2021 IRC Essentials

Based on 2021 International Residential Code® (IRC®)

Use this QR Code or URL to Sign In & Sign Out

(Automates CEU/CPE Credits in “myICC” Account

iccsafe.org/attend

INSTRUCTOR


TIME
FOR
INTRODUCTIONS
Shutterstock

GOAL & OBJECTIVES

Apply the critical concepts and provisions of the 2021 *International Residential Code*®

1) Explain fundamental provisions of 2021 IRC
2) Locate topics and applicable tables in the 2021 IRC
3) Define terms for correct code interpretation
4) Identify code provisions that relate to design, construction or inspection of residential buildings

Tips to be successful

- 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!!!!

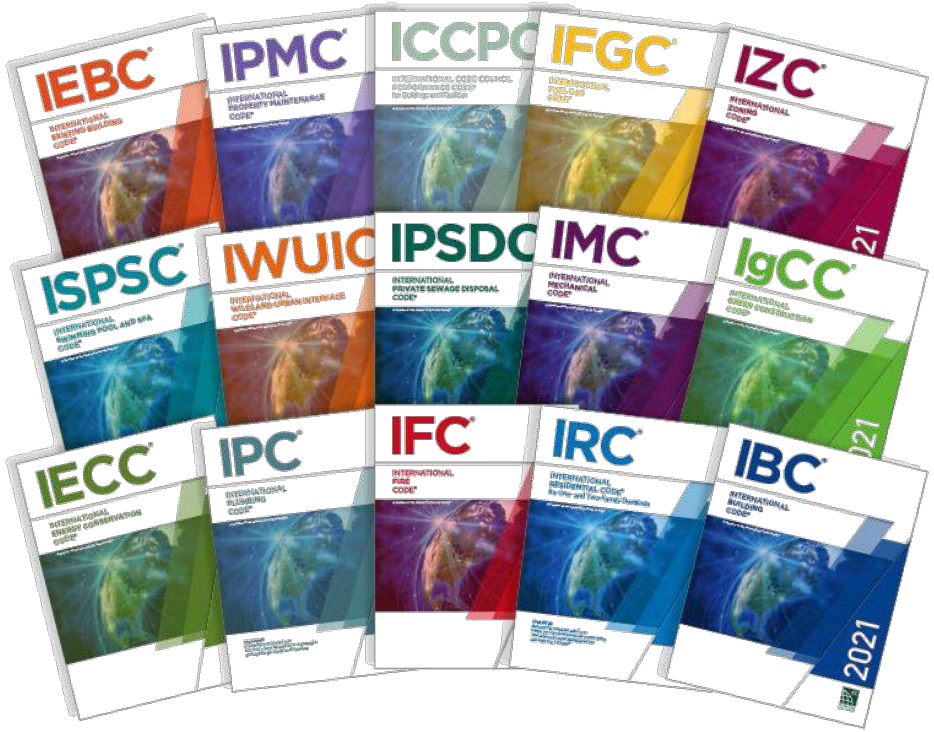
COURSE OUTLINE

- Administration
- Site Development
- Structural
- Finishes & Weather Protection
- Health & Safety
- Building Utilities
- Energy Conservation
- Protection from Other Hazards
- Summary, Q&A and Debrief

