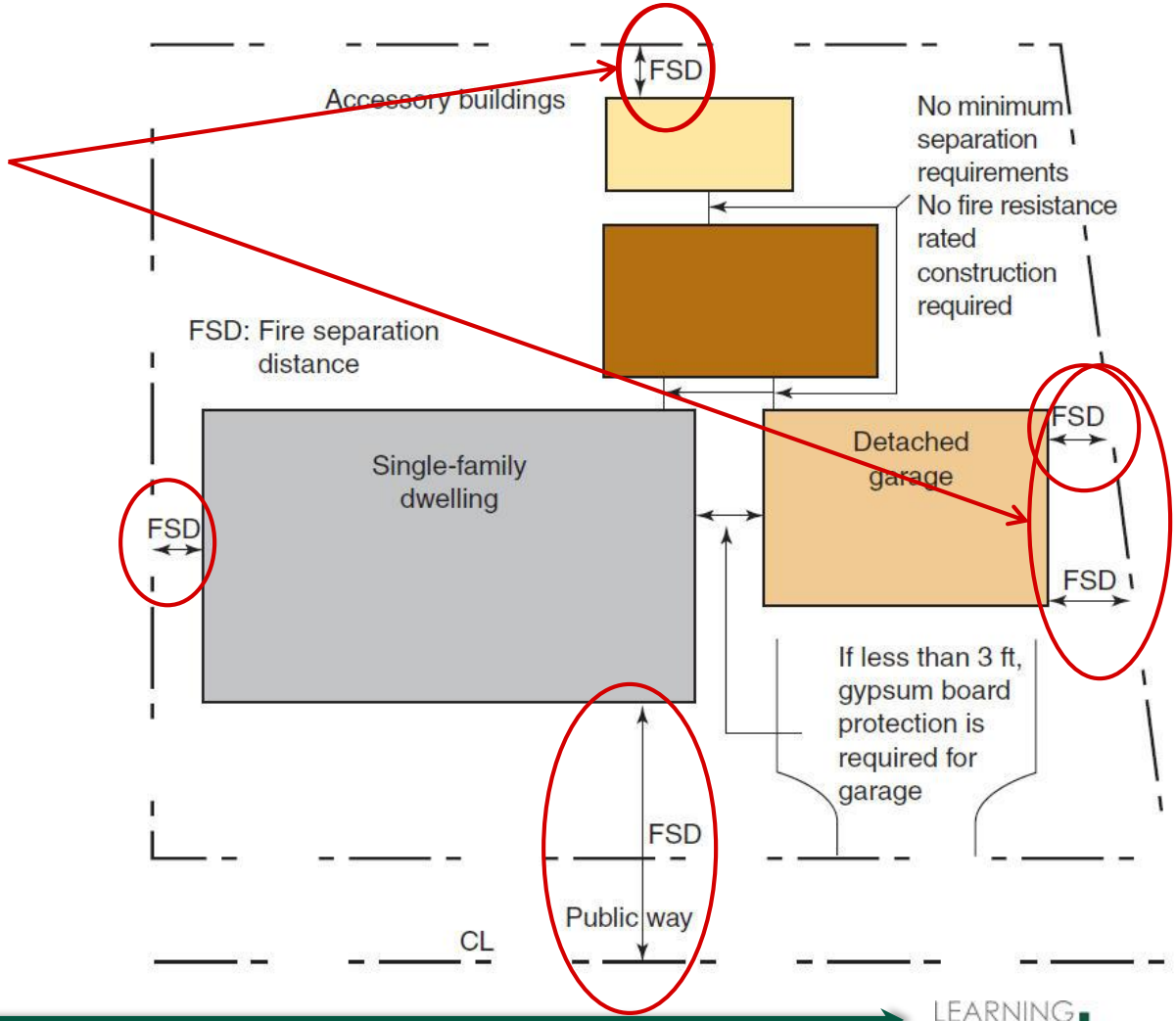
- Overview
- Part I: Code Administration and Enforcement
- Part II: Site Development
- Part III: Structural
- Part IV: Finishes and Weather Protection
- Part V: Health and Safety
- Part VI: Building Utilities
- Part VII: Energy Conservation
- Part VIII: Protection from Other Hazards
- Summary, Q and A and Debrief

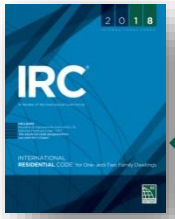


Site Preparation

Location on Property

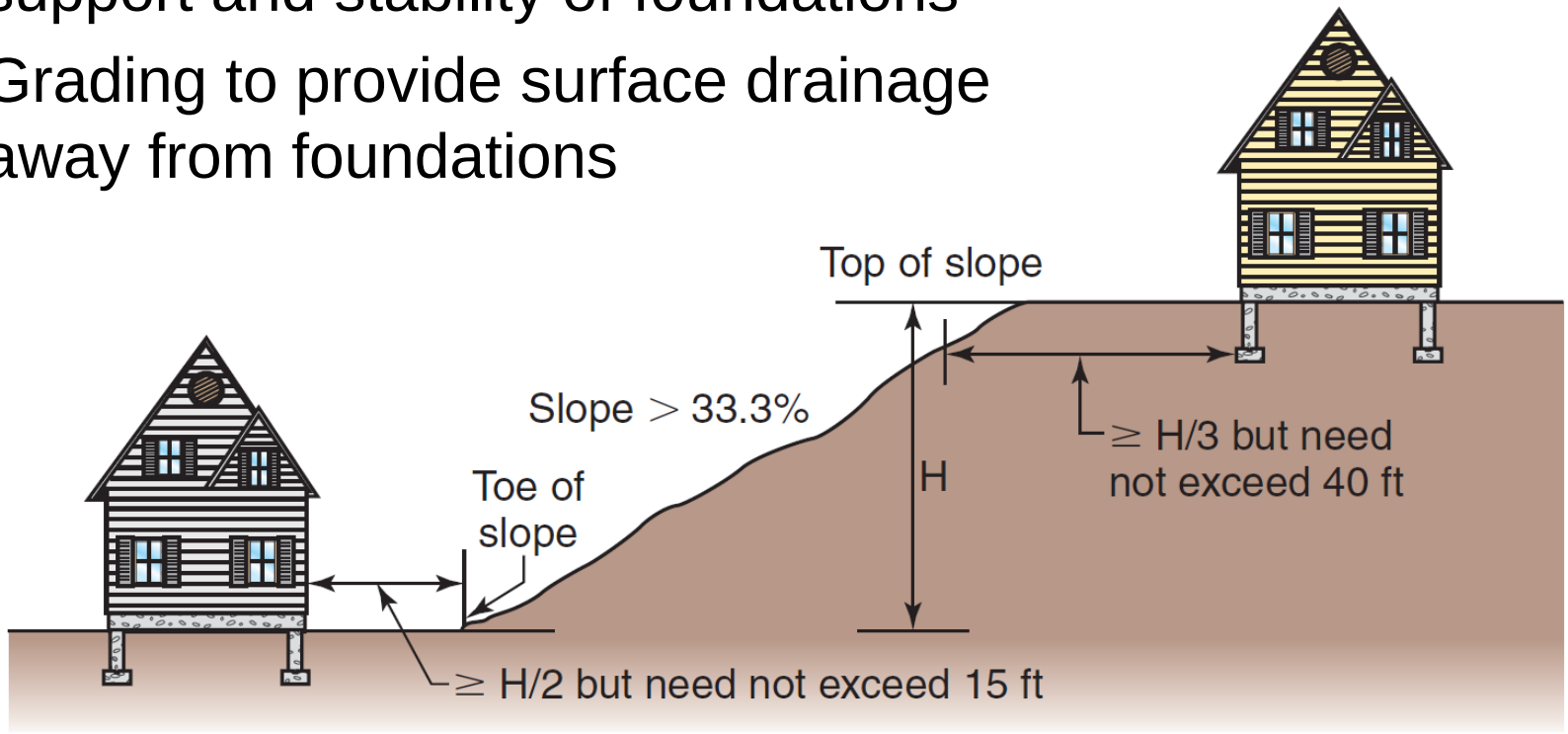
- Measured perpendicular to the exterior wall
- Measured between the building and:
  - Lot lines
  - Centerline of a street or alley





Site Preparation

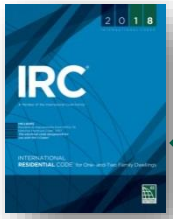
- Two basic provisions:
  - Soil characteristics as they relate to the support and stability of foundations
  - Grading to provide surface drainage away from foundations



General Requirements

- Exterior footings
  - Minimum of 12” below the undisturbed ground level
  - Protected against frost

- All footings must bear on:
  - Natural soil; or
  - Compacted engineered fill



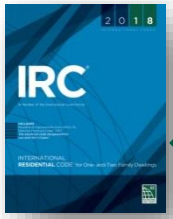
Presumptive Load-bearing Values & Properties of Soils

Unified Soil Classification System Symbol	Soil Description	Load Bearing Pressure (psf)	Drainage Characteristics	Frost Heave Potential	Volume Change Potential Expansion
GW	Well-graded gravels, gravel sand mixtures, little or no fines	3000	Good	Low	Low
GP	Poorly graded gravels or gravel sand mixtures, little or no fines	3000	Good	Low	Low
SW	Well-graded sands, gravelly sands, little or no fines	2000	Good	Low	Low
SP	Poorly graded sands or gravelly sands, little or no fines	2000	Good	Low	Low
GM	Silty gravels, gravel-sand-silt mixtures	2000	Good	Medium	Low
SM	Silty sand, sand-silt mixtures	2000	Good	Medium	Low
GC	Clayey gravels, gravel-sand-clay mixtures	2000	Medium	Medium	Low
SC	Clayey sands, sand-clay mixture	2000	Medium	Medium	Low
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	1500	Medium	High	Low
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	1500	Medium	Medium	Medium to Low
CH	Inorganic clays of high plasticity, fat clays	1500	Poor	Medium	High
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	1500	Poor	High	High

Fill

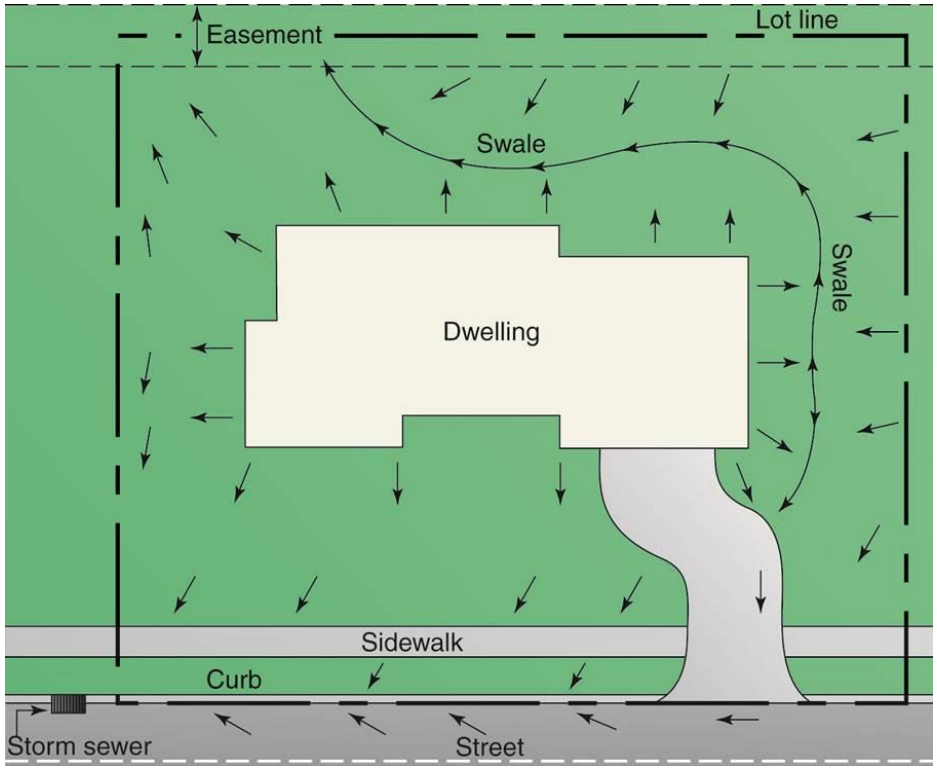
- Engineered fill is required for:
  - Over-excavation to remove unsuitable soils
  - Additional material to raise the elevation of the footings above the existing undisturbed soil

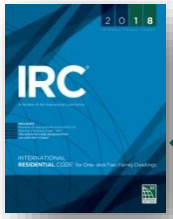
- Engineered fill must be:
  - Designed by a registered design professional
  - Installed as specified in design requirements
  - Tested as specified in design requirements



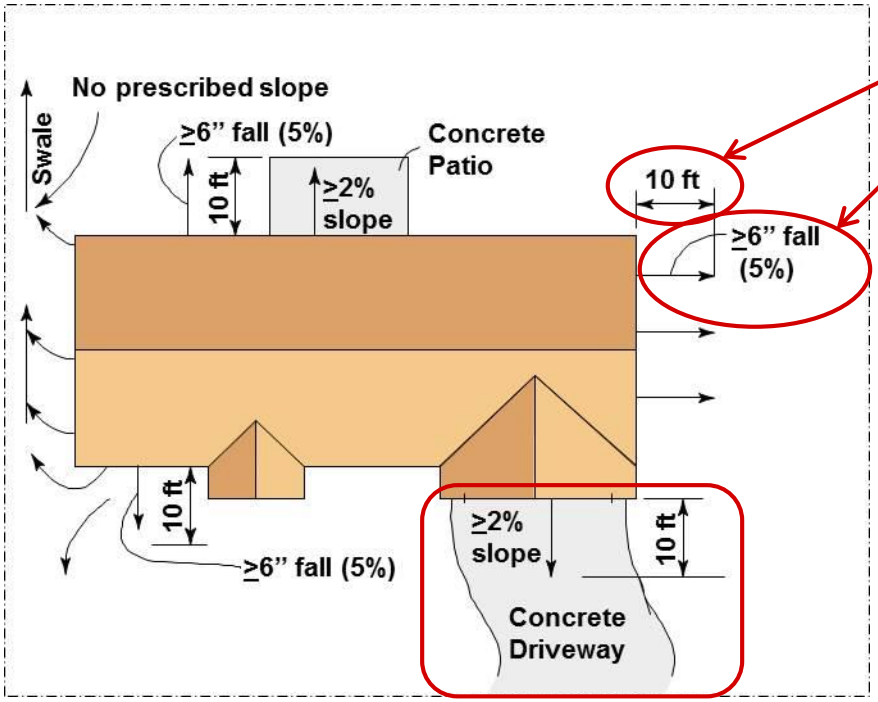
Storm Drainage

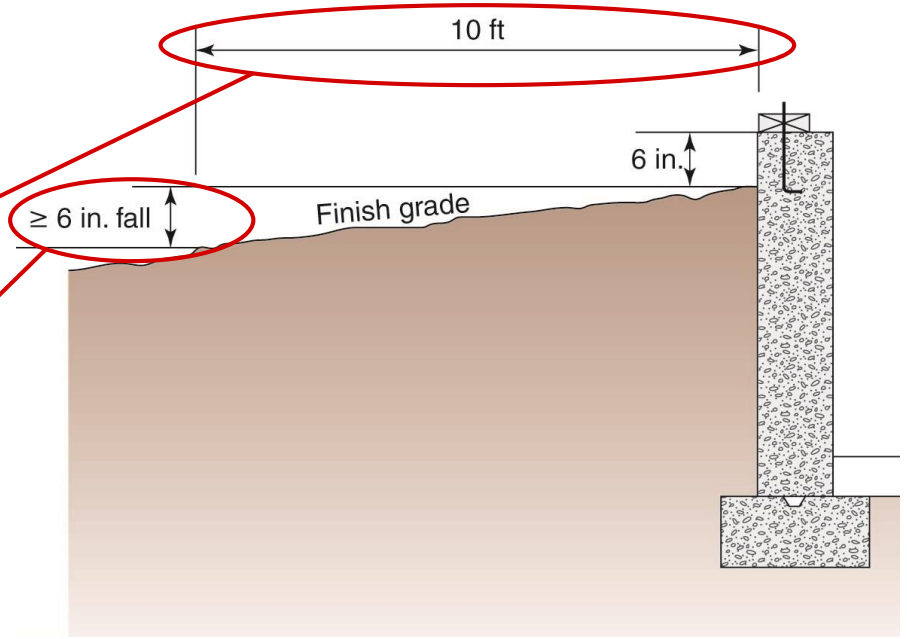
- Final grade
  - Minimum fall 6” within 10’ of foundation
  - Exception for local site conditions
    - Water can be directed to swales or drains
  - Concrete surfaces within 10’ of the foundation need 2% slope





Storm Drainage





Structural

Table R301.2(1)
Climatic and Geographic Design Criteria

- IRC adoption: jurisdiction completes table with data applicable to the jurisdiction – for example:

Ground Snow Load	Wind Design				Seismic Design Category
	Speed (mph) V_{ult}	Topographic Effects	Special Wind Region	Wind-borne Debris Zone	
30 psf	115 mph	Yes or No	Yes or No	Identify or No	B

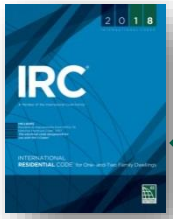


Table R301.2(1) (Continued)
Climatic and Geographic Design Criteria

- IRC adoption: jurisdiction completes table with data applicable to the jurisdiction – for example:

Subject to Damage from			Ice Barrier Underlayment Required
Weathering	Frost Line Depth	Termite	
Negligible or Moderate or Severe	42 in.	Yes or No	Yes or No

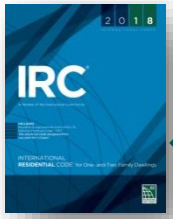


Table R301.2(1) (Continued)
Climatic and Geographic Design Criteria

Winter Design Temp	Flood Hazards	Air Freezing Index	Mean Annual Temp
2º F	Date NFIP, Etc.	1197	51º F

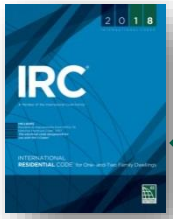


Table R301.2(1) (Continued)
Climatic and Geographic Design Criteria

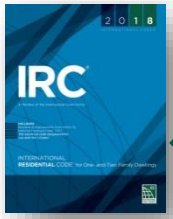
Manual J Design Criteria						
Elevation	Latitude	Winter Heating	Summer Cooling	Altitude Correction Factor	Indoor Design Temp.	Design Temp. Cooling

Heating Temp. Differ.	Cooling Temp. Differ.	Wind Velocity Heating	Wind Velocity Cooling	Coincident Wet Bulb	Daily Range	Winter Humidity	Summer humidity

Prescriptive and Performance

- Prescriptive requirements
  - A specific set of rules to follow

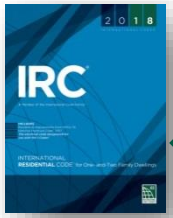
- Performance requirements
  - Expectation that the system will function in a certain way
  - For structural requirements, performance is achieved through engineering



Prescriptive and Performance

- Conventional construction
  - Engineered design can be used for structural elements that:
    - Exceed the limits in the code; or
    - Are not included in the code
- Alternative to wood framing provisions
  - Wood Frame Construction Manual published by the American Wood Council
    - WFCM addresses wind speeds up to 150 mph
    - IRC wind speeds are less than 110 mph

For example, the sizing of wide flange steel beams

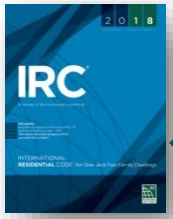


Live Loads

IRC Table R301.5

Minimum Uniformly Distributed Live Loads

USE	LIVE LOAD (psf)
Uninhabitable attics without storage	10
Uninhabitable attics with limited storage	20
Habitable attics and attics served with fixed stairs	30
Balconies (exterior) and decks	40
Fire escapes	40
Rooms other than sleeping rooms	40
Sleeping rooms	30



Live Loads (Continued)

IRC Table R301.5

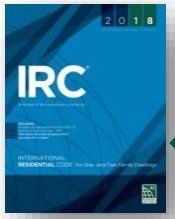
Minimum Uniformly Distributed Live Loads

USE	LIVE LOAD (psf)	
Guardrails and handrails	200	Single concentrated load applied in any direction along the top.
Guardrail in-fill components	50	Horizontally applied normal load of 50 lb. on area of 1 sq. ft.
Passenger vehicle garages	50	2,000-lb concentrated load / 20-sq. in. area.
Stairs	40	300-lb concentrated load / 4 sq. in. of tread

Dead Loads

- Average dead loads are included in the prescriptive tables for:
  - Footings
  - Floors
  - Walls
  - Roofs

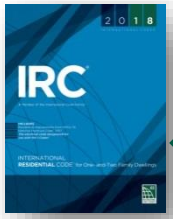
For example, spread footing sizes for conventional frame construction assume average weights for the construction materials being supported



Deflection

- Allowable deflection in structural framing members:
  - Studs
  - Joists
  - Beams
  - Rafters
- Table R301.7
  - L = span length
  - H = span height