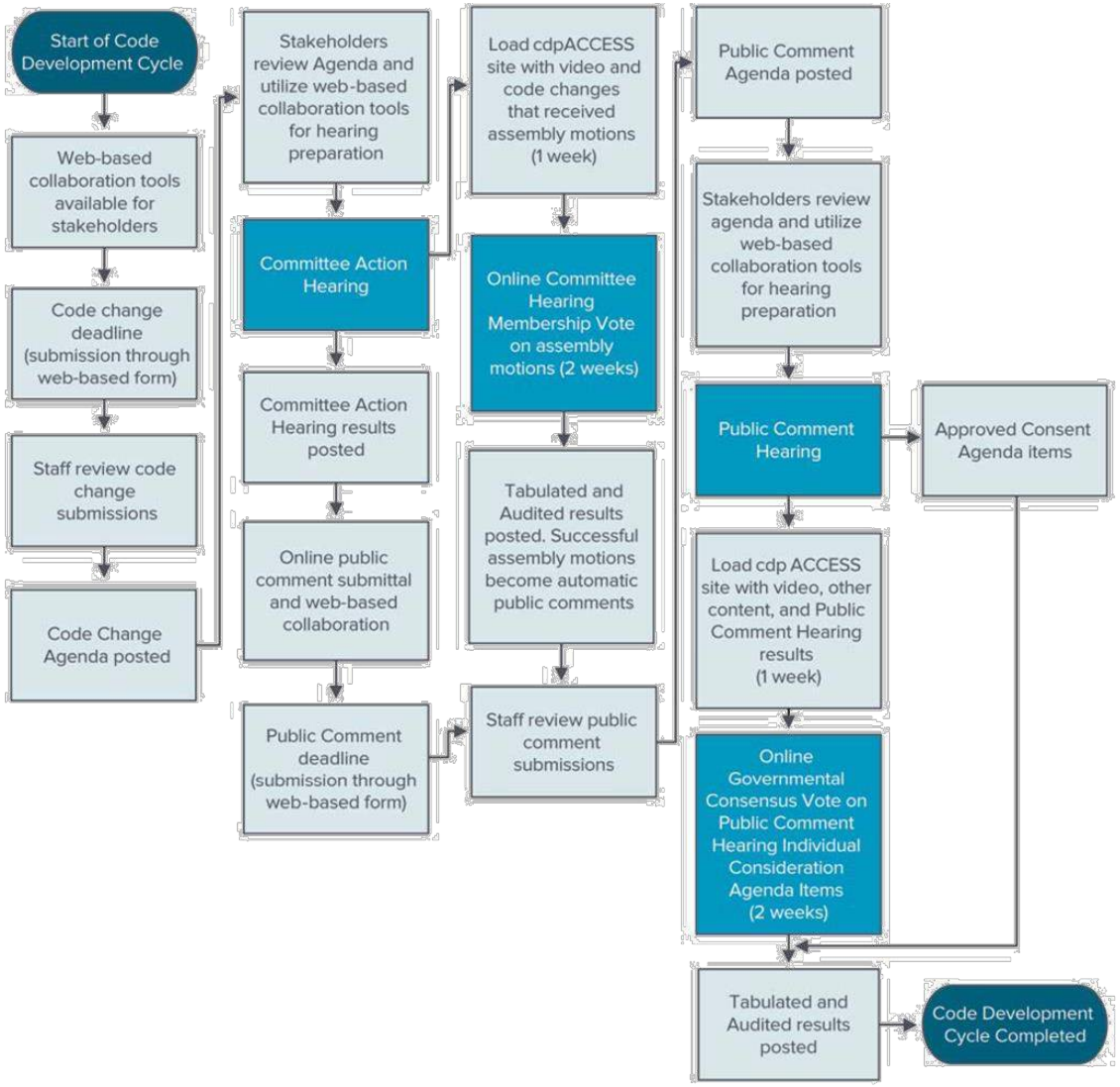
Code Administration

Introduction to Building Codes

- Codes are minimum requirements to safeguard health, safety and welfare of the public and occupants or users of spaces or buildings.