Structural Member	Allowable Deflection
Rafters having slopes greater than 3:12 with no finished ceiling attached to rafters	*L*/180
Interior walls and partitions	*H*/180
Floors/ceilings with plaster or stucco finish	*L*/360
All other structural members	*L*/240
Exterior walls—wind loads with plaster or stucco finish	*H*/360
Exterior walls with other brittle finishes	*H*/240
Exterior walls with flexible finishes	*H*/120
Lintels supporting masonry veneer walls	*L*/600



Example 4-1 Floor Joist Deflection

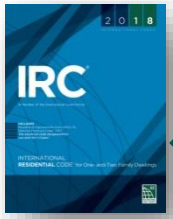
- Floor joist span is 14’
- Allowable deflection from Table R301.7 is L/360

L = 14’ x 12” = 168”

168 ÷ 360 = 0.47

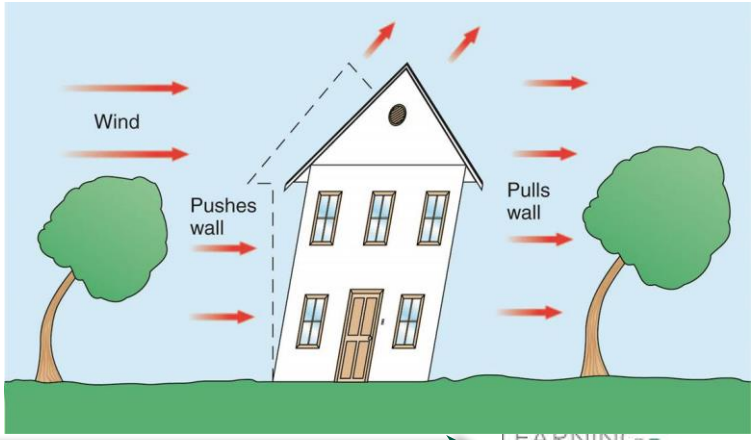
Allowable deflection is 0.47”

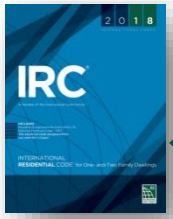
Note: a 14’ span rafter with 4:12 slope and no ceiling attached has an allowable deflection of L/180, which is twice the deflection allowed for floor joists



Wind Loads

- Wind forces acting on buildings
  - IRC conventional framing limits wind speed to 140 mph V_{ult} (130 in hurricane prone areas)
  - AWC – *Wood Framing Construction Manual* (WFCM)
  - ICC 600 – *Standard for Residential Construction in High-Wind Regions*
  - ICC – *International Building Code*
  - ASCE 7 – *Minimum Design Loads for Buildings and Other Structures*



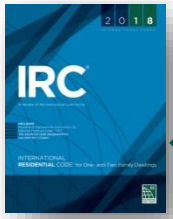


Wind Exposure Category

- Exposure B
  - Some wind protection with trees and buildings
  - Default
- Exposure C
  - Open terrain with scattered obstructions
- Exposure D
  - Flat, unobstructed areas exposed to open water, smooth mud flats, salt flats and unbroken ice for ≥ 5,000 ft

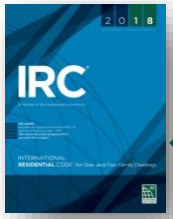
Wind exposure B

Wind exposure C



Hurricane-prone regions

- **Hurricane-prone regions.** Areas vulnerable to hurricanes, defined as the U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed, Vult, is greater than 115 miles per hour , and Hawaii, Puerto Rico, Guam, Virgin Islands and America Samoa.
- **Windborne debris region.** Areas within hurricane-prone regions located in accordance with one of the following:
  - 1.Within 1 mile of the coastal mean high water line where the ultimate design wind speed, Vult, is 130 mph or greater.
  - 2. In areas where the ultimate design wind speed, Vult, is 140 mph or greater; or Hawaii.



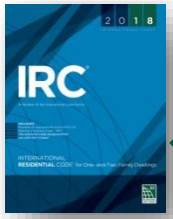
Snow Loads

- Snow loads must be considered where applicable
- IRC and WFCM conventional framing tables are limited to snow load <70 psf

Earthquakes

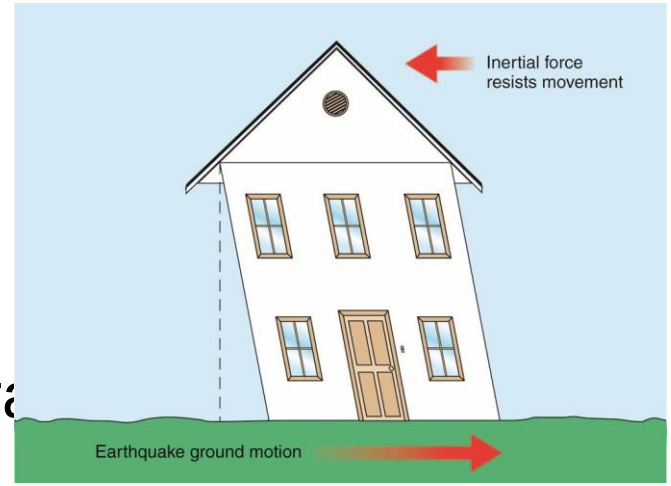
Seismic Design Category	1- and 2-Family Dwellings	Townhouses
A & B	No seismic requirements	No seismic requirements
C	No seismic requirements	Seismic Requirements Apply
D_0, D_1, D_2	Seismic Requirements Apply	
E	Engineered Design Required	

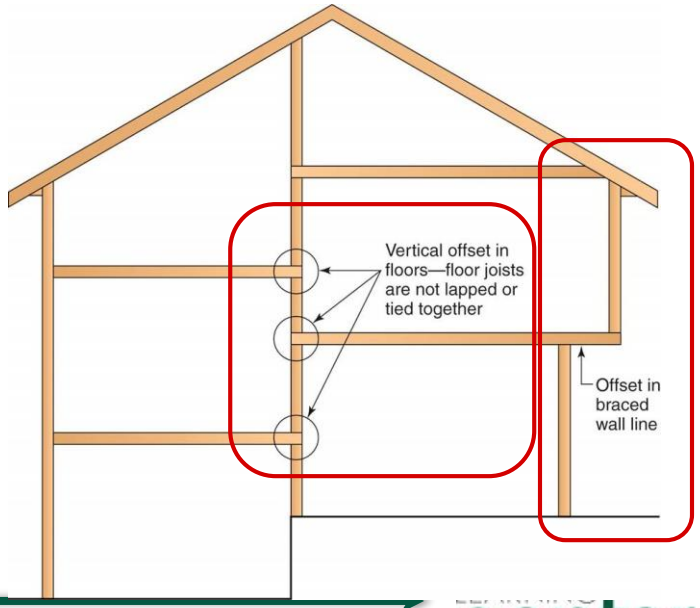
- The IRC assigns a Seismic Design Category to building sites relative to the anticipated intensity and frequency of earthquakes
- Prescriptive provisions of the IRC are adequate for SDC A and B

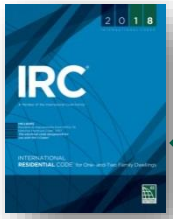


Earthquakes

- Regularly shaped buildings
  - Uniform distribution of forces
  - More predictable response chara
- Irregularly shaped buildings
  - Force concentrations
  - Generally less effective in resisting earthquake load effects

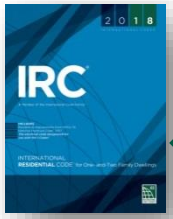






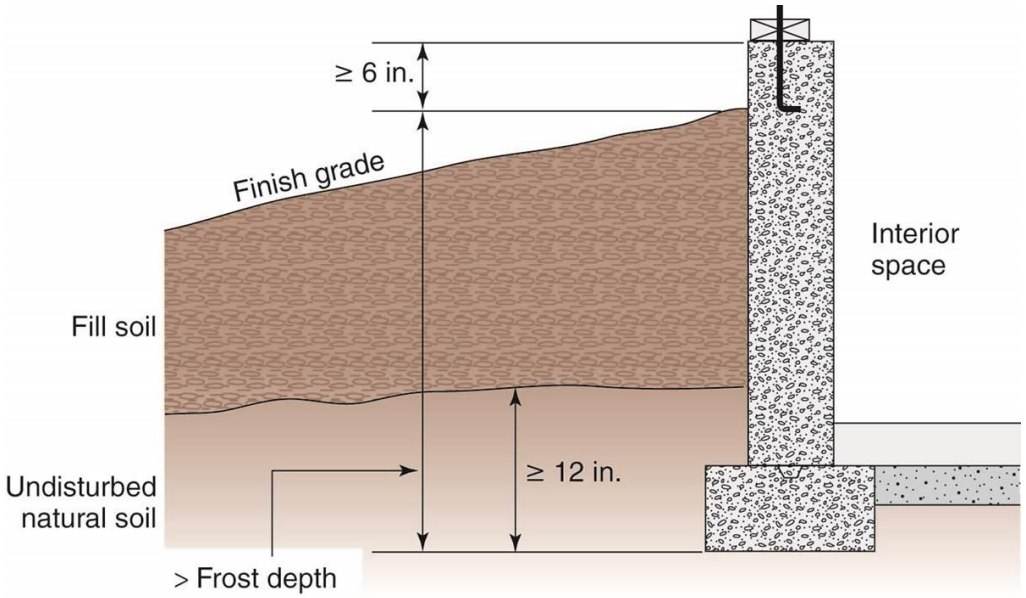
Foundation Materials

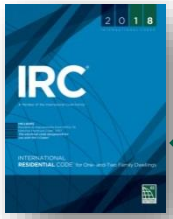
- Concrete
  - Removable forms
  - Stay-in-place insulating concrete forms (ICF)
- Precast concrete
- Masonry
- Wood
- Engineered or alternative designs



Footings

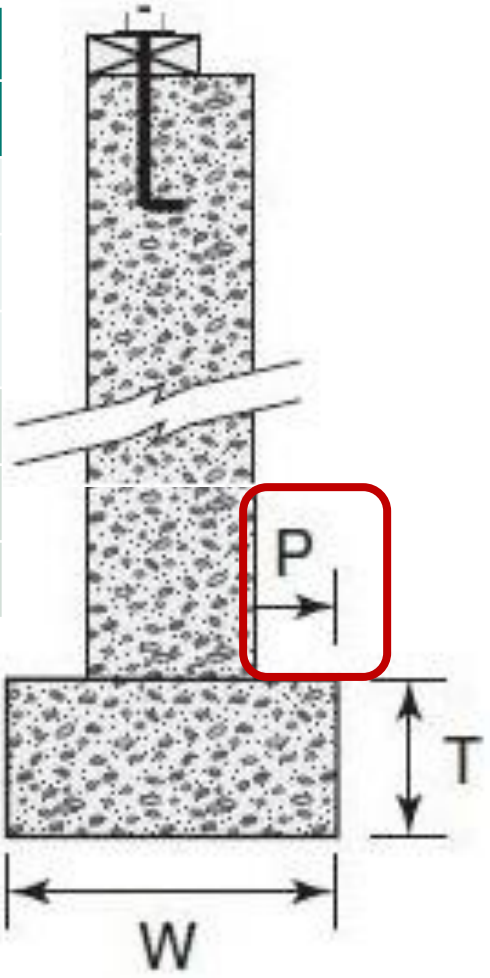
- Footings must bear on undisturbed ground
- Footings must extend below the frost depth
- Exterior footings 12” below undisturbed ground level
- Detrimental materials removed prior to placing concrete



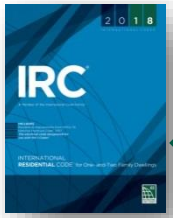


Size of Concrete Footings

Conventional Light-Frame Construction				
Snow load	Type of foundation	Load bearing value of soil		
30 psf		1,500	2,000	2,500
1-story	Slab-on-grade	12 x 6	12 x 6	12 x 6
	With crawl space	13 x 6	12 x 6	12 x 6
	Plus basement	19 x 6	14 x 6	12 x 6
2-story	Slab-on-grade	12 x 6	12 x 6	12 x 6
	With crawl space	17 x 6	13 x 6	12 x 6
	Plus basement	23 x 6	17 x 6	14 x 6

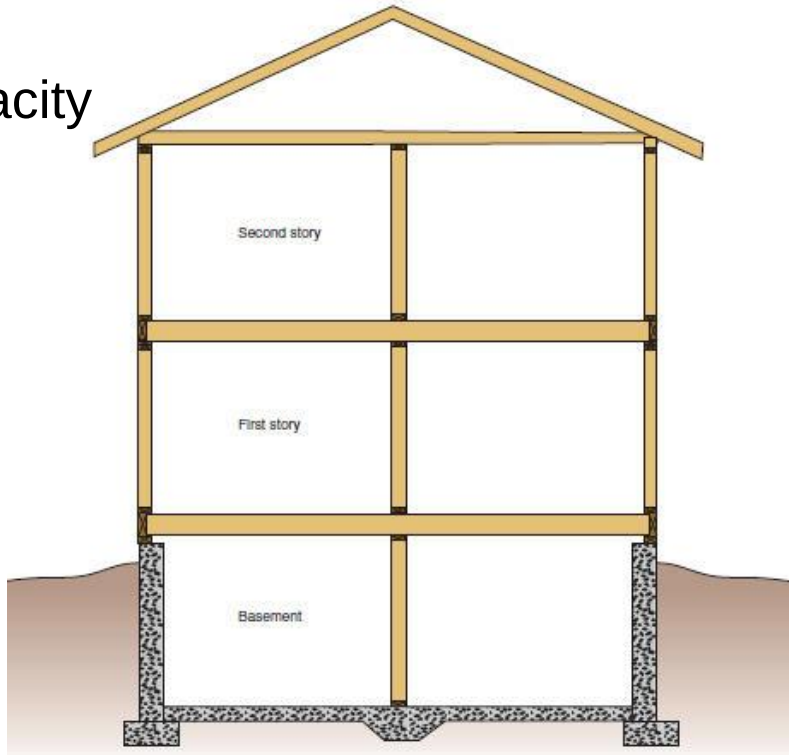


Projection “P” ≥ 2 in. and ≤ T
Thickness “T” ≥ 6 in.
Width “W” per table



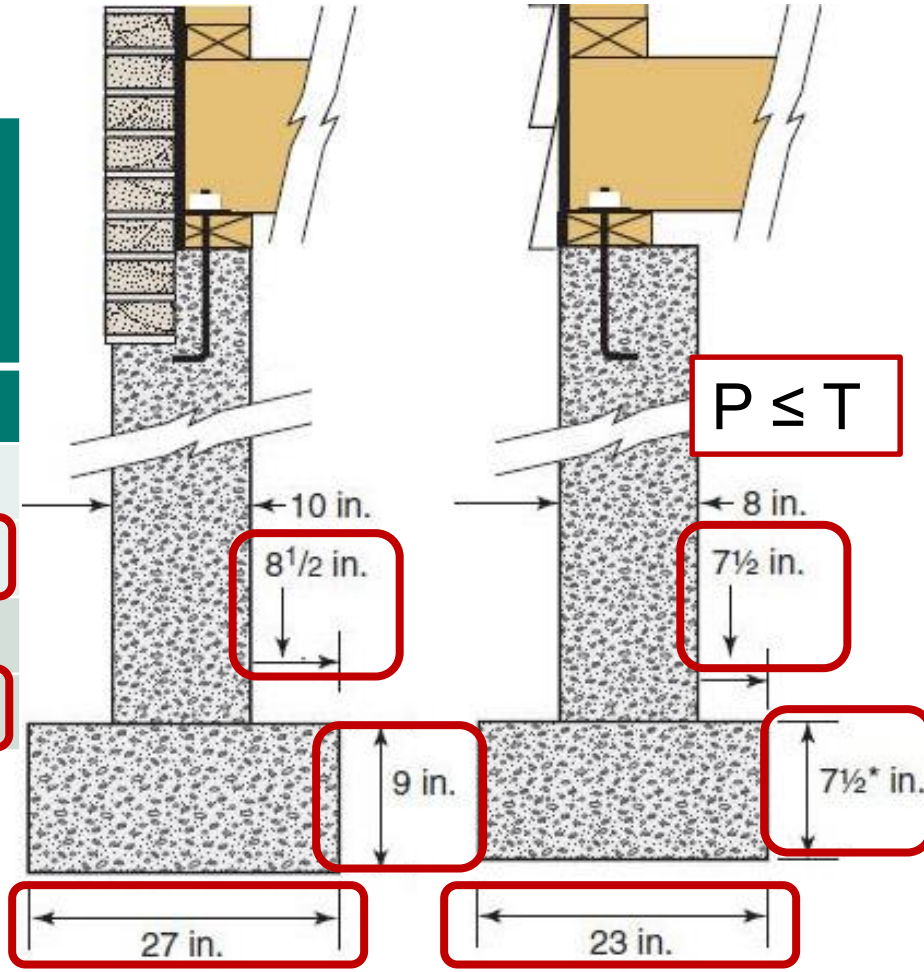
Example 5-1 Footing Size

- Determine minimum width (W), projection (P) and thickness (T) of a continuous spread footing
- Given:
  - 2-story dwelling with basement
  - 1500 psf assumed soil bearing capacity
  - 30 psf snow load
  - Conventional construction:
    a) Light-frame construction with siding
    b) Light-frame construction with brick veneer



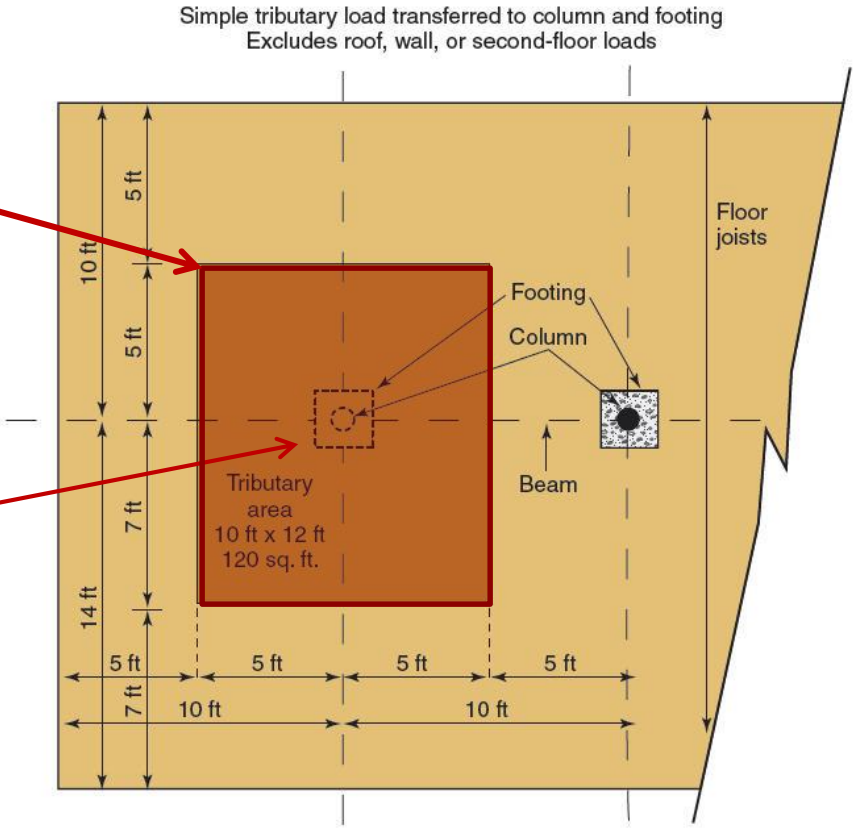
Example 5-1 Footing Size

Snow load	Type of foundation	Load bearing value of soil
30 psf		1,500
Conventional Light-Frame Construction		
2-story	Plus basement	23 x 6
With Brick Veneer		
2-story	Plus basement	27 x 9



Example 5-2
Isolated Footing Size

- Given:
  - Column supports tributary floor area of 120 ft^2 at 50 psf
  - 1,500 psf assumed soil-bearing capacity
- Determine minimum footing size

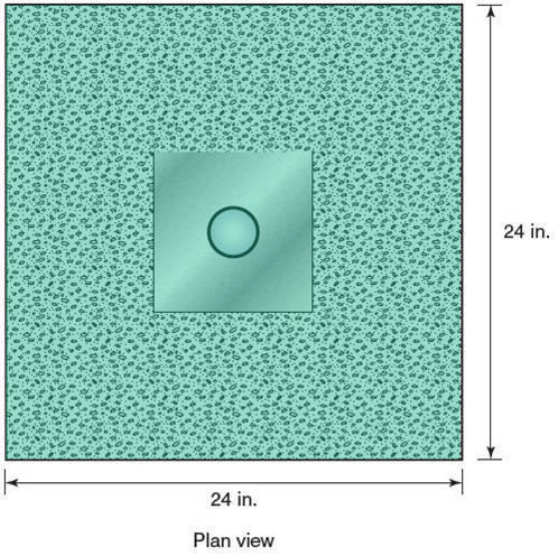


Example 5-2
Isolated Footing Size

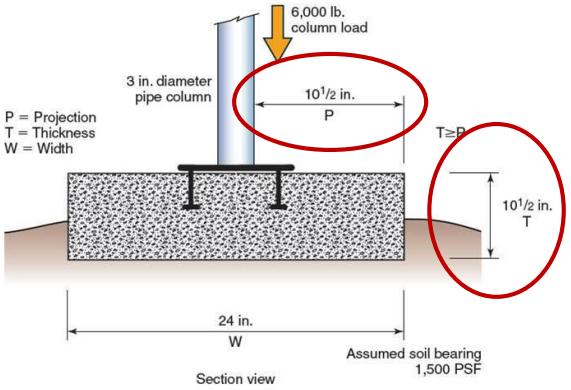
- Soil load-bearing capacity
  - 1500 psf
- Tributary column load
  - 120 ft^2 x 50 lbs. = 6,000 lbs.

6,000 lbs. ÷ 1,500 psf = 4 ft^2

- Thickness (T) Min. 6”
- Projection (P) cannot exceed footing thickness



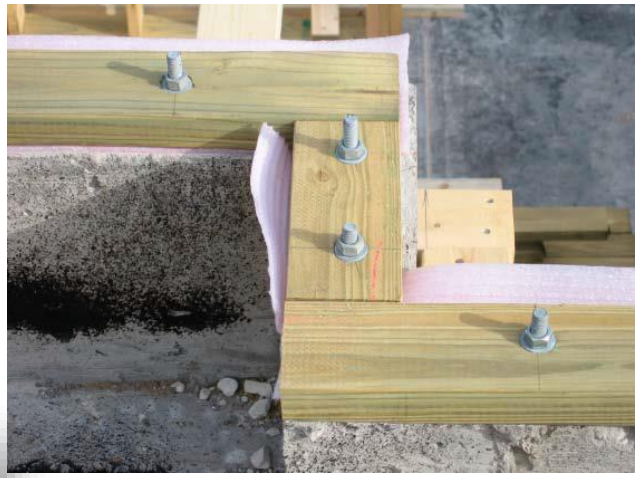
Plan view

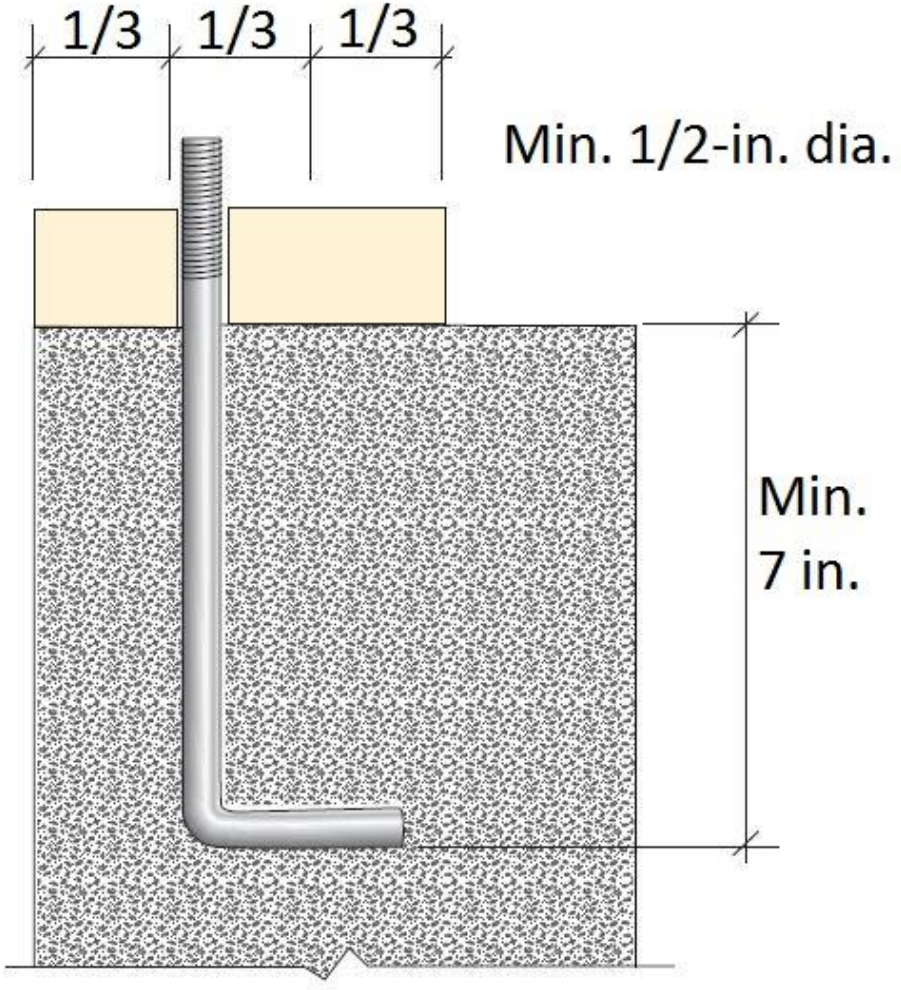


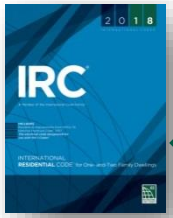
Section view

Foundation Anchorage

- Anchor bolts
  - ½-inch diameter
  - 7-inch embedment
  - Middle 1/3 of plate





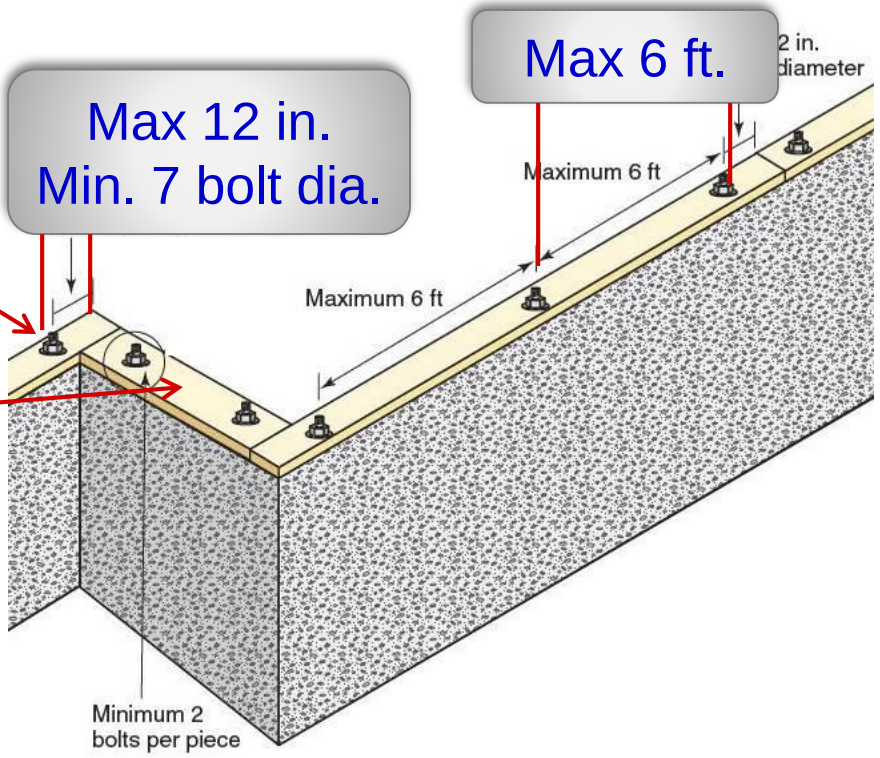


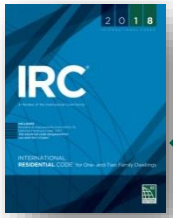
Foundation Anchorage

- Wood sill plate anchorage to foundation for
  - Dwellings and townhouses in SDC “A” and “B”
  - Dwellings in SDC “C”

Standard washer and nut on each bolt

Note: Offsets ≤ 24” require only one anchor bolt in center third of plate

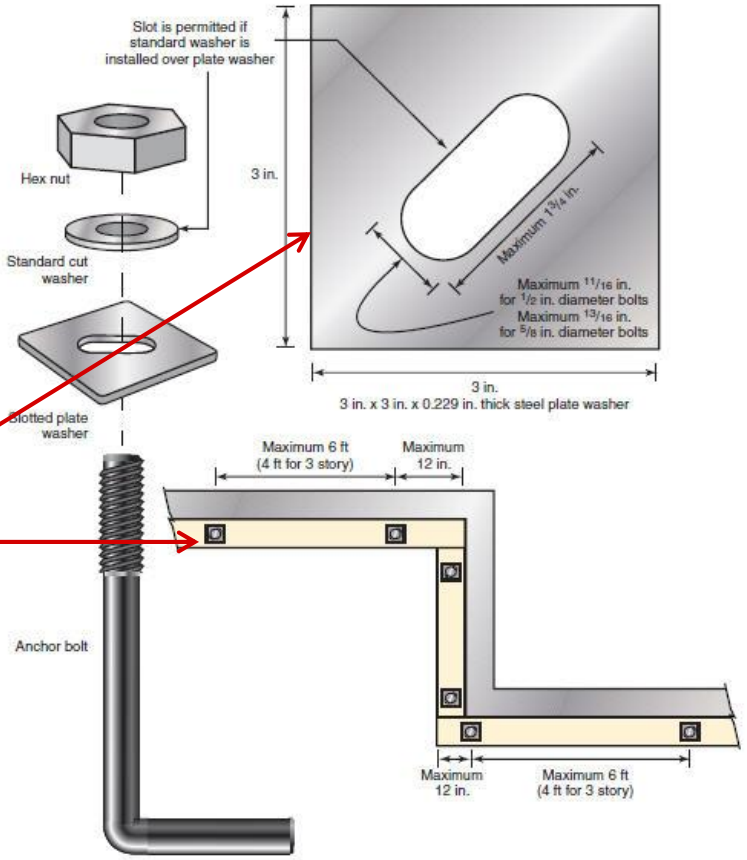




Foundation Anchorage

- Wood sill plate anchorage Seismic
  - Dwellings and townhouses in SDC D_0, D_1 and D_2
  - Townhouses in SDC C

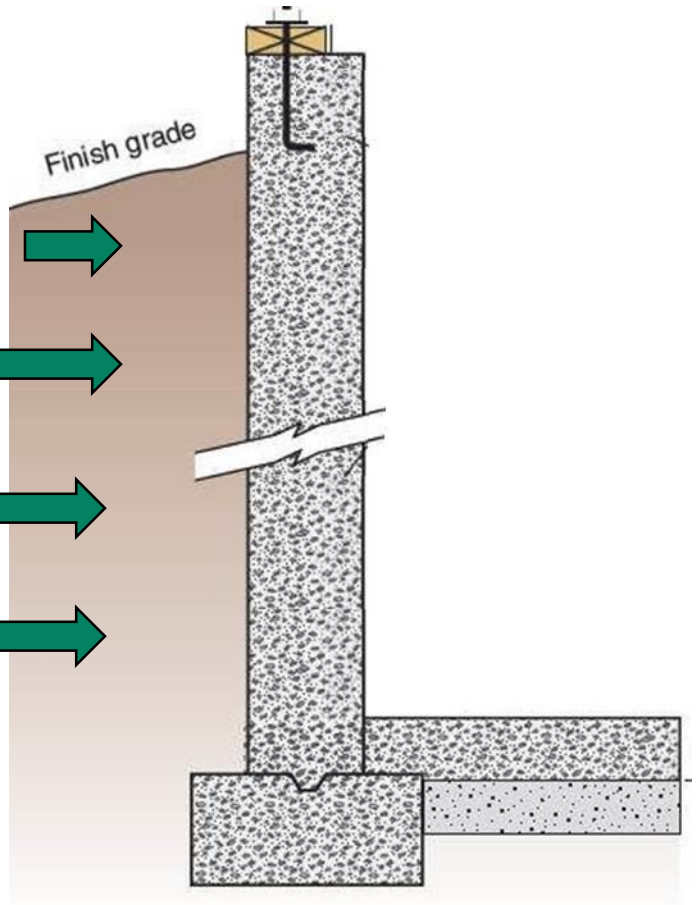
3” x 3” plate washers approximately ¼” thick

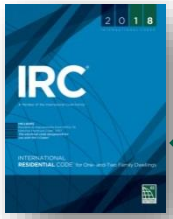


Bolt spacing ≤ 4’ for anchorage of 3-story buildings

Concrete Foundation Walls

- Foundation walls must be constructed to resist lateral loads
- Thickness and vertical reinforcement determined by:
  - Soil type
  - Height of foundation
  - Height of unbalanced backfill
    - Difference in height between the exterior finish ground level and the top of the interior basement floor



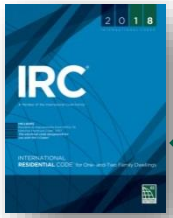


Concrete Foundation Walls

- Horizontal reinforcing required for basement walls
  - Table R404.1.2(1)

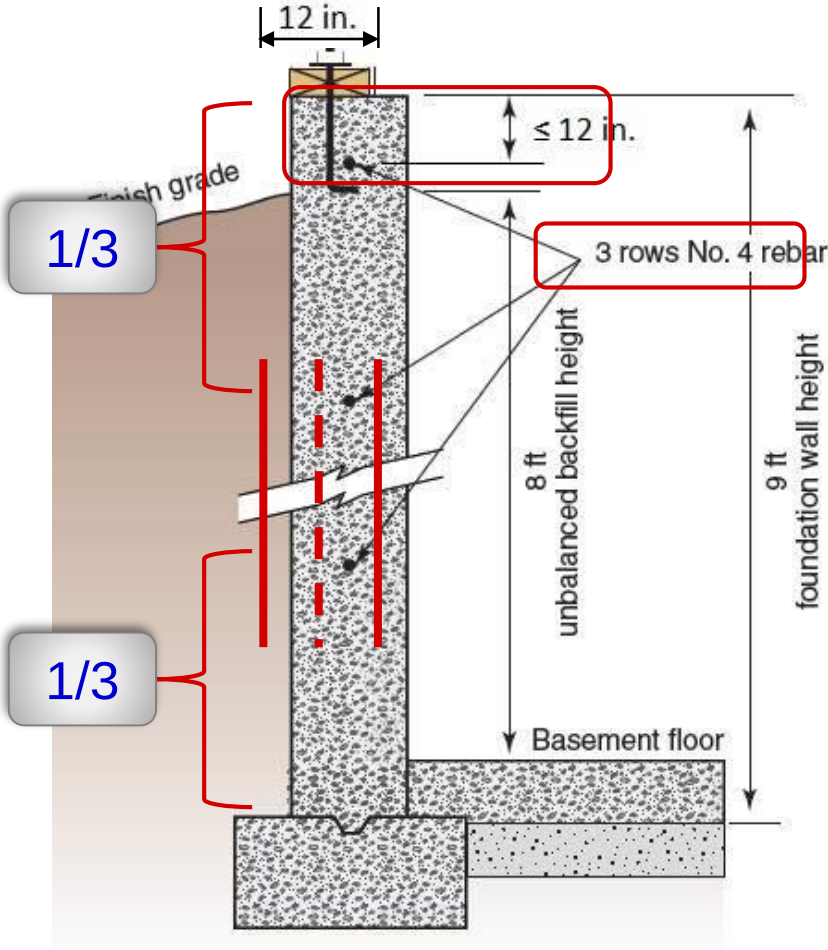
Maximum Unsupported Height of Basement Wall	Location of Horizontal Reinforcement
≤8 feet	One No. 4 bar within 12” of the top of the wall and one No. 4 bar near mid-height of the wall story
>8 feet	One No. 4 bar within 12” of the top of the wall and one No. 4 bar near third points the wall story

- Vertical reinforcing required
  - Tables R404.1.2(2) through R404.1.2(9)



Horizontal Reinforcing in Concrete Basement Wall

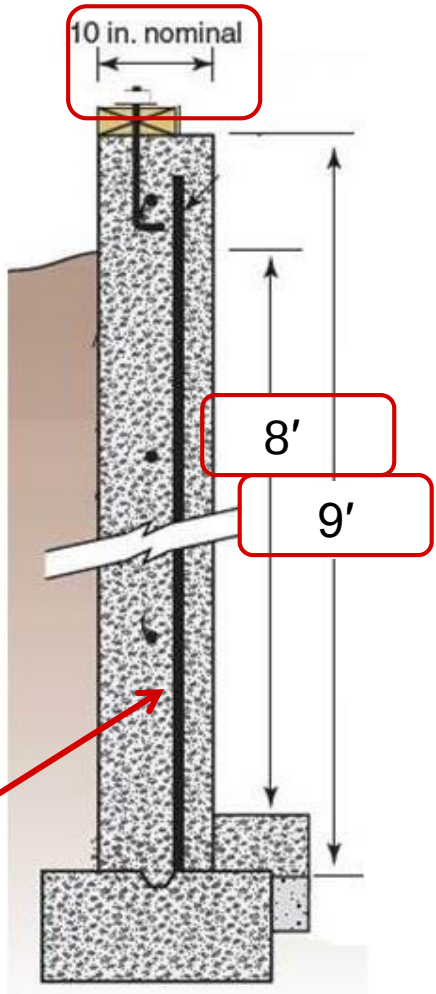
- Table R404.1.2(1)
  - 3 horizontal No. 4 bars
  - One bar within 12” of top
  - Other bars at third points
  - Bars located in center of wall



Vertical Reinforcing in Concrete Basement Wall

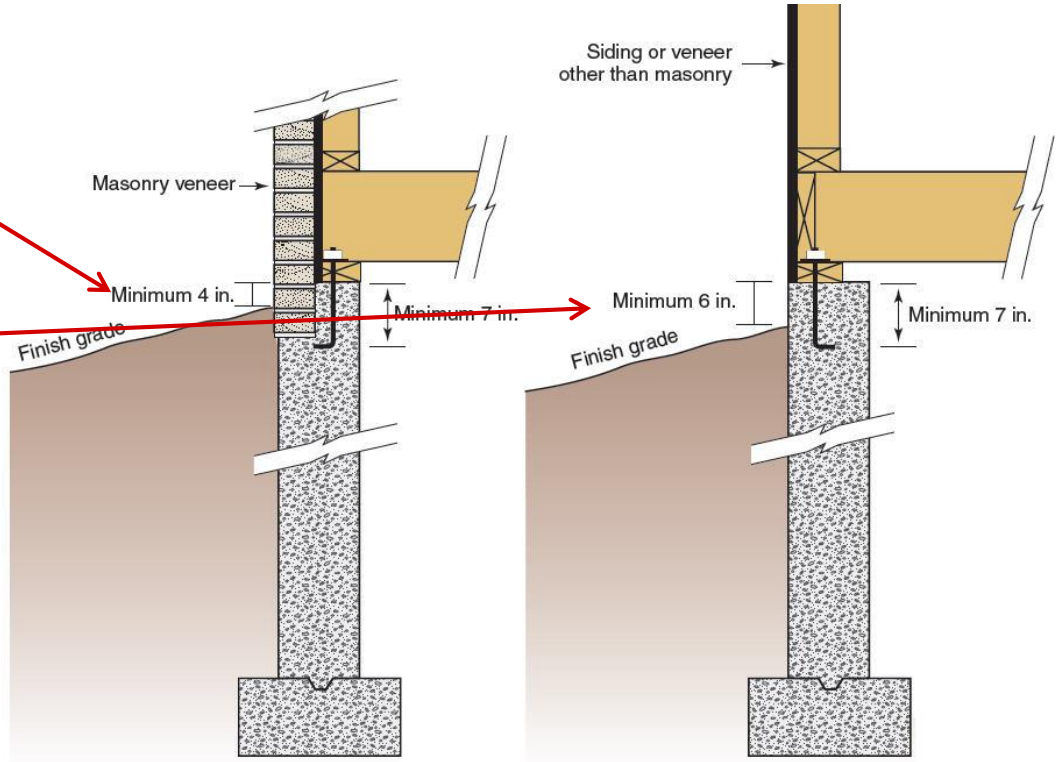
- Soil class = CL inorganic sandy clay
- 10″ nominal thickness
- Wall height = 9′
- Unbalanced backfill height = 8′
- Table R404.1.2(8) Vertical Reinforcement
  - No. 6 bars at 39 inches on center

Wall Hgt.	Unbal. backfill	Soil class			
		SC, ML-CL and inorganic CL			
		6″	8″	10″	12″
	6	6 @ 36	6 @ 39	NR	NR
9	7	6 @ 33	6 @ 38	5 @ 37	NR
	8	6 @ 24	6 @ 29	6 @ 39	4 @ 48