ICC Code Development Cycle



International Residential Code

- Regulates 1- and 2- family dwellings and townhouses
- Combines all regulations into on document

Single-family dwelling

Townhouses

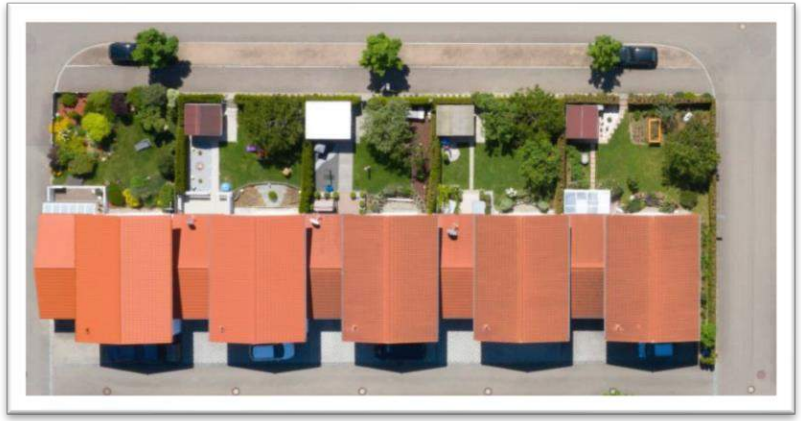
Dwellings and Townhouses

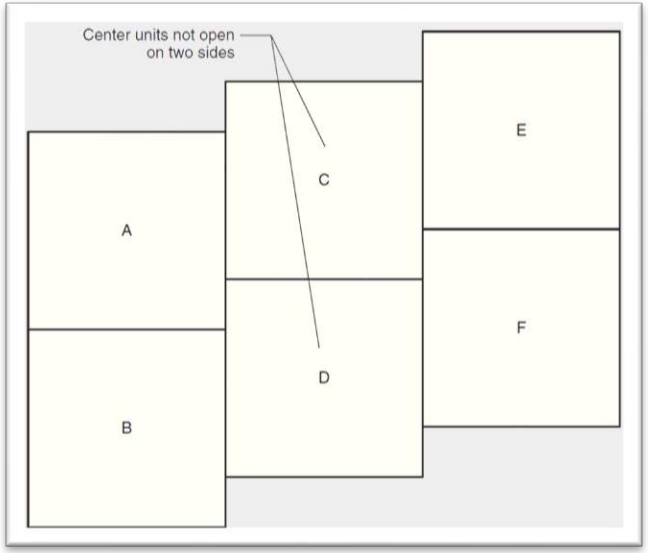
Dwellings

- Separate means of egress for each unit
  - One exterior door
  - Egress travel distance not regulated
- No size limit
- 2- family dwelling require fire-resistant separations

Townhouses

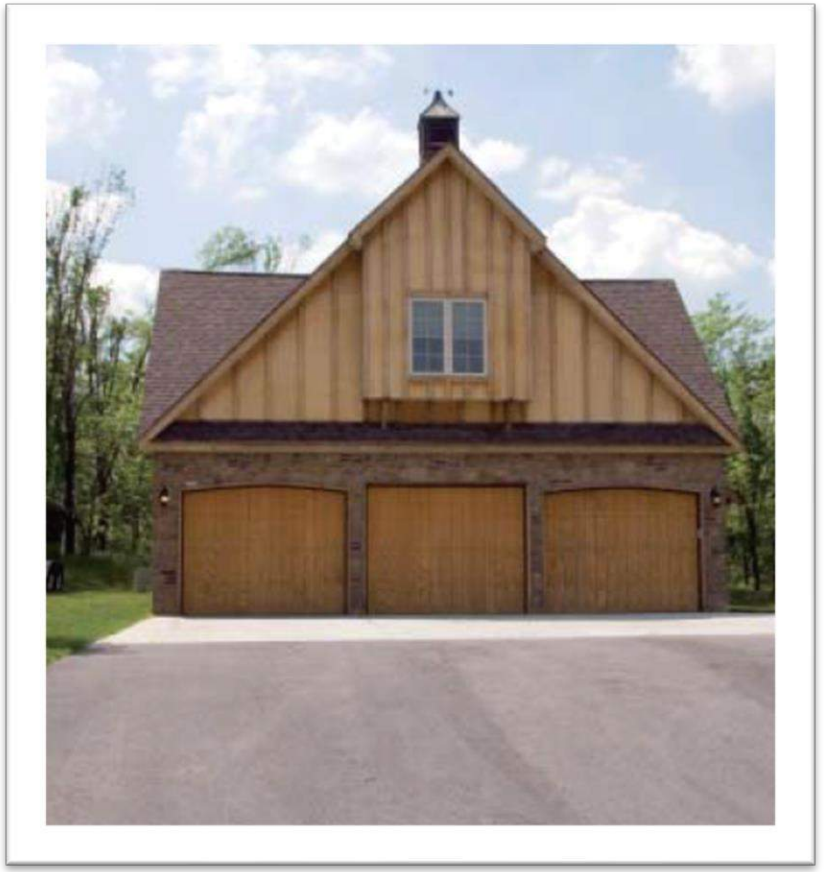
- Minimum of 3 townhouses
- No maximum number of townhouses
- Fire-resistant separations between townhouses
- Open on front and back