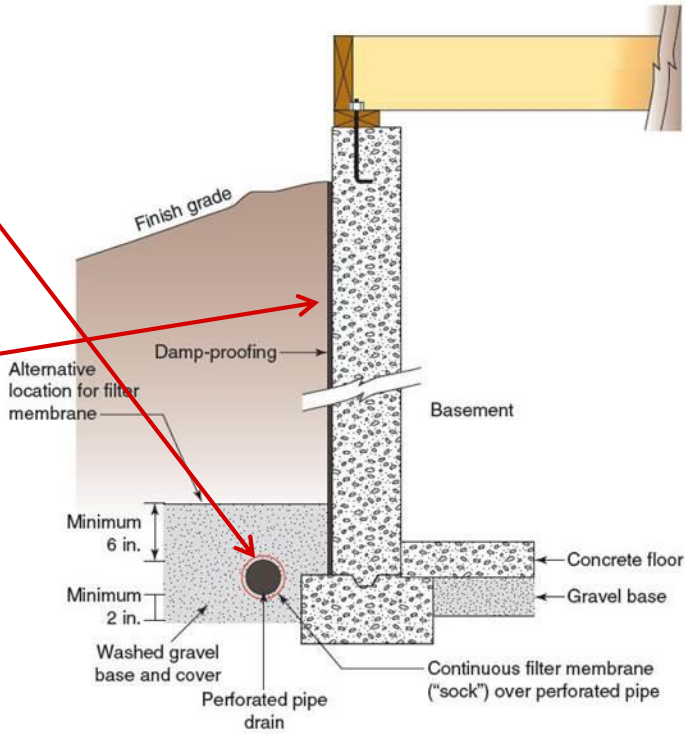
Height Above Finished Grade

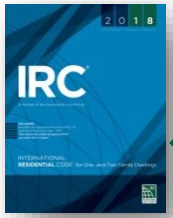
- Concrete and masonry foundation walls must extend above the finished grade adjacent to the foundation
  - Minimum of 4” with masonry veneer
  - Minimum of 6” elsewhere



Moisture Protection

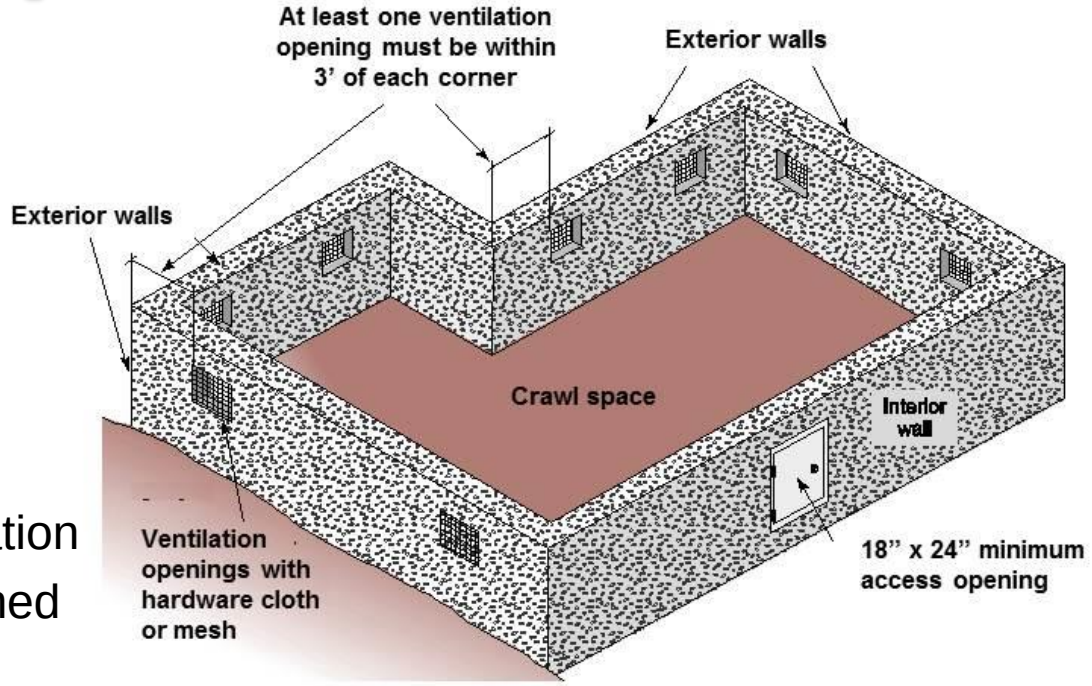
- Drainage by perforated pipe or other approved drain system
  - Installed at or below the level of the basement or crawl space floor
  - Exception for areas with well-drained soils
- Dampproofing materials applied to the exterior of the foundation
- Waterproofing in areas with a high water table or other known severe soil-water conditions
  - Flexible sealants or other impervious material

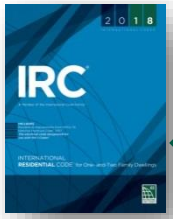




Underfloor Space

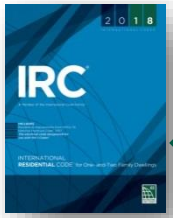
- Ventilation of crawl space required
  - Circulate air
  - Dissipate condensation
- Method of ventilation
  - Foundation openings
  - Mechanical exhaust ventilation
  - Connection to the conditioned air supply of the dwelling
- Access to underfloor spaces
  - 18” x 24” through floor
  - 16” x 24” through perimeter wall





Framing

- Light-frame construction
  - Wood or cold-formed steel
- Grade mark on wood products
  - Wood structural panels
  - Load-bearing dimension lumber

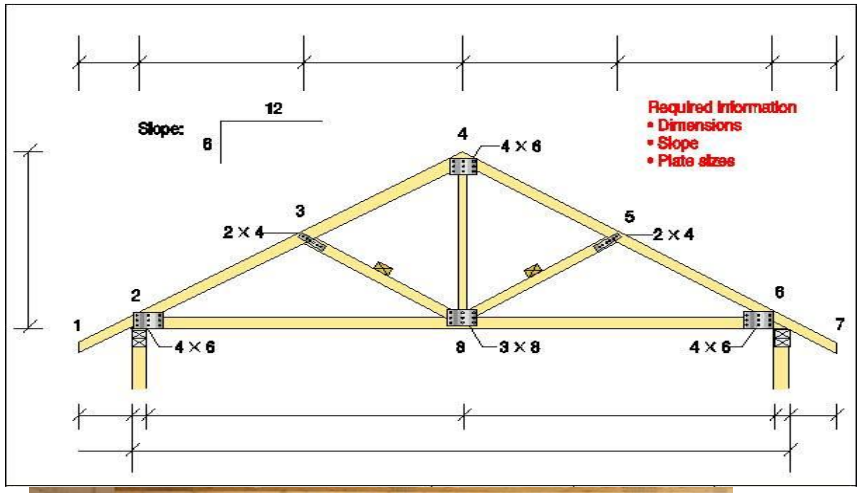


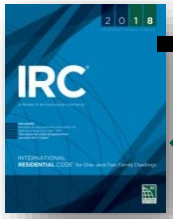
Engineered Wood Products

- Plate-connected open web trusses
- I-joists
- Glued-laminated lumber
- Laminated veneer lumber (LVL)
- Other structural composite lumber (SCL)

Wood Trusses

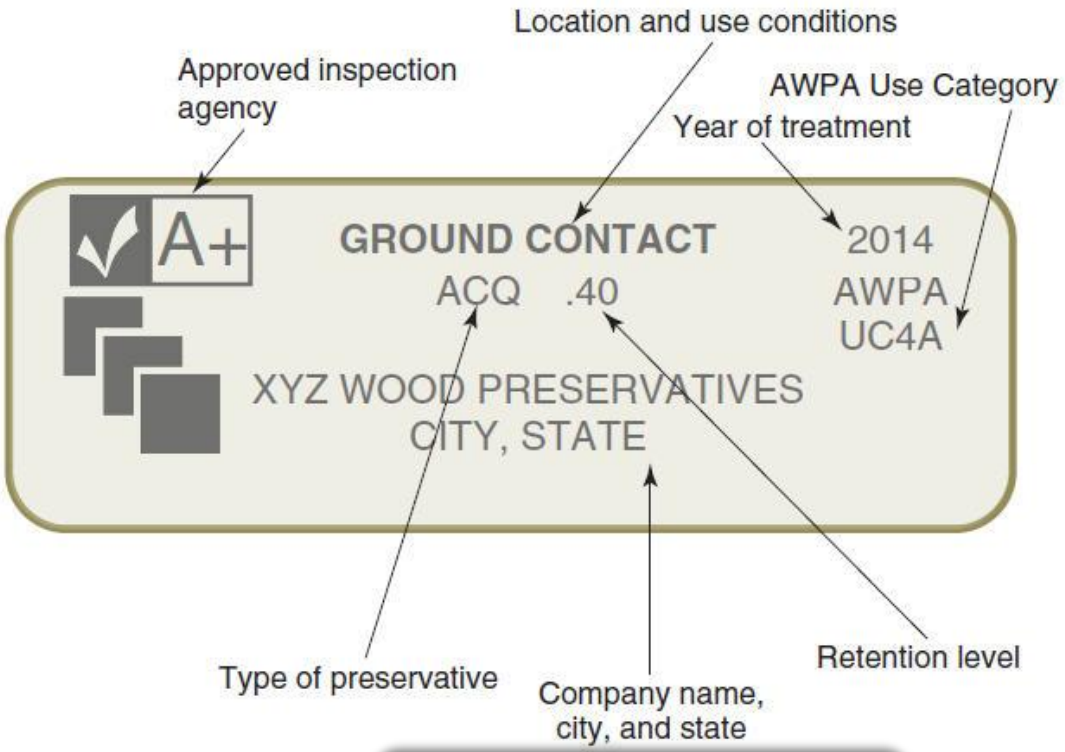
- Design submitted to building official for approval
- Include:
  - Design loads
  - Slope or depth, span and spacing
  - Required bearing widths
  - Lumber size, species and grade
  - Connection requirements
  - Required permanent bracing location
  - Other information





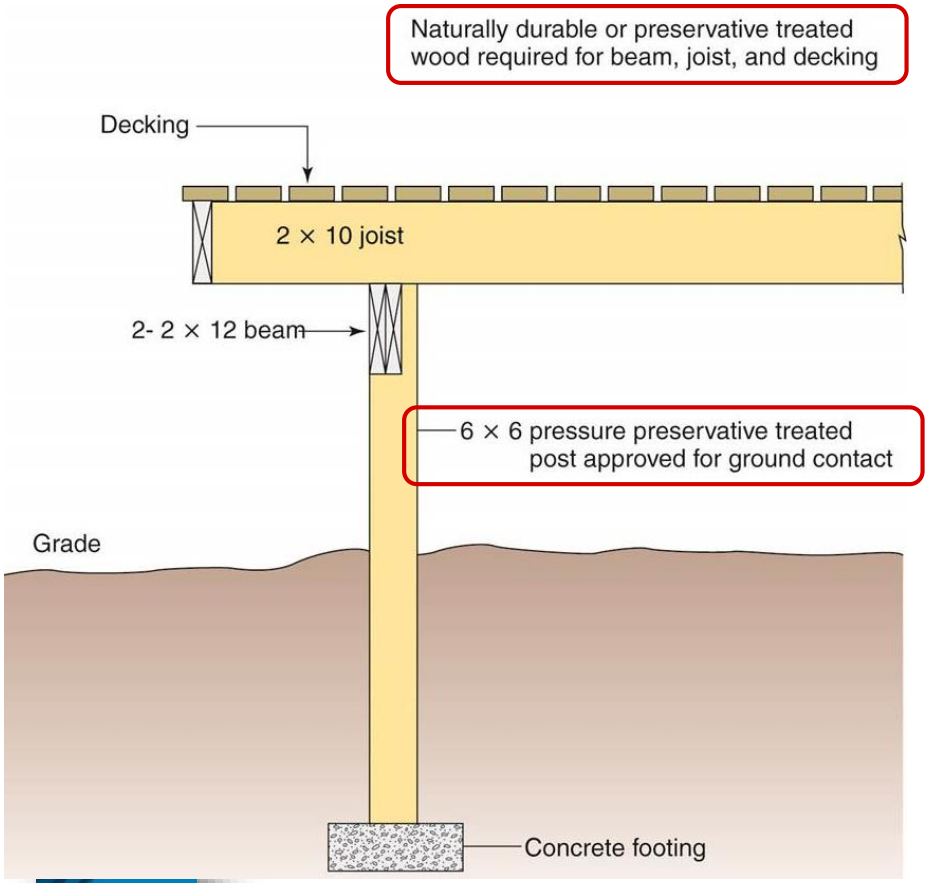
Wood Treatment

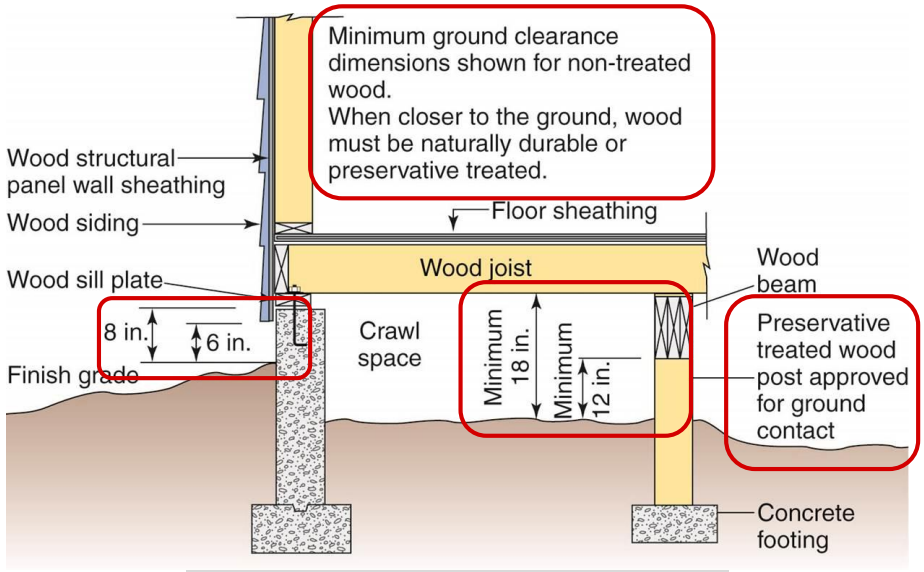
- Wood in locations subject to decay requires:
  - Wood treated with preservatives; or
  - Naturally durable wood
    - Redwood
    - Cedar
    - Black locust
    - Black walnut



Tag on preservative treated wood

Protection Against Decay

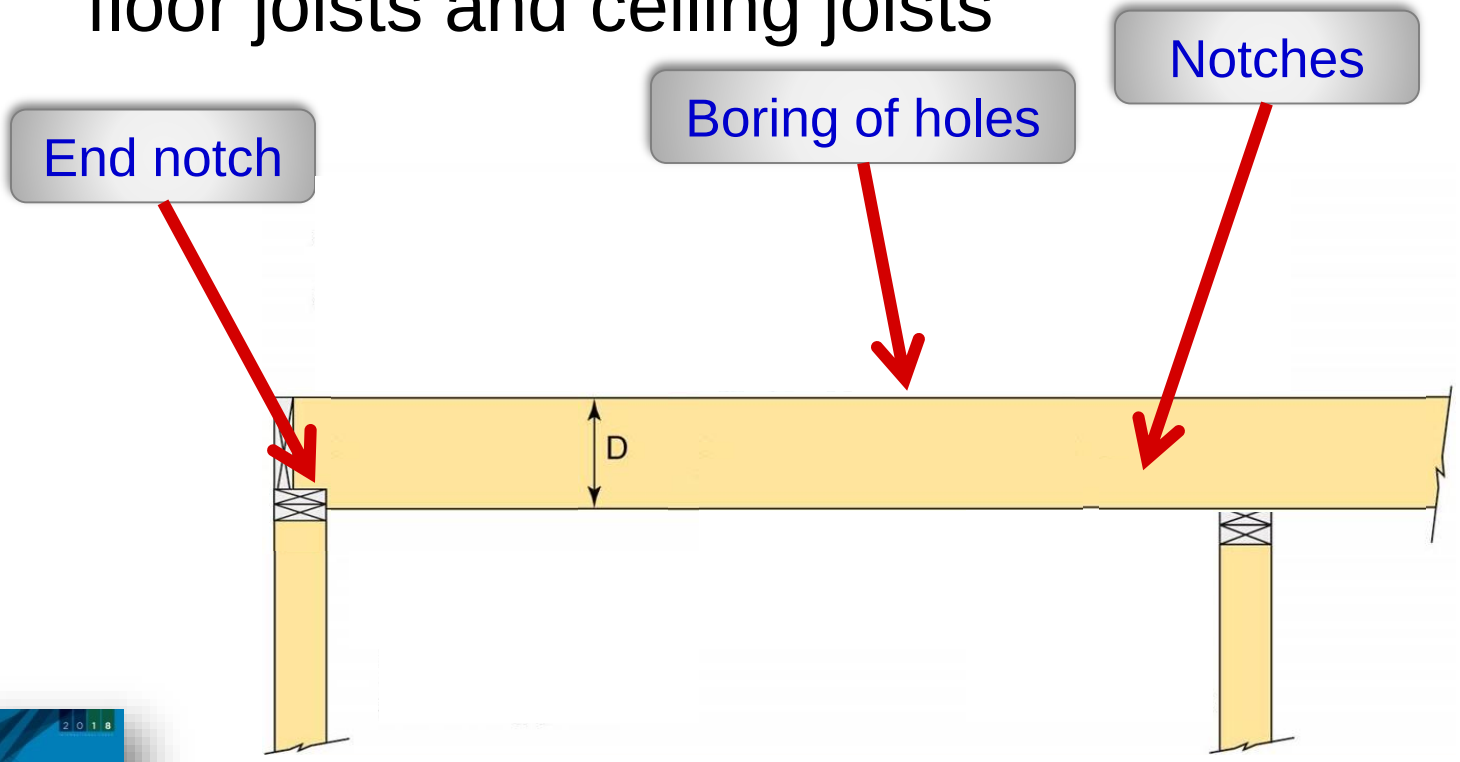




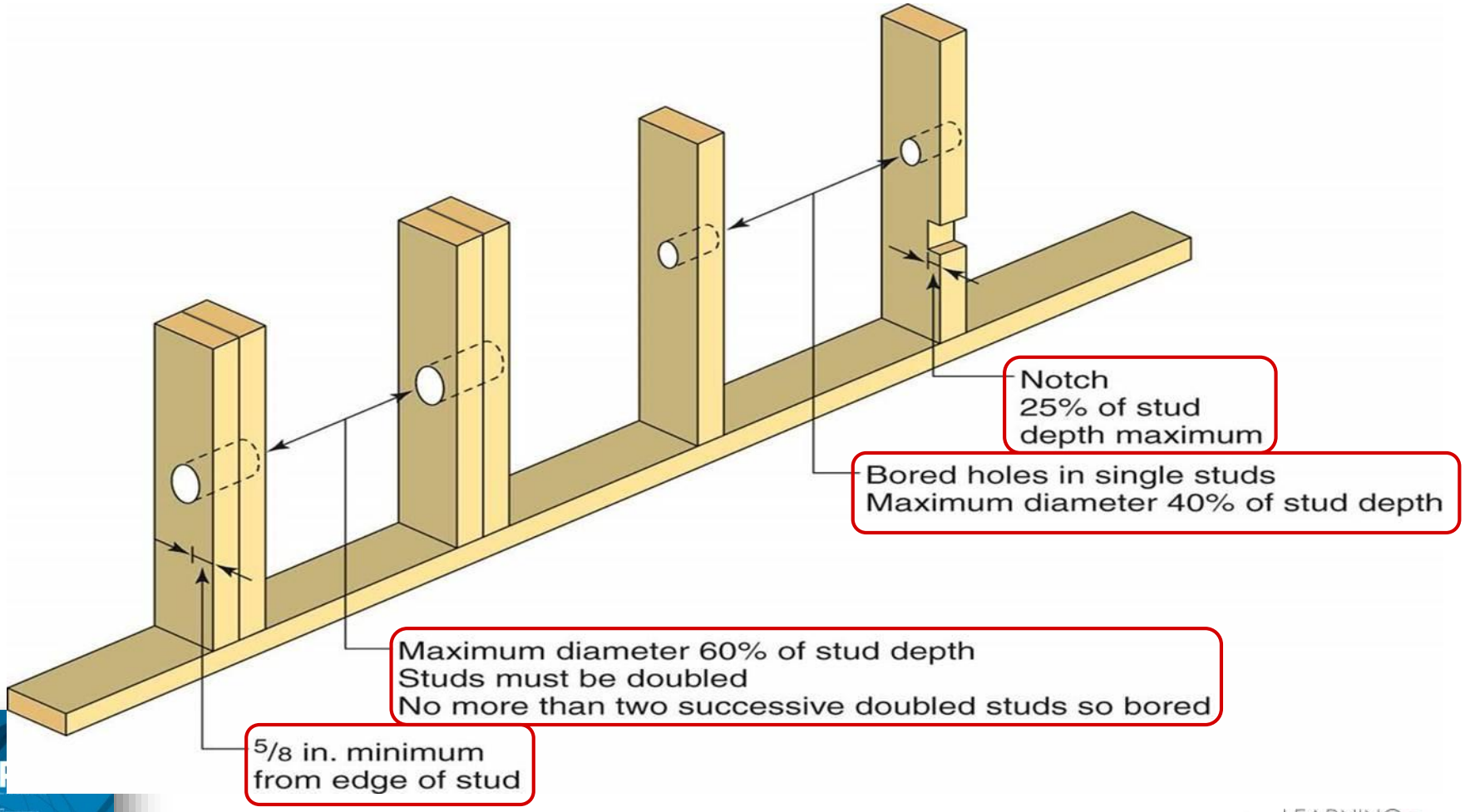
Clearance above grade

Boring and Notching Floor and Ceiling Joists

- Boring holes and notching of solid sawn beams, floor joists and ceiling joists

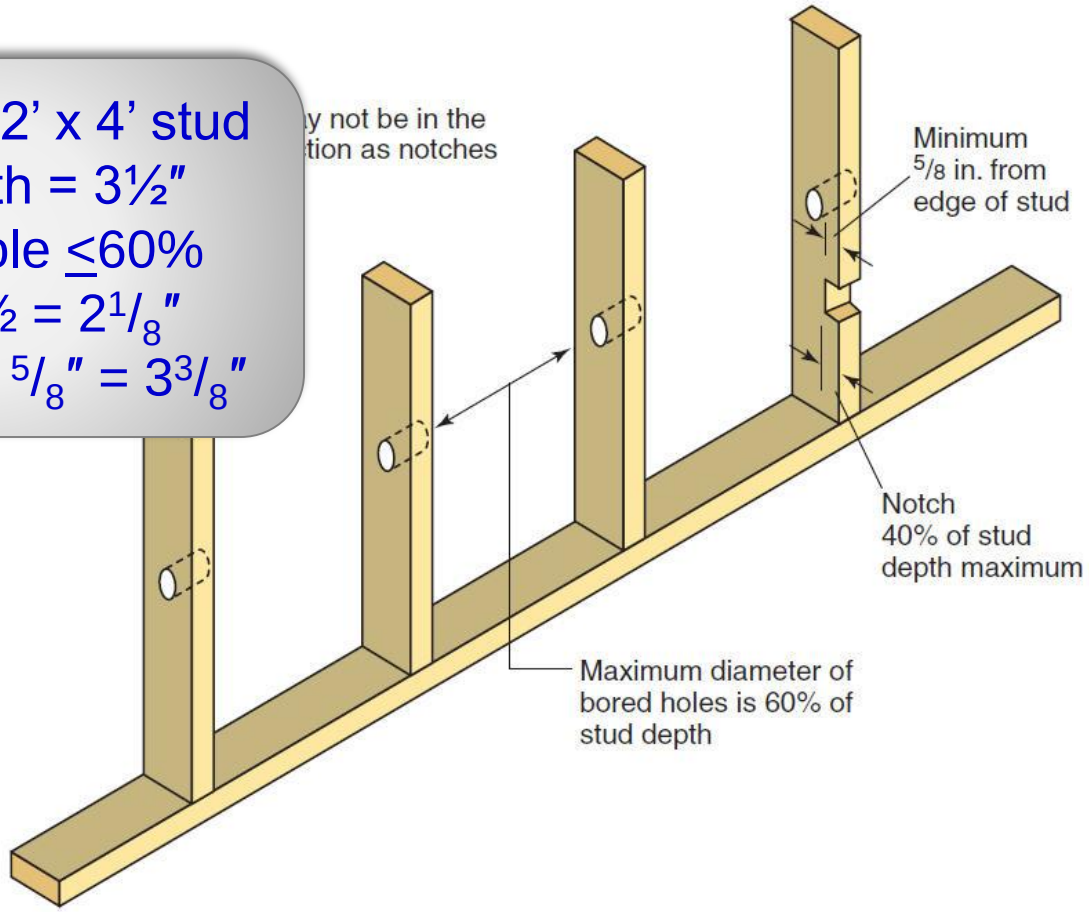


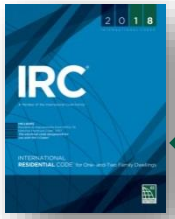
Boring and Notching Bearing Walls



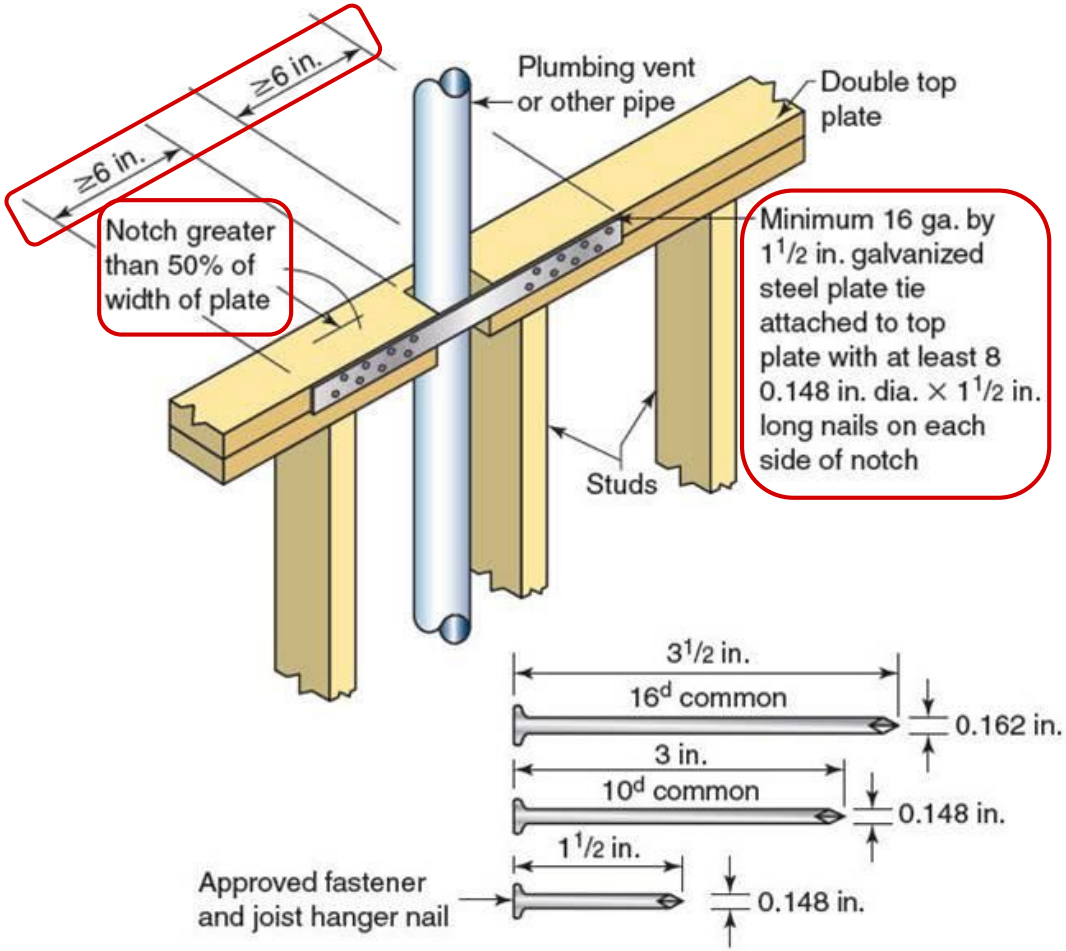
Boring and Notching Nonbearing Walls

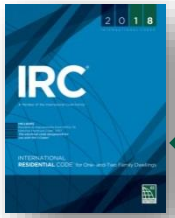
Hole size in 2’ x 4’ stud
Stud depth = 3½″
Largest hole ≤60%
60% x 3½ = $2^1/_8$″
$^5/_8$″ + $2^1/_8$″ + $^5/_8$″ = $3^3/_8$″





Boring and Notching Top Plate of Bearing Wall



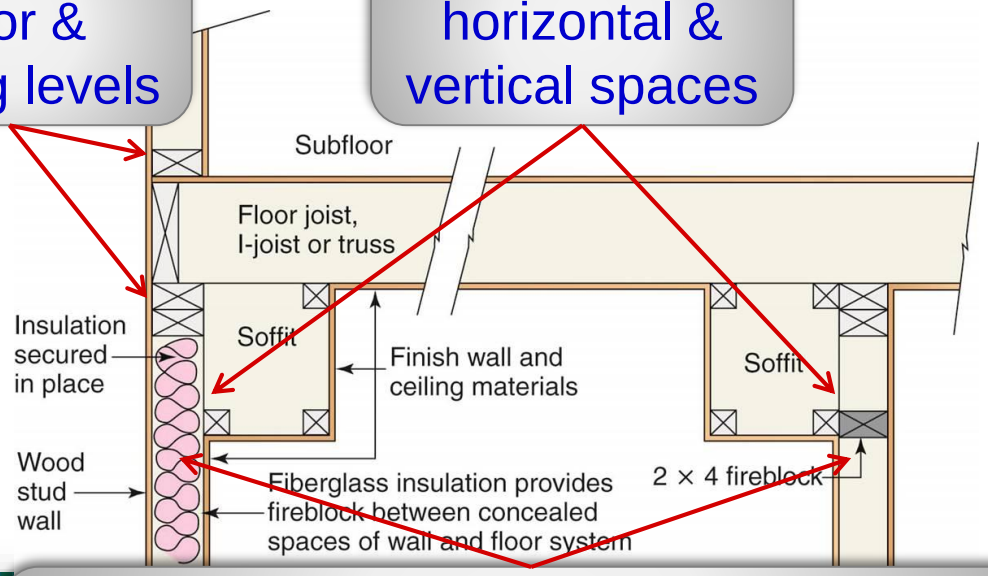


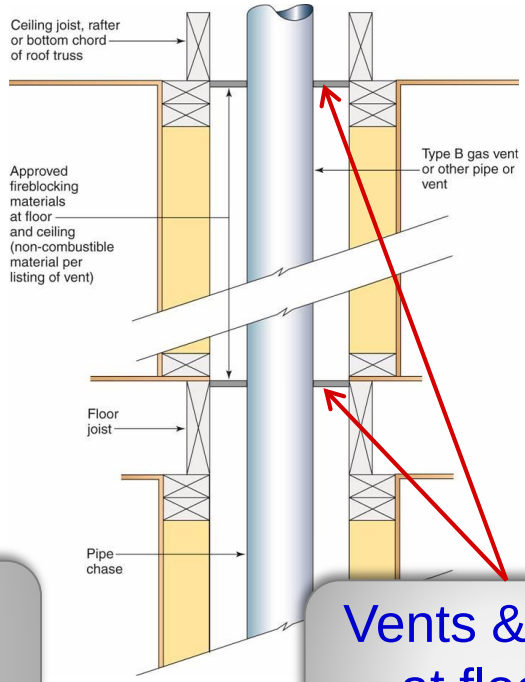
Fireblocking

- Designed to stop the spread of fire in concealed spaces of wood frame construction

Walls at floor & ceiling levels

Connection of horizontal & vertical spaces





- Nominal 2” lumber
- Layers of structural wood panels
- Glass fiber insulation secured in place

Vents & ducts at floor & ceiling levels

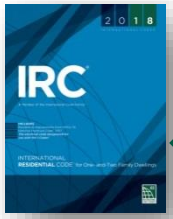
Draftstopping

- Divide concealed floor assembly spaces into areas of <1000 ft^2

- Materials:
  - 1/2” gypsum board
  - 3/8” wood structural panels
  - Other approved materials

Wood Floor Framing

- Prescriptive tables for:
  - Beams and girders
    - No. 2 grade Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir
    - Various support conditions
  - Floor joists
    - Specific grade and species of lumber
    - Live load 30 or 40 psf
    - Dead load 10 or 20 psf



Example 6-1
Beam Size and Bearing Support

- Determine the minimum size and bearing support requirements for an interior beam supporting 2 floors
- #2 hem-fir lumber
- Building width = 28’
- Beam span = 6’

Girder supporting	Size	Building width		
		20	28	36
		Span	Span	Span
Two floors	3-2x10	6-2	5-4	4-10
	3-2x12	7-2	6-3	5-7
	4-2x8	6-1	5-3	4-8
	4-2x10	7-2	6-2	5-6

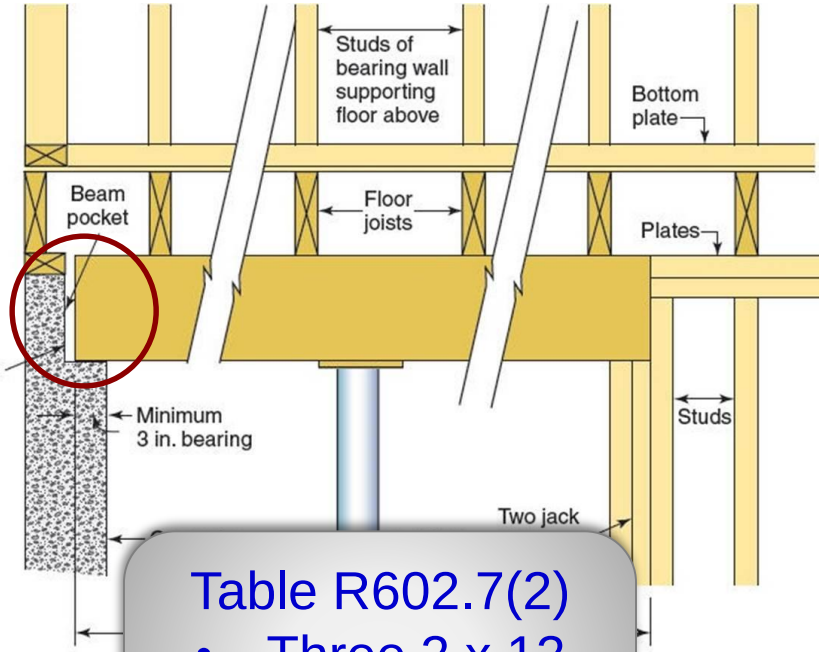


Table R602.7(2)
- Three 2 x 12

or
- Four 2 x 10

Example 6-2
Joist Size and Spacing

- Living area = 40 psf LL
- #2 Douglas fir-larch
- Dead load = 10 psf
- Span = 14’

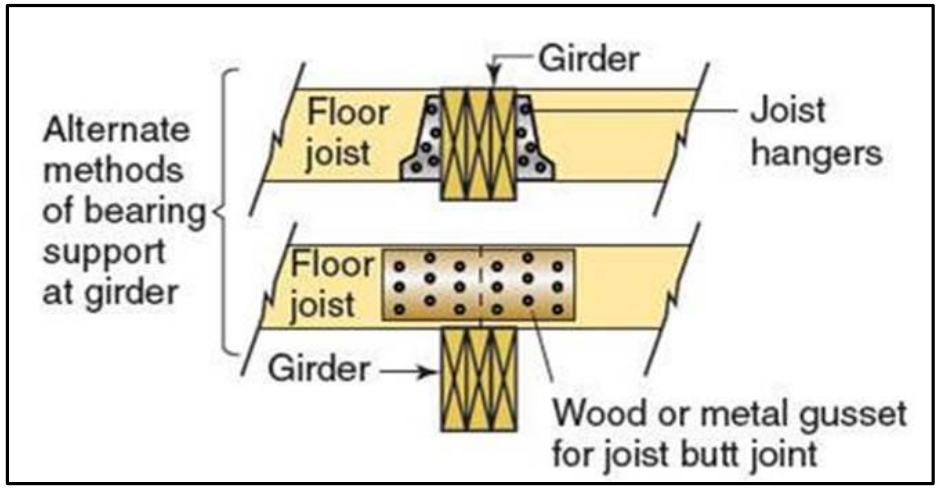
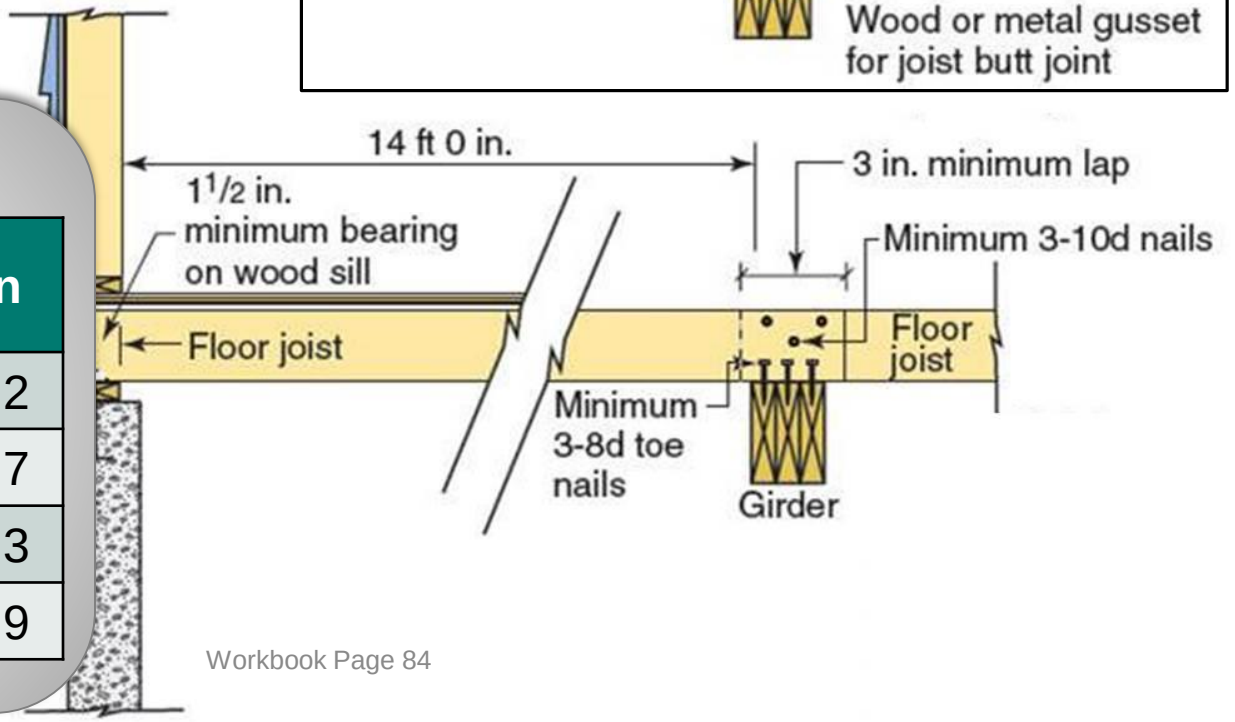


Table R502.3.1(2)

Joist Spacing	Joist Size	Span
12” O.C.	2 x 8	14 – 2
16” O.C.	2 x 10	15 – 7
19.2” O.C.	2 x 10	14 – 3
24” O.C.	2 x 12	14 – 9



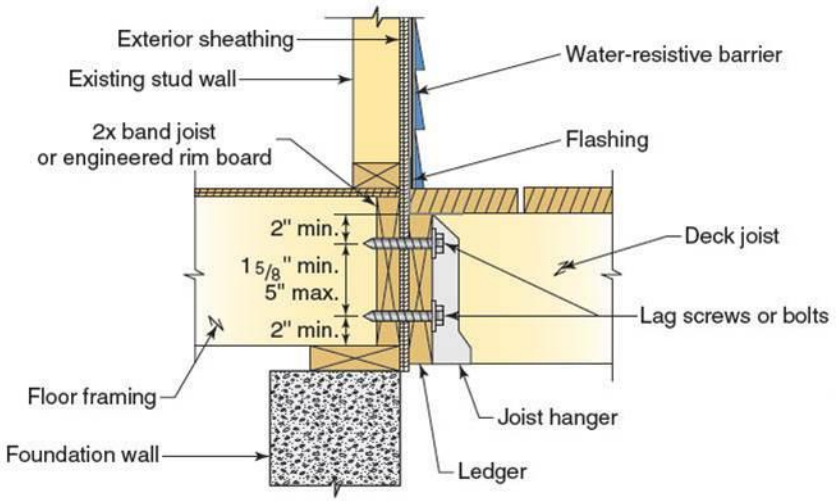
Fastener Schedule for Floor Framing

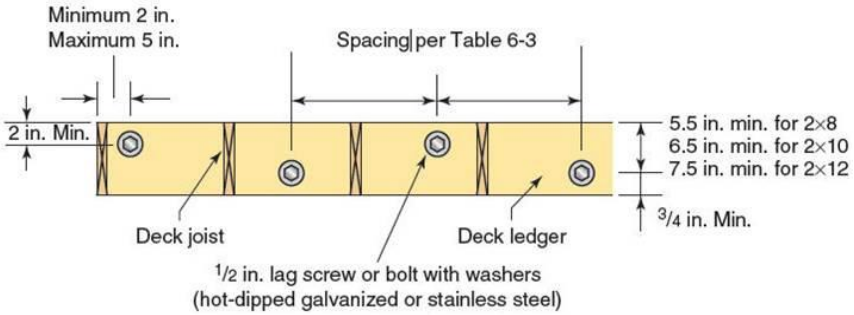
- IRC Table R602.3(1)
  Fastener Schedule for Structural Members
- Common nails

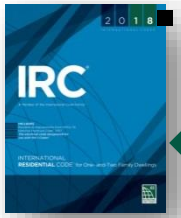
Description	Nails	Spacing
Rim joist to plate, toe nail	8d	6” O.C.
Joist to sill or girder, toe nail	3 - 8d	–
Joists lapped at bearing support, face nail	3 - 10d	IRC Section R502.6.1
Built-up girders and beams	10d	24” O.C. at top and bottom and staggered. Three nails at ends and at each splice.