Accessory Buildings

- Use incidental and accessory to dwelling
- On same lot as dwelling
- Unlimited area
- ≤ 3 stories AGP



Existing Buildings

- Existing buildings permitted to continue without change
  - Maintained per code under which they were constructed
- IRC regulates additions, alterations and repairs to existing buildings
- Appx J offers compliance alternatives for construction on existing buildings
  - Categorized as repair, renovation, alteration or reconstruction

ORDINANCE NO. 000-18
Residential Building Regulations

An ordinance of the city adopting the 2021 edition of the *International Residential Code*, regulating and governing the construction, alteration, movement, enlargement, replacement, repair, equipment, location, removal and demolition of detached one and two family dwellings and townhouses not more than three stories in height with separate means of egress and their accessory structures in the city providing for the issuance of permits and collection of fees therefore; repealing Ordinance No. 000-18 of the city and all other ordinances and parts of the ordinances in conflict therewith.

- Adopting by local ordinance includes
  - Edition and title of the IRC
  - Purpose and scope
  - Effective date for ordinance
  - Insertion of local information and criteria into code text

Appendices

- Developed same way as main code body
- Provides guidelines of recommended practices
- Assists in determination of alternative methods
- No legal status until recognized in adopted ordinance

APPENDIX AA SIZING AND CAPACITIES OF GAS PIPING

APPENDIX AB SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS, CATEGORY I APPLIANCES AND APPLIANCES LISTED FOR USE WITH TYPE B VENTS

APPENDIX AC EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT-VENT VENTING SYSTEMS

APPENDIX AD RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION

APPENDIX AE MANUFACTURED HOUSING USED AS DWELLINGS

APPENDIX AF RADON CONTROL METHODS

APPENDIX AG PIPING STANDARDS FOR VARIOUS APPLICATIONS

APPENDIX AH PATIO COVERS

APPENDIX AI PRIVATE SEWAGE DISPOSAL

APPENDIX AJ EXISTING BUILDINGS AND STRUCTURES

APPENDIX AK SOUND TRANSMISSION

APPENDIX AL PERMIT FEES

APPENDIX AM HOME DAY CARE—R-3 OCCUPANCY

APPENDIX AN VENTING METHODS

APPENDIX AO AUTOMATIC VEHICULAR GATES

APPENDIX AP SIZING OF WATER PIPING SYSTEM

APPENDIX AQ TINY HOUSES

APPENDIX AR LIGHT STRAW-CLAY CONSTRUCTION

APPENDIX AS STRAWBALE CONSTRUCTION

APPENDIX AT [RE] SOLAR-READY PROVISIONS—DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES

APPENDIX AU COB CONSTRUCTION (MONOLITHIC ADOBE)

APPENDIX AV BOARD OF APPEALS

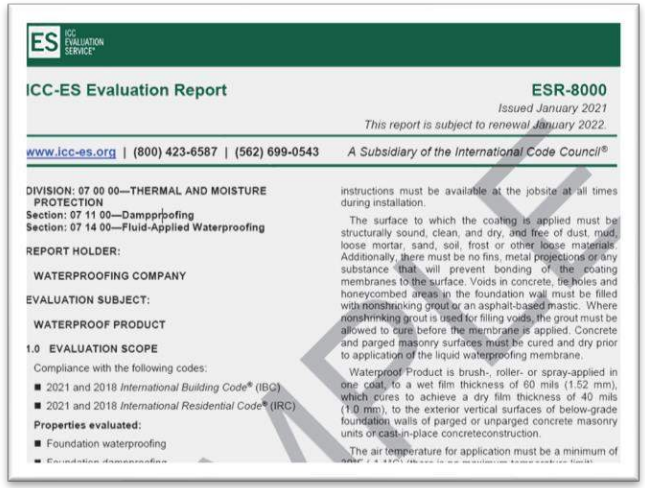
APPENDIX AW 3D-PRINTED BUILDING CONSTRUCTION

Building Official Authority and Duties

- Authorized and directed to
  - Enforce provisions of code and make interpretations
  - Adopt policies and procedures
  - Approve modifications and alternatives
- Not authorized to
  - Waive code requirements
  - Require more than the code

Alternative Methods and Materials

- IRC does not exclude any material or method
- Building Official has an obligation to approve alternatives that meet IRC intent
  - Reports issued by ICC Evaluation Service (ICC-ES) are valuable resources
- Reason for disapproval in writing



ES ICC EVALUATION SERVICE®

ICC-ES Evaluation Report **ESR-8000**

Issued January 2021

This report is subject to renewal January 2022.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 11 00—Dampproofing
Section: 07 14 00—Fluid-Applied Waterproofing

REPORT HOLDER:

WATERPROOFING COMPANY

EVALUATION SUBJECT:

WATERPROOF PRODUCT

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021 and 2018 *International Building Code®* (IBC)
- 2021 and 2018 *International Residential Code®* (IRC)

Properties evaluated:

- Foundation waterproofing

instructions must be available at the jobsite at all times during installation.

The surface to which the coating is applied must be structurally sound, clean, and dry, and free of dust, mud, loose mortar, sand, soil, frost or other loose materials. Additionally, there must be no fins, metal projections or any substance that will prevent bonding of the coating membranes to the surface. Voids in concrete, tie holes and honeycombed areas in the foundation wall must be filled with nonshrinking grout or an asphalt-based mastic. Where nonshrinking grout is used for filling voids, the grout must be allowed to cure before the membrane is applied. Concrete and parged masonry surfaces must be cured and dry prior to application of the liquid waterproofing membrane.

Waterproof Product is brush-, roller- or spray-applied in one coat, to a wet film thickness of 60 mils (1.52 mm), which cures to achieve a dry film thickness of 40 mils (1.0 mm), to the exterior vertical surfaces of below-grade foundation walls of parged or unparged concrete masonry units or cast-in-place concreteconstruction.