Deck Attachment

- Deck ledger connection to:
  - 2” band joist; or
  - 1 x 9½ Douglas Fir LVL rim board
- Fasteners
  - ≥½” diameter lag screws or bolts with washers
  - Hot-dipped galvanized or stainless steel
  - Lag screws full-depth through rim joist
  - Fasteners staggered along length of ledger

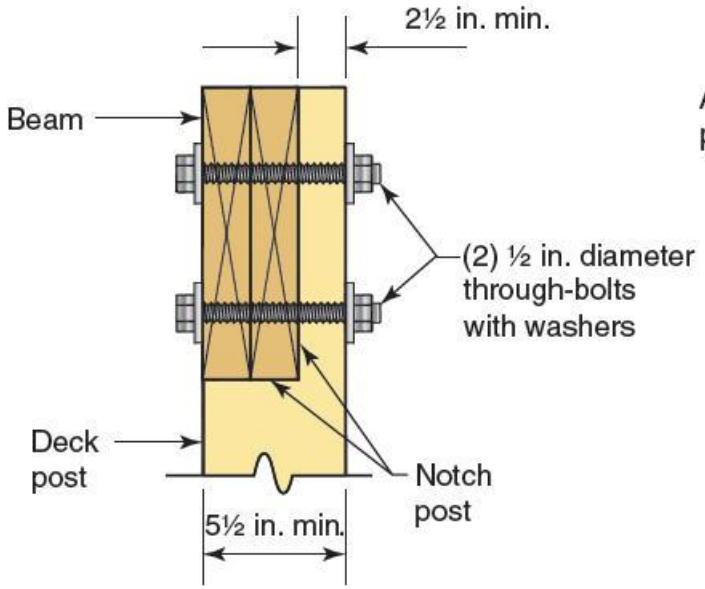




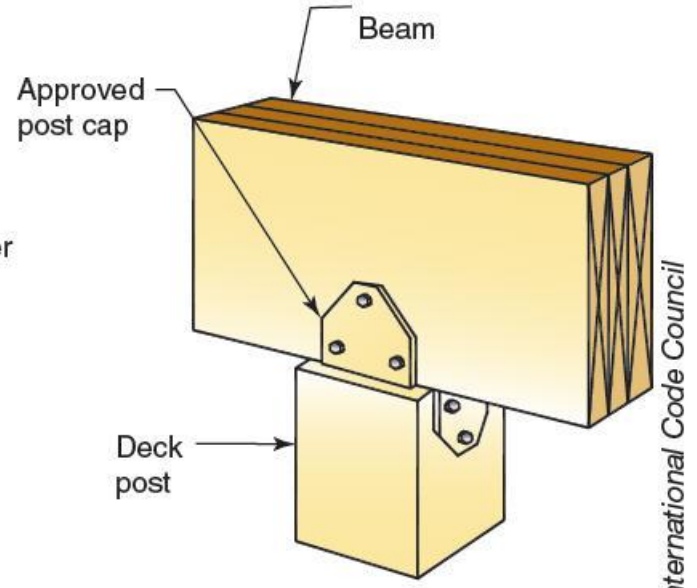


Deck Joists and Beams

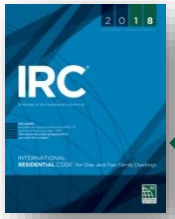
- Prescriptive methods for joists and beams in deck construction.
  - Spans & bearing requirements



Notched post



Post cap



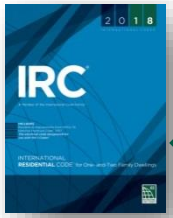
Example 6-3
Deck Footings

- Determine the minimum round concrete footing size for the deck corner post and interior post of a 20-foot x 12-foot free-standing deck based on Table 6-5 and Figure 6-18. The live load is 40 psf and exceeds the snow load. The presumed soil bearing pressure is 2000 psf.

TABLE 6-5 Minimum concrete footing size for decks

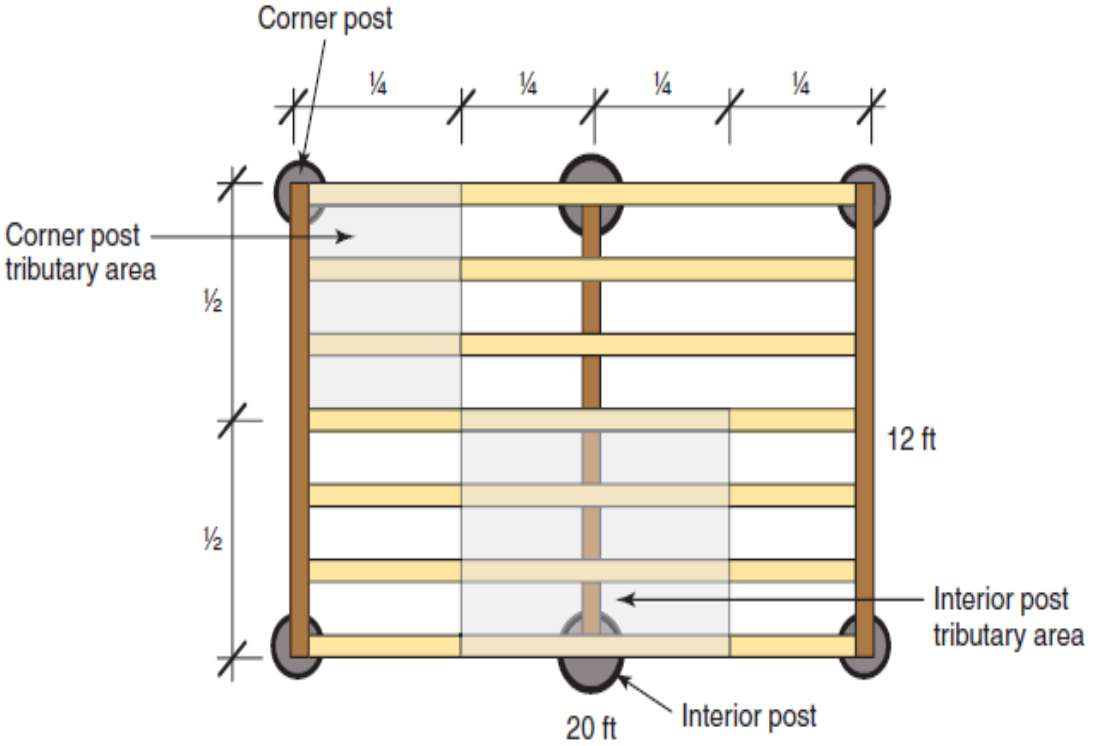
Live or Ground Snow Load (psf)	Tributary area (ft^2)	Load Bearing Value of Soil (psf)					
		1500			2000		
		Side of a square footing (in)	Diameter of a round footing (in)	Thickness (in)	Side of a square footing (in)	Diameter of a round footing (in)	Thickness (in)
40	20	12	14	6	12	14	6
	40	14	16	6	12	14	6
	60	17	19	6	15	17	6
	80	20	22	7	17	19	6
	100	22	25	8	19	21	6
	120	24	27	9	21	23	7
	140	26	29	10	22	25	8
	160	28	31	11	24	27	9

[Ref. Excerpt of Table R507.3.1]



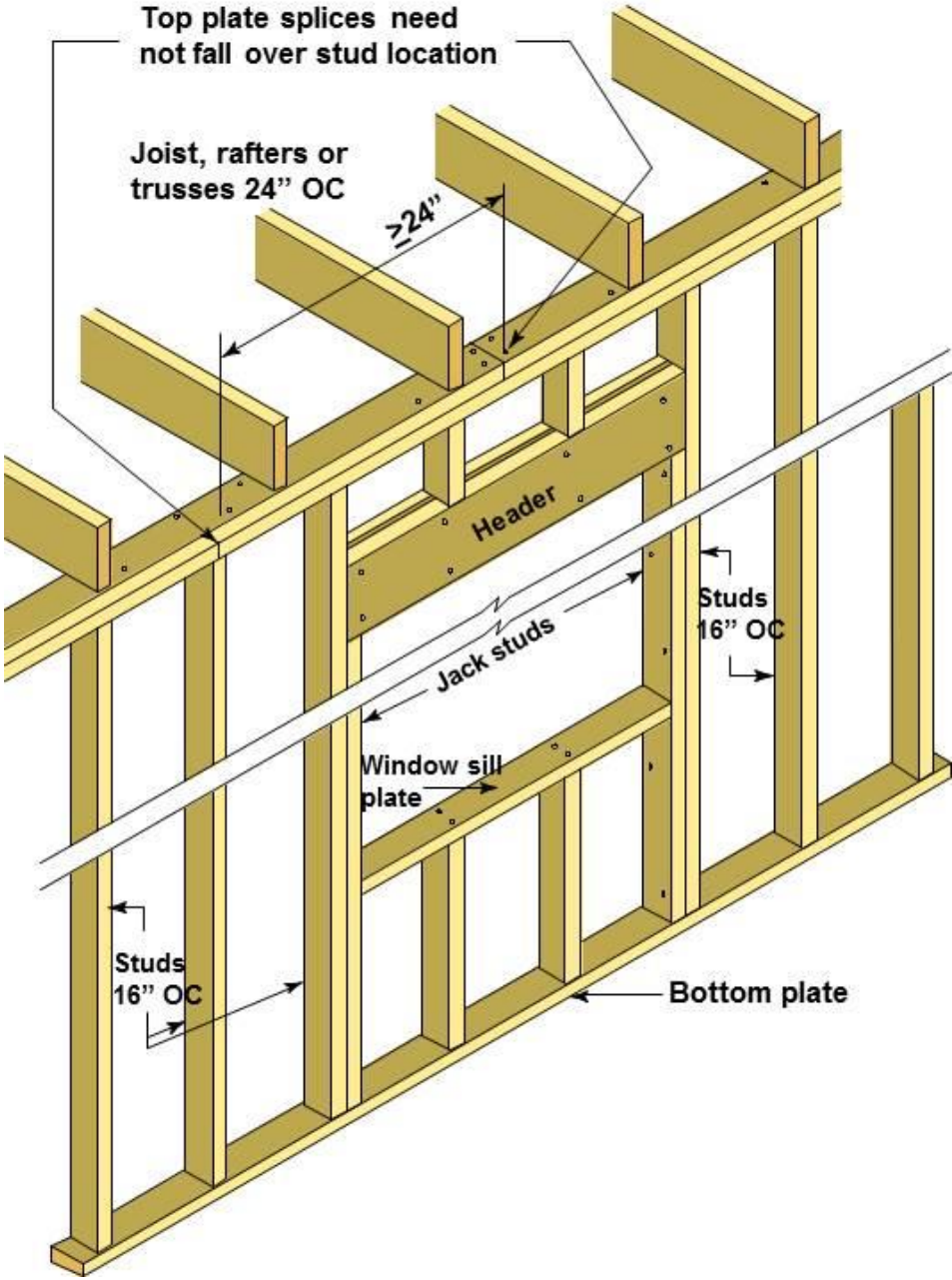
Example 6-3
Deck Footings

- **Tributary area – Corner post**
- Length is ¼ of total length = 20 ft × ¼ = 5 ft Width is ½ of total width = 12 ft × ½ = 6 ft Area = 5 ft × 6 ft = 30 ft^2
- **Tributary area – Interior post**
- Length is ½ of total length = 20 ft × ½ = 10 ft Width is ½ of total width = 12 ft × ½ = 6 ft Area = 10 ft × 6 ft = 60 ft^2
- **Footing size – Corner post**
- Min. 14 in. diameter
- Min. 6 in. thick
- **Footing size – Interior post**
- Min. 17 in. diameter
- Min. 6 in. thick



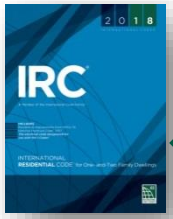
Wall Framing

- Size and spacing of studs is related to:
  - Number of floors being supported
  - With or without the additional load of the roof-ceiling assembly



Example 6-3
Stud Size and Spacing

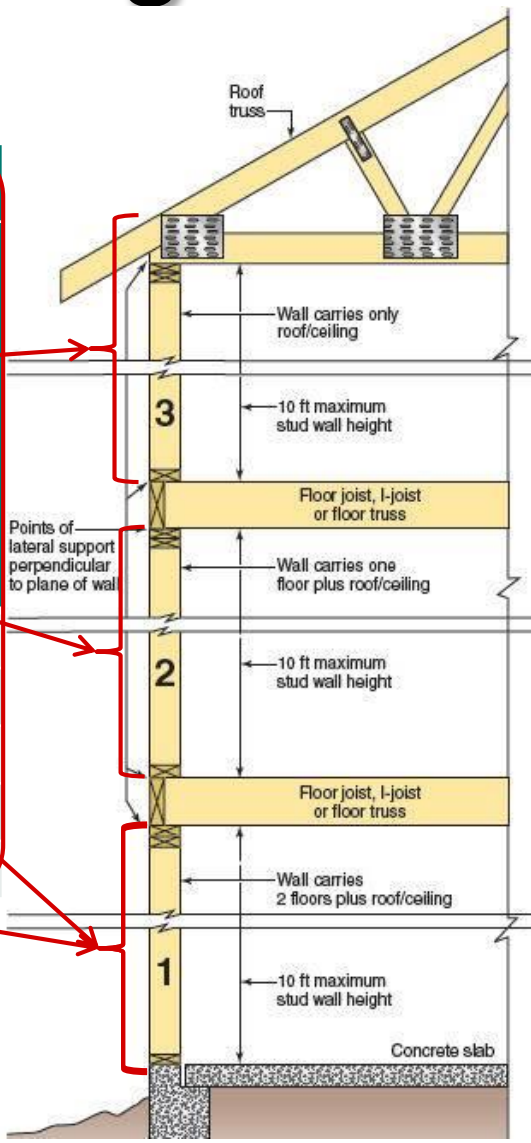
- Determine the minimum size, maximum height and maximum spacing of standard studs in an exterior bearing wall
- Given:
  - 3 stories of wood framing (walk-out basement plus 2 stories)
  - Standard- or stud-grade lumber



Example 6-3
Stud Size and Spacing

- Table R602.3(5)

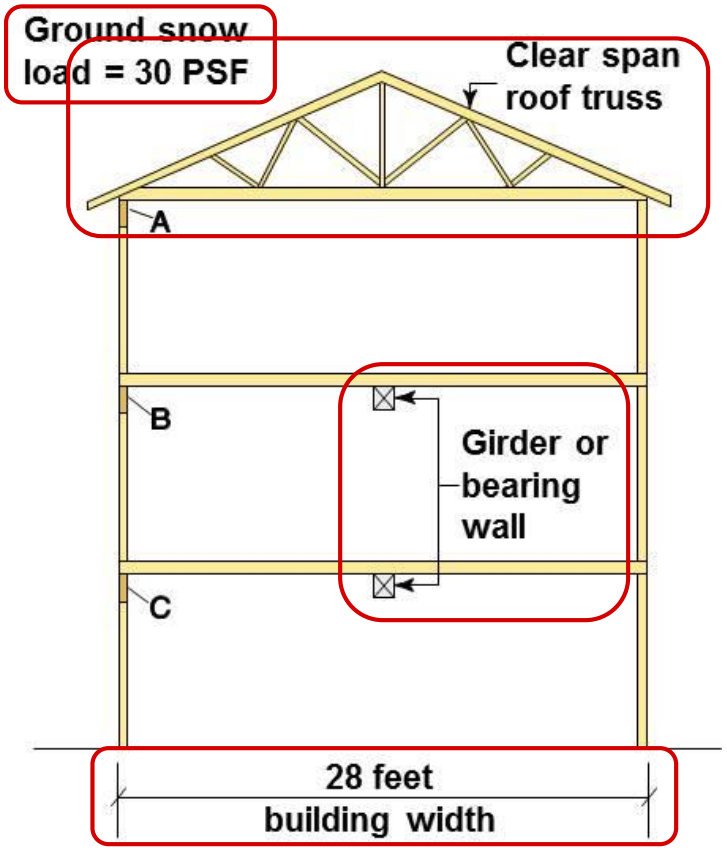
Stud Size (inches)	Bearing Walls					Nonbearing Walls	
	Laterally Unsupported Stud Height (feet)	Maximum Spacing When Supporting a Roof/Ceiling Assembly or a Habitable Attic Assembly Only	Maximum Spacing When Supporting One Floor, Plus a Roof/Ceiling Assembly or a Habitable Attic Assembly	Maximum Spacing When Supporting Two Floors, Plus a Roof/Ceiling Assembly or a Habitable Attic Assembly	Maximum Spacing When Supporting One Floor Only	Laterally Unsupported Stud Height	Maximum Spacing
2 x 3	--	--	--	--	--	10’	16”
2 x 4	10 ft	24”	16”	--	24”	14’	24”
3 x 4	10 ft	24”	24”	16”	24”	14’	24”
2 x 5	10 ft	24”	24”	--	24”	16’	24”
2 x 6	10 ft	24”	24”	16”	24”	20’	24”



Stud height in bearing walls is generally limited to 10’

Example 6-4
Header Size in Exterior Walls

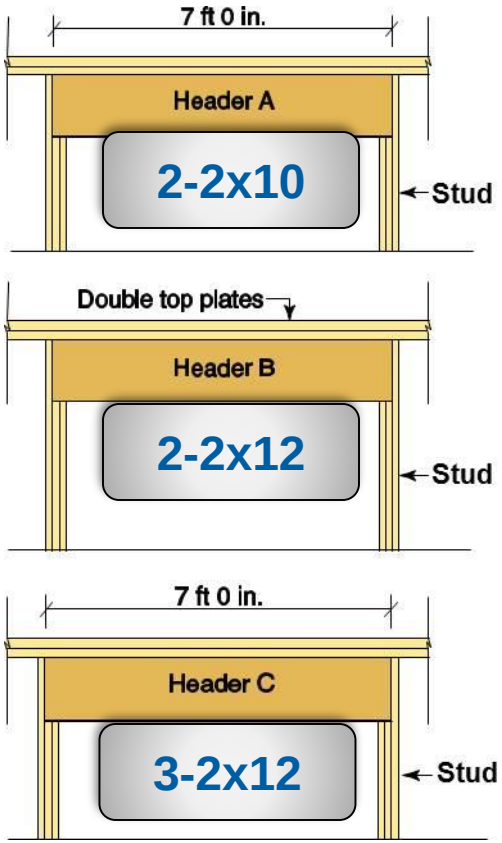
- Given:
  - Ground snow load = 30 psf
  - Clear span roof truss
  - Center bearing floor framing
  - Building width = 28’
  - Header span = 7’
  - #2 Douglas fir-larch



Example 6-4
Header Size in Exterior Walls

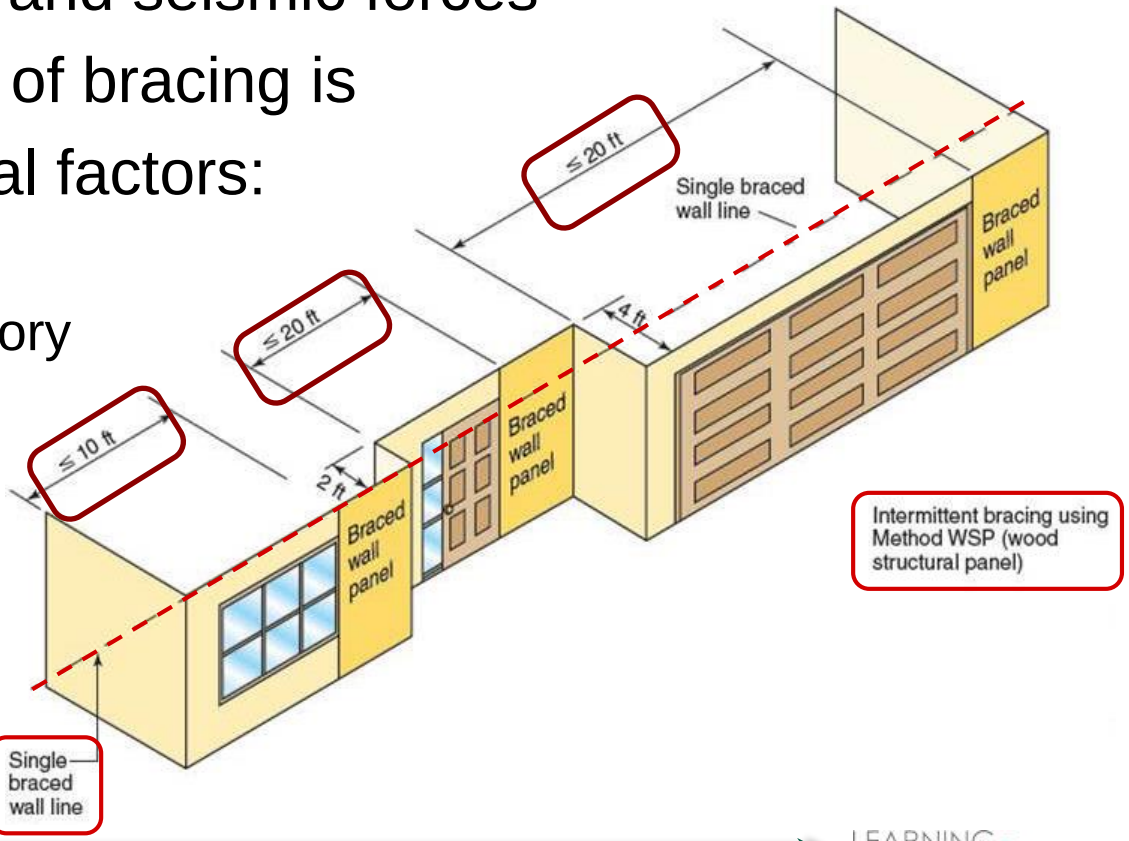
Table R602.7.1

Ground snow load = 30 psf Building width = 28 feet			
Supporting	**Size**	**Span**	**Jack studs**
Roof & Ceiling	2-2x10	7-3	2
	2-2x12	8-5	2
Roof, ceiling, one center-bearing floor	2-2x10	6-2	2
	2-2x12	7-1	2
Roof, ceiling, two center-bearing floors	3-2x10	6-4	2
	3-2x12	7-4	2



Wall Bracing

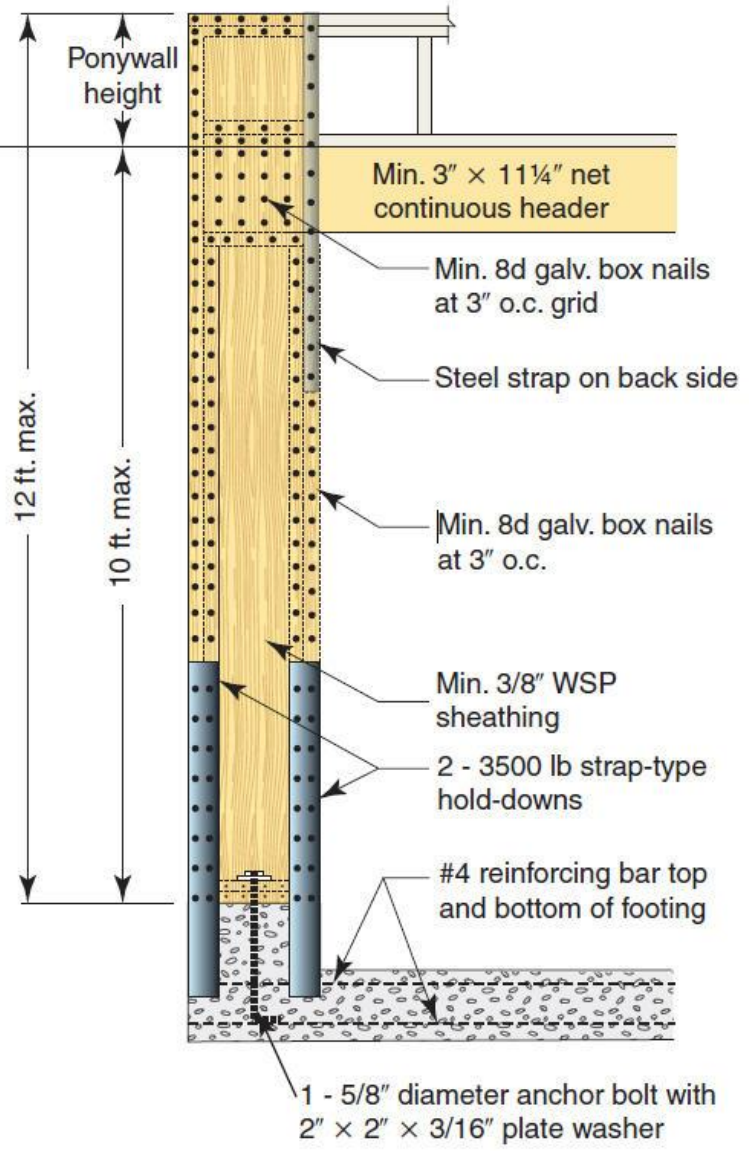
- Wall bracing provides resistance to racking from lateral loads, primarily wind and seismic forces
- Amount and location of bracing is determined by several factors:
  - Number of stories
  - Seismic design category
  - Design wind speed
  - Method of bracing

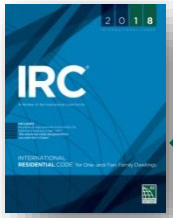


Method PFH Braced Wall Panels

Portal Frame with Hold-Downs

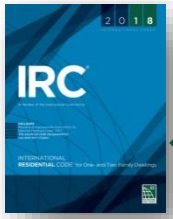
- Minimum hold-down capacity 3500 lbs
- Double sill plate
- 5/8-inch anchor bolt





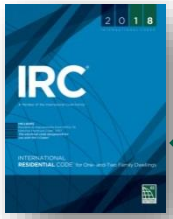
Ceiling Joists

- Ceiling joists
  - Support ceiling materials
  - Serve as rafter ties to resist the outward thrust of the rafters at the top of the wall
  - Require adequate connection to the rafter and top of wall
- Ceiling joist spans for:
  - Attics without storage
  - Attics with limited storage
    - Attics with fixed stair access require joists sized as floor joists



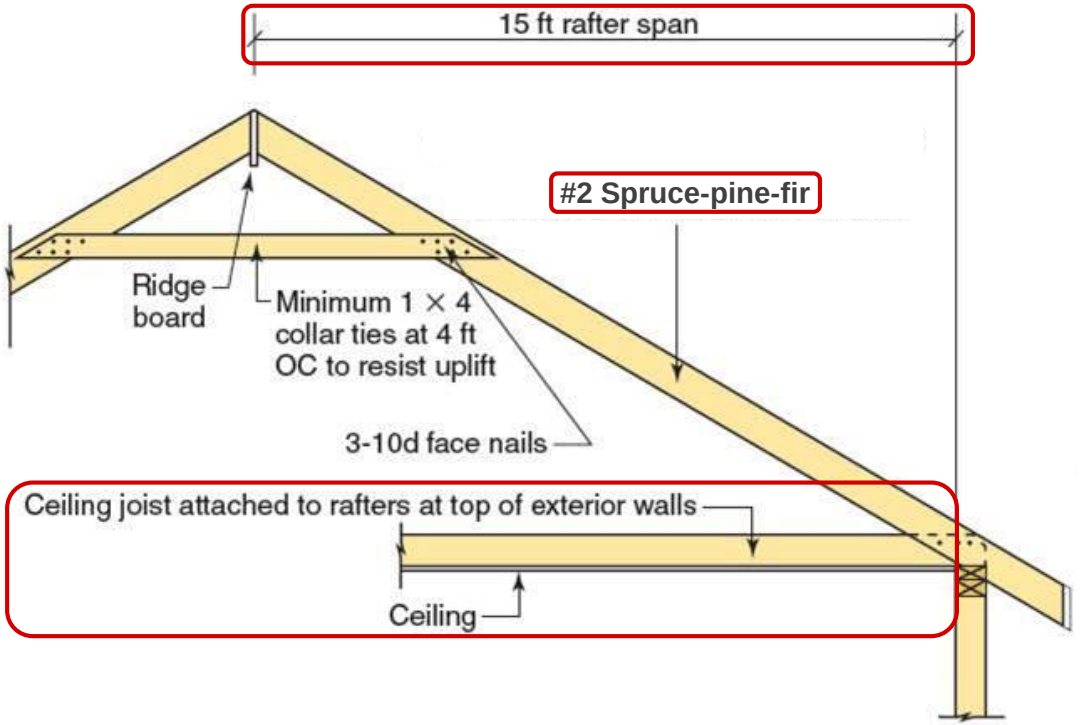
Rafters

- Rafter spans based on:
  - Snow load of the geographic area;
  - Roof live load of 20 psf where snow load <30 psf;
  - Whether ceiling material is attached to the bottom of the rafter
- Connection to ceiling joists
  - Rafters are connected to the ceiling joists at the top plate; or
  - 2 x 4 rafter ties are required to resist the outward thrust forces of the rafters on the wall



Example 6-6
Rafter Size and Spacing

- Given:
  - #2 Spruce-pine-fir lumber
  - Span = 15’
  - Ground snow load = 30 psf
  - Dead load = 10 psf
  - Ceiling not attached to rafters

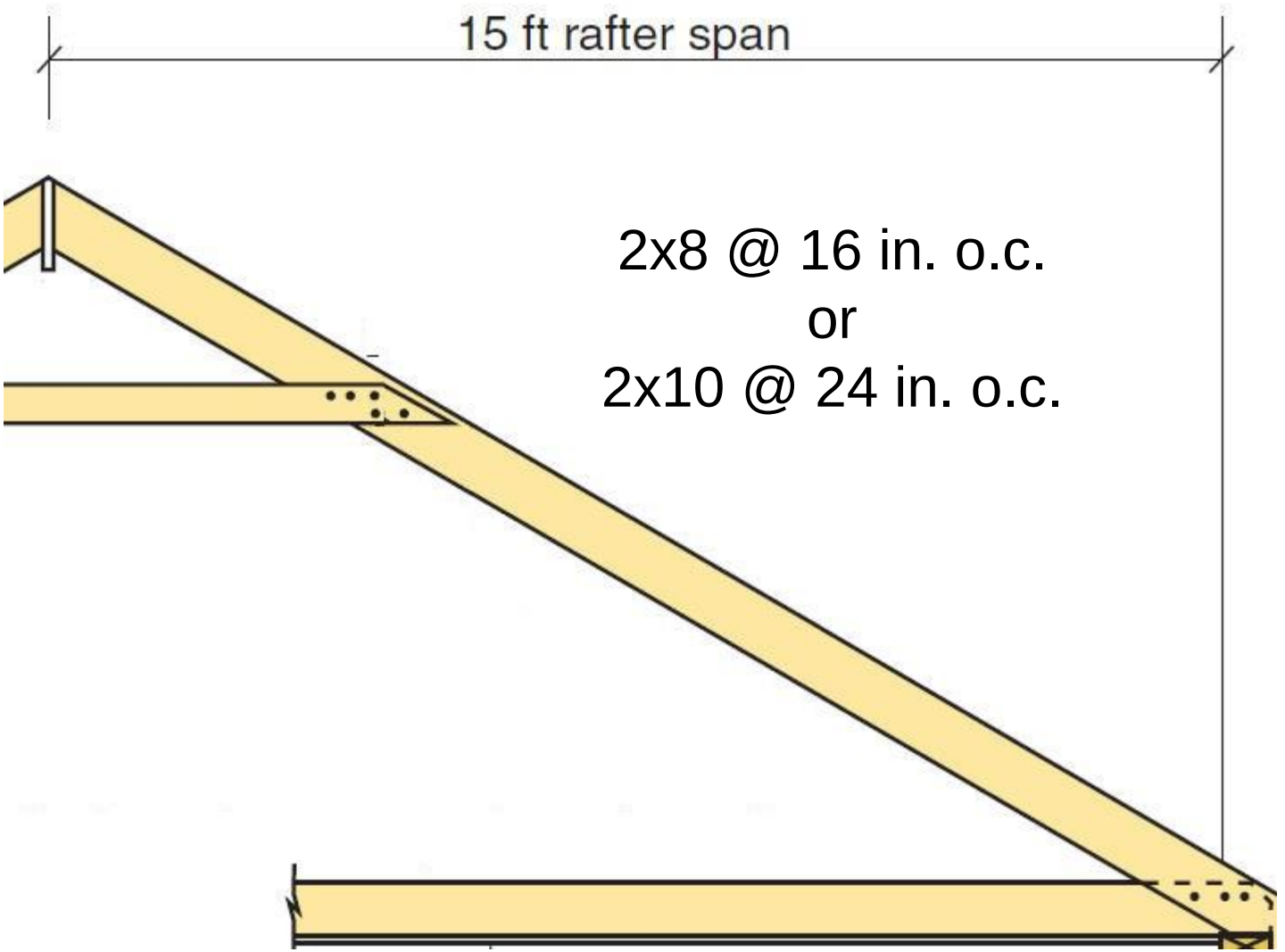


Example 6-6
Rafter Size and Spacing

Table 802.5.1(3) - Rafter Spans

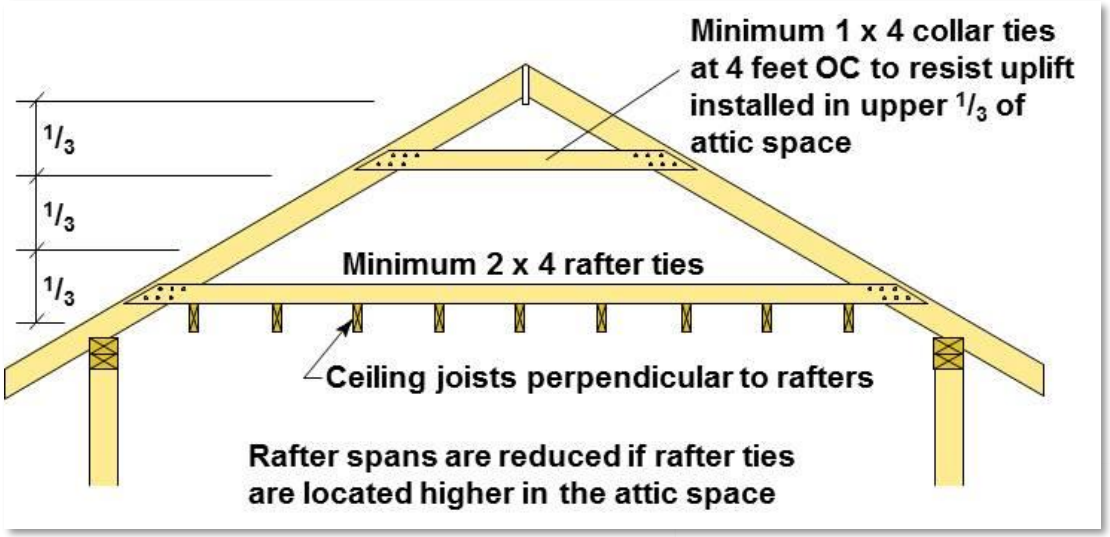
Rafter Spacing (inches)	Species and Grade	Dead Load = 10 psf		
		2 x 6	2 x 8	2 x 10
		Maximum rafter spans		
		ft - in	ft - in	ft - in
16	Douglas fir-larch #2	12-1	15-4	18-9
	Southern Pine #2	11-2	14-2	16-10
	Spruce-pine-fir #2	11-11	15-1	18-5
24	Douglas fir-larch #2	9-9	12-4	15-1
	Southern Pine #2	10-2	13-2	15-9
	Spruce-pine-fir #2	9-9	12-4	15-1

Example 6-6



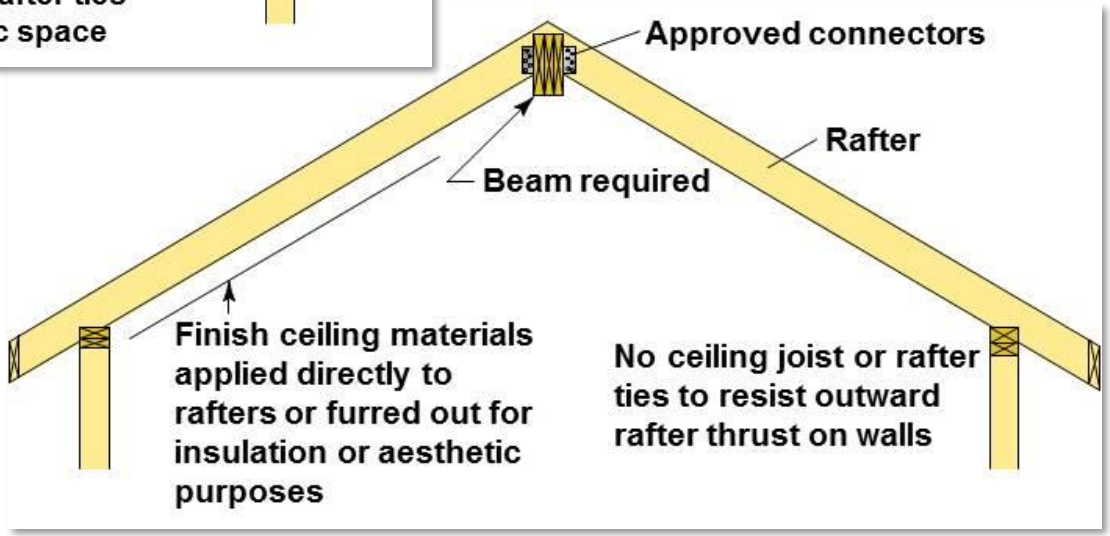
2x8 @ 16 in. o.c.
or
2x10 @ 24 in. o.c.

Rafter Tie Alternatives



- Rafter ties

- Ridge beam



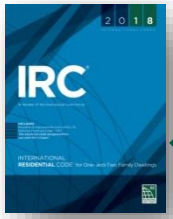
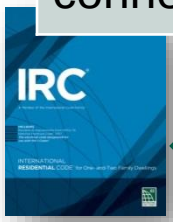


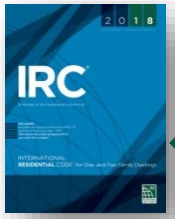
Table R602.3(1)
Fastener Schedule for Roof Framing

Description	Nails	Spacing
Rafter or roof truss to plate, toe nail	3-16d box or 3-10d common	2 toe nails on one side and 1 toe nail on opposite side
Roof rafters to ridge, valley or hip rafters	4-16d toe nail 3-16d face nail	–
Ceiling joists to plate, toe nail	3-8d common	–
Collar tie to rafter, face nail	3-10d common	–
Rafter/ceiling joist heel joint connection	Table R802.5.1(9)	–



Roof Uplift Connections

- Table provides uplift values based on:
  - Building width
  - Wind speed
  - Exposure category
  - Roof pitch
- For ≤200 lbs. uplift, toe-nail connection is OK
- For >200 lbs. uplift, a connector is required



Example
Roof Uplift Connection

- Determine uplift forces
- Given:
  - Wind speed = 115 mph
  - Wind exposure B
  - Trusses 24 in. o.c.
  - Building width = 36 ft
  - Roof slope = 5:12

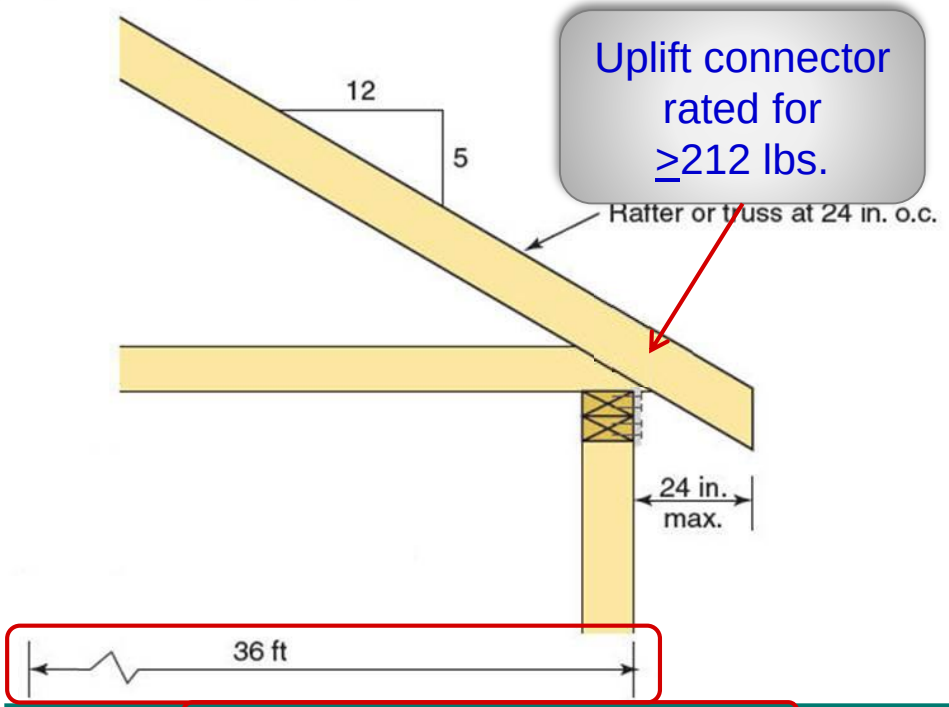
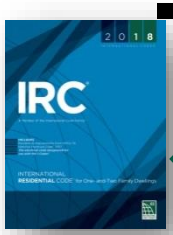


Table R802.11 – Rafter or Truss Uplift Connection Forces from Wind

115 MPH wind speed, Exposure B			
Rafter or Truss Spacing	Roof Span (feet)	Roof Pitch	
		< 5:12	≥ 5:12
24” OC	28	198	176
	32	218	194
	36	240	212

Attic Ventilation and Access

- Total net free ventilating area must be 1/150 of attic area
  - Reduced to 1/300 when 40% to 50% of ventilating area in upper portion of space
  - Unvented attics may be permitted with certain conditions
- Access to attics required when:
  - Attic area >30 ft^2, and
  - Attic height >30”
- Access
  - Minimum 22” x 30”
  - 30” headroom above the opening
  - Located in a hallway or other readily accessible location

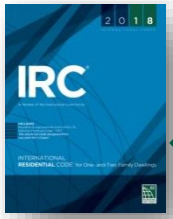


Part IV

Finishes and Weather Protection

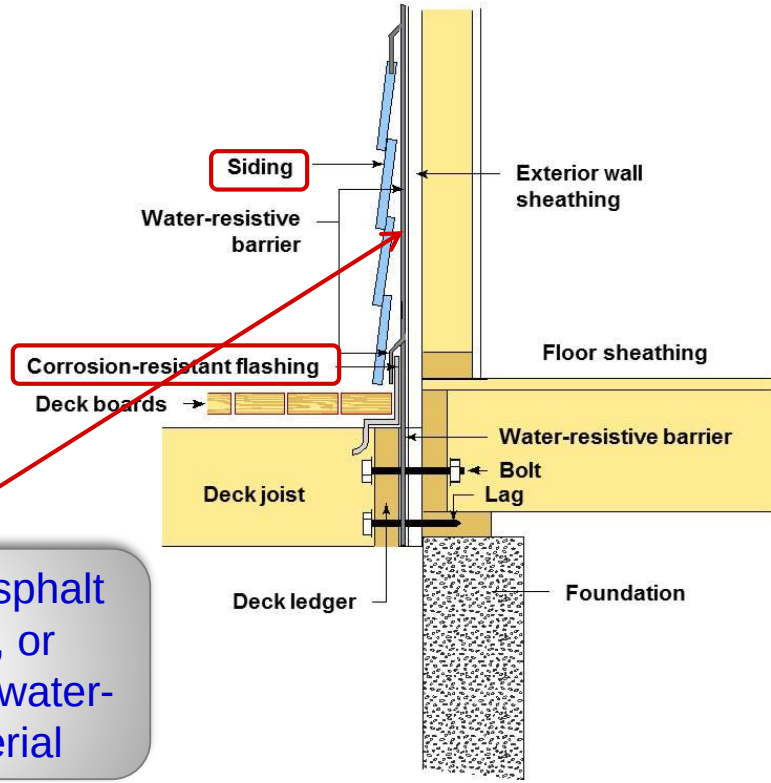
Interior Finishes

- Minimum installation requirements for:
  - Gypsum board (drywall)
  - Plaster
  - Ceramic tile
  - Wood paneling
- Inspection is not required except when part of a fire-resistance-rated assembly

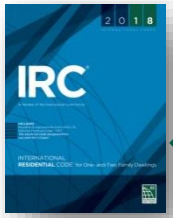


Exterior Wall Covering

- 3 components of a weather-resistant exterior wall assembly:
  - Water-resistive barrier required over sheathing of all exterior walls, except for detached accessory buildings
  - Flashing
  - Siding or veneer

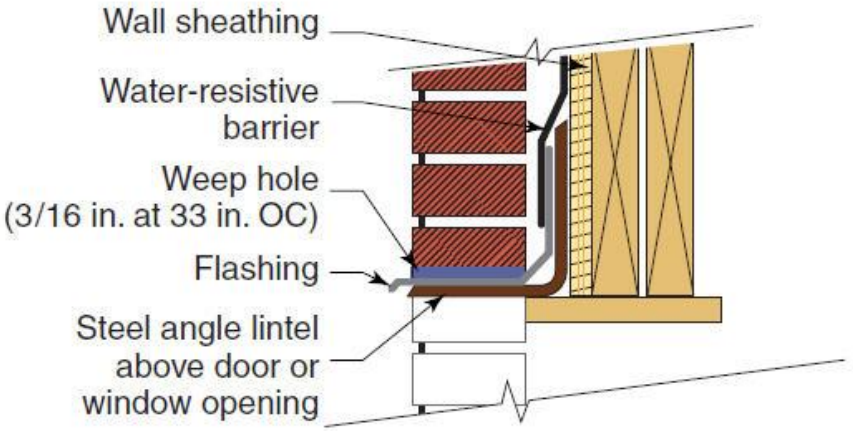


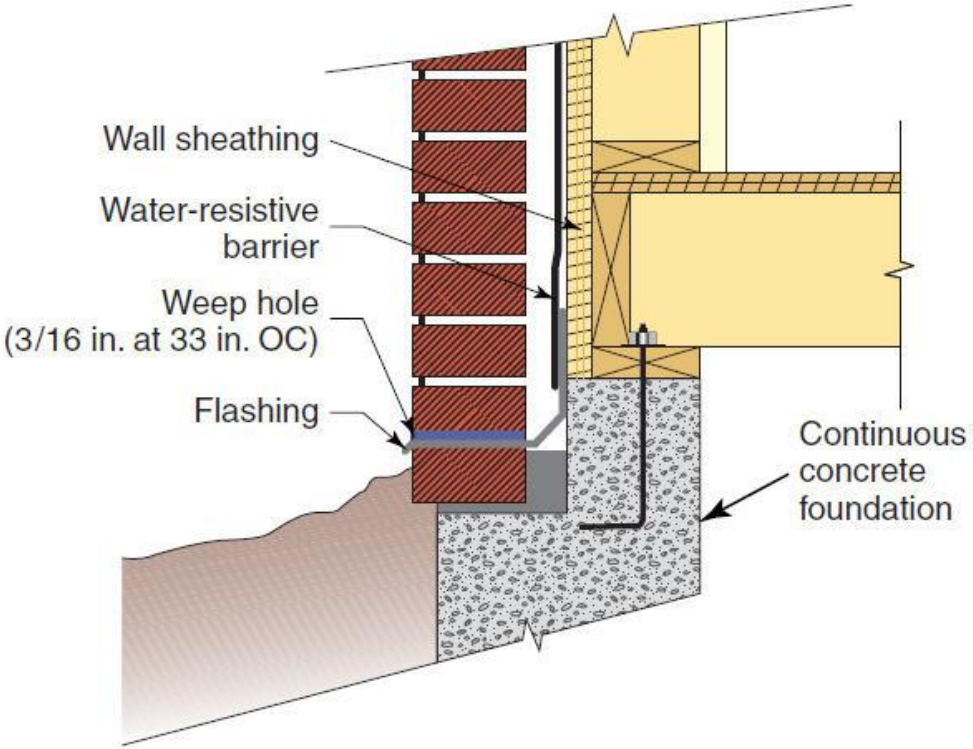
1 layer of #15 asphalt saturated felt, or
Other approved water-resistant material

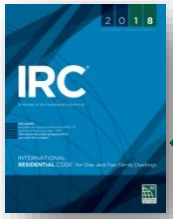


Masonry and Stone Veneer

- SDC A, B or C
  - < 3 stories
  - < 30 feet above noncombustible foundations
  - Additional 8 feet for gable end walls
  - < 5 inches thick
  - Weight < 50 psf weight
- SDC D_0, D_1, or D_2
  - Reduced height, weight and thickness limitations







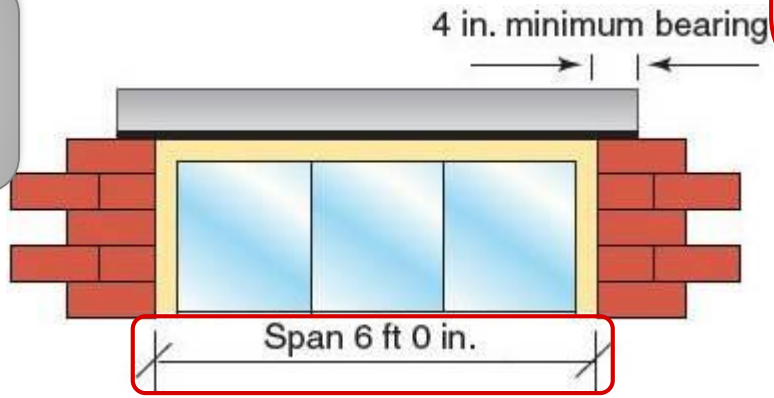
Example 7-1
Size of a Steel Lintel

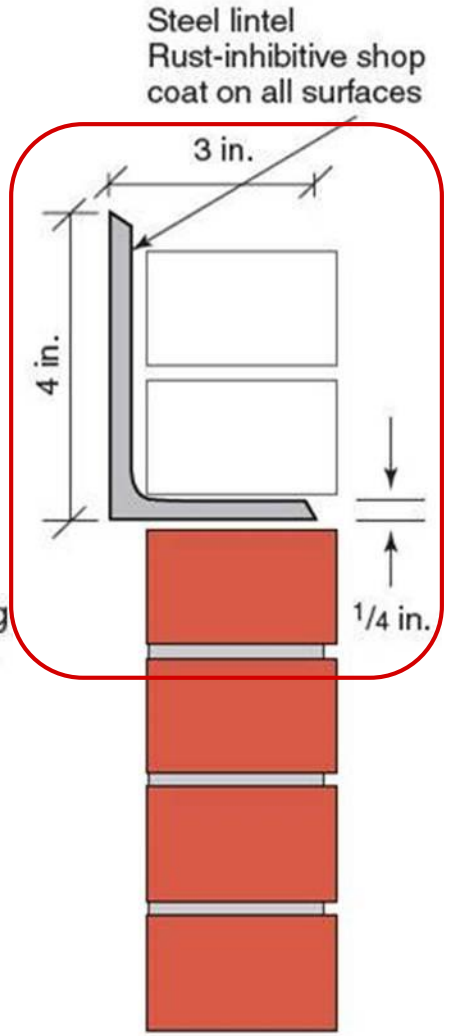
- Determine the minimum size of a steel lintel masonry veneer with 1 story above

Table R703.8.3.1
Allowable Spans for Lintels
Supporting Masonry Veneer

Stories above = 1
Span = 6'0"
Steel angle = 4" x 3" x ¼"

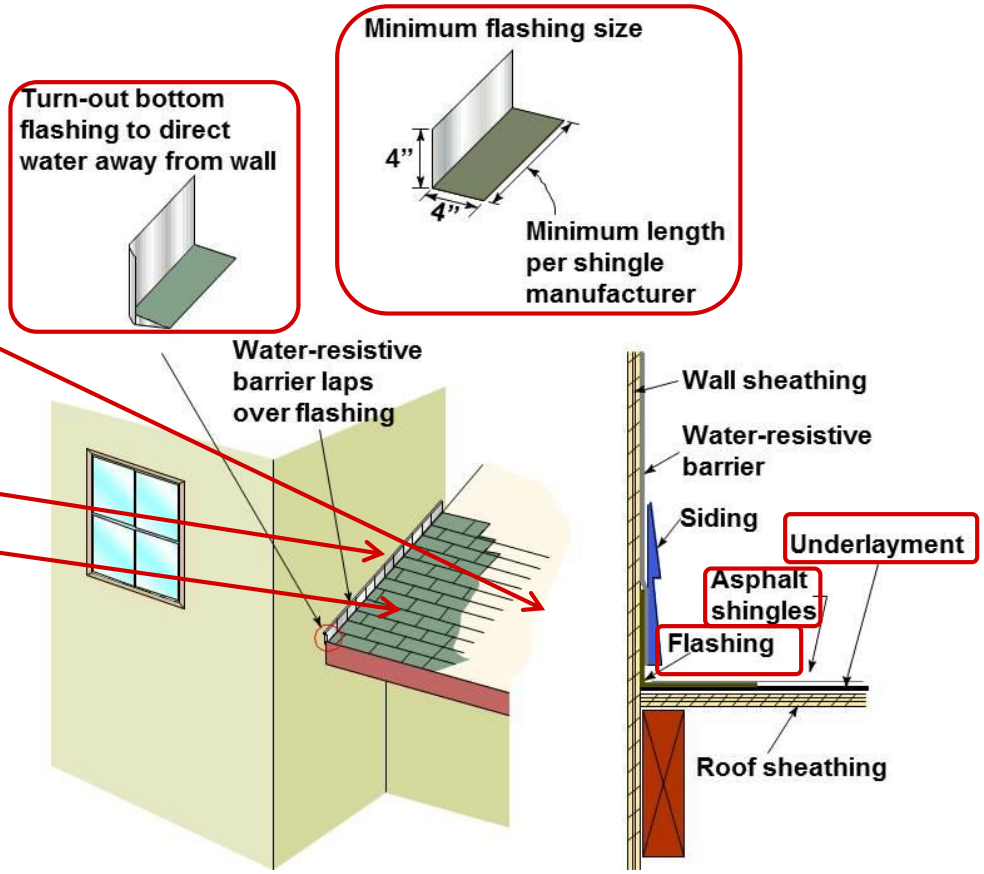
Long side of steel angle must be in the vertical position



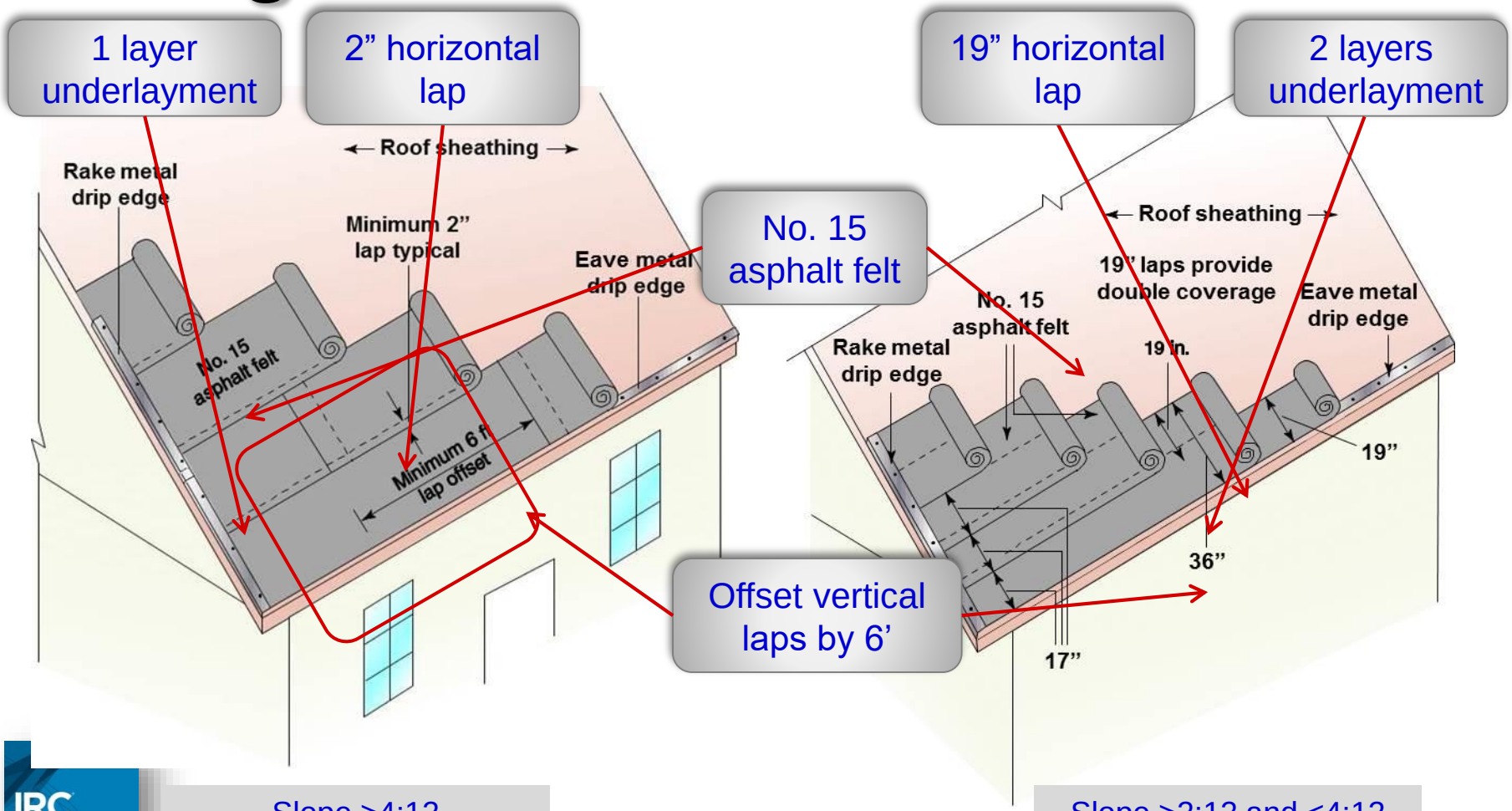


Roof Covering

- Weather protection system:
  - Underlayment
  - Ice barriers
  - Flashing
  - Roofing material

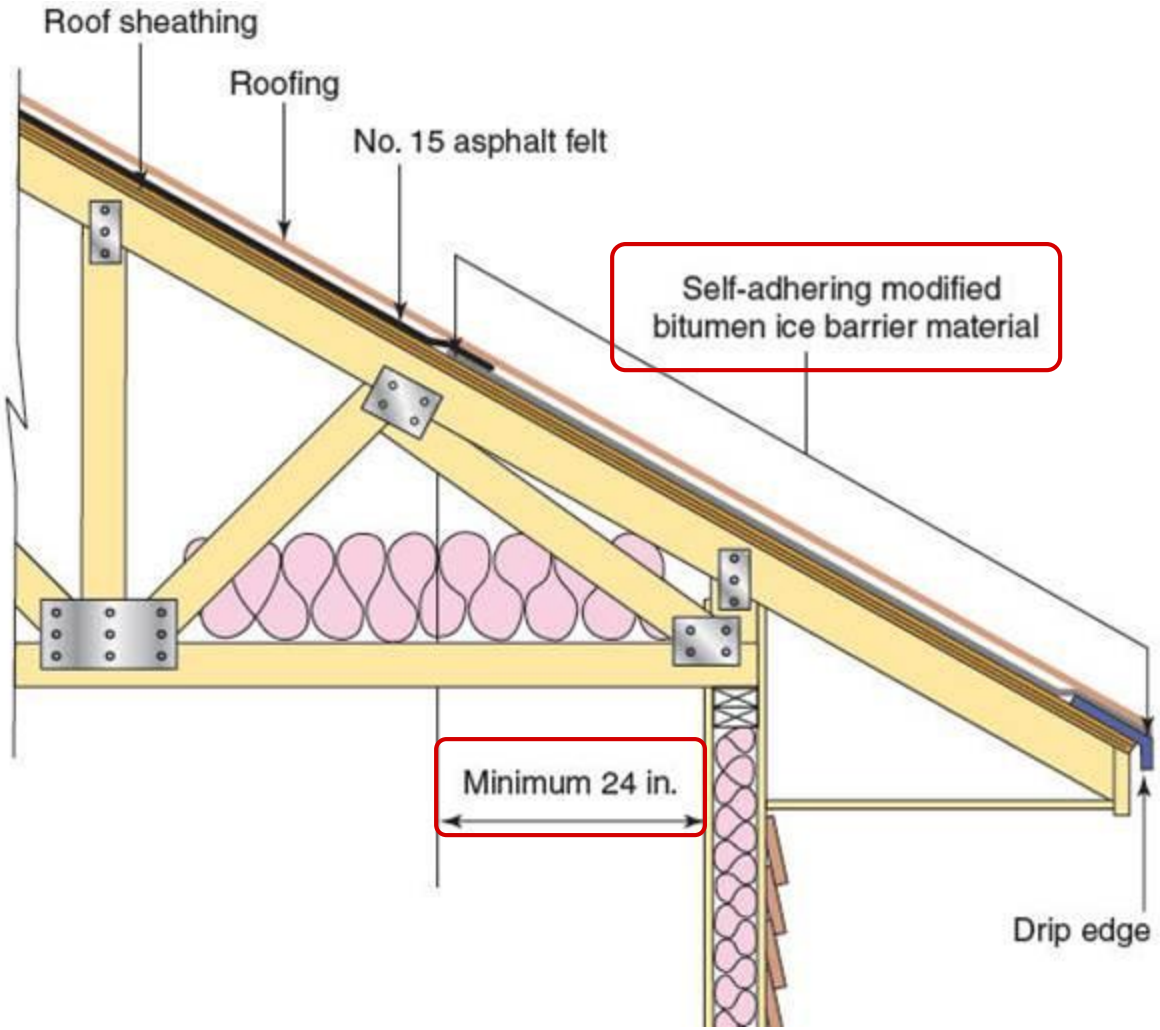


Underlayment for Asphalt Shingles



Ice Barriers

- Ice barrier is required in areas with a history of water damage to structures from ice dams at roof eaves

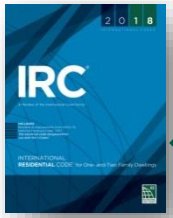


Discussion Activity

Final Reflection

This slide will help the learner to reflect on the day and what they will take back to the job and apply.

- **What?** What happened and what was observed in the training?
- **So what?** What did you learn? What difference did this training make?
- **Now what?** How will you do things differently back on the job as a result of this training?



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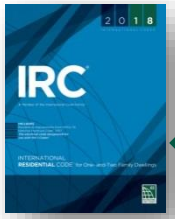

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