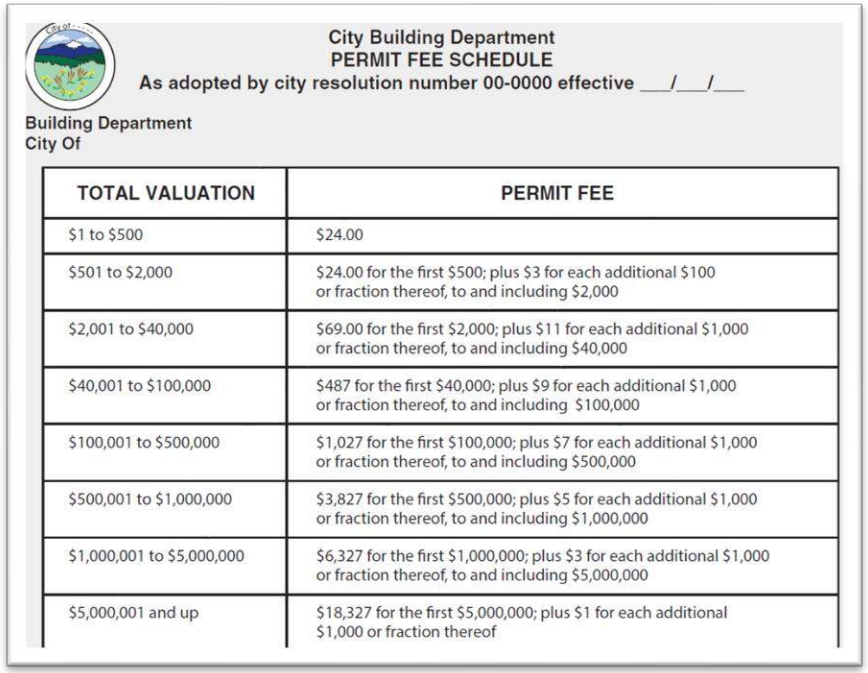
The air temperature for application must be a minimum of

Permits

- Construction requires a permit before work begins
- Exempt work
  - 1-story tool and storage sheds, playhouses, and similar uses ≤ 200 ft^2
  - Decks
    - ≤ 200 ft^2 and ≤ 30” above grade
    - Not attached to a dwelling **and** does not serve required exit door
  - Fences ≤ 7’ height

Fees

- Jurisdiction may charge fees to offset service costs
  - Administration
  - Plan review
  - Inspection
- Building Official develops equitable and consistent procedures for establishing fees



City Building Department
PERMIT FEE SCHEDULE
As adopted by city resolution number 00-0000 effective ___/___/___

Building Department
City Of

TOTAL VALUATION	PERMIT FEE
$1 to $500	$24.00
$501 to $2,000	$24.00 for the first $500; plus $3 for each additional $100 or fraction thereof, to and including $2,000
$2,001 to $40,000	$69.00 for the first $2,000; plus $11 for each additional $1,000 or fraction thereof, to and including $40,000
$40,001 to $100,000	$487 for the first $40,000; plus $9 for each additional $1,000 or fraction thereof, to and including $100,000
$100,001 to $500,000	$1,027 for the first $100,000; plus $7 for each additional $1,000 or fraction thereof, to and including $500,000
$500,001 to $1,000,000	$3,827 for the first $500,000; plus $5 for each additional $1,000 or fraction thereof, to and including $1,000,000
$1,000,001 to $5,000,000	$6,327 for the first $1,000,000; plus $3 for each additional $1,000 or fraction thereof, to and including $5,000,000
$5,000,001 and up	$18,327 for the first $5,000,000; plus $1 for each additional $1,000 or fraction thereof

Required Inspections

- Foundation
- Floodplain
- Plumbing, mechanical, gas and electrical systems
- Frame and masonry
- Fire-resistance-rated construction
- Final inspection

Inspection Record

Building Department
City Of

Permit No. _____

Name _____

Address _____

INSPECTOR SHALL SIGN ALL SPACES WHICH APPLY TO THIS JOB

Inspection Category	Date	Comment	Inspector
Foundation Inspection:			
Setbacks, Footings			
Under Slab Inspections:			
Plumbing			
Mechanical			
Electrical			
Utility Inspections:			
Electrical Service			
Gas Piping/Air Test			
Rough-In Inspections:			
Plumbing			
Mechanical (HVAC)			
Electrical			
Framing			

Board of Appeals

- Public has right of due process to appeal an orders of building official
- Basis for appeal
  - Code has been interpreted incorrectly
  - Code does not apply
  - Equivalent alternative was not accepted
- Board has no authority to waive code requirements

Department of Building Safety

Application for Appeal

Board of Appeals

Building Department
City Of

Project address _____

Use of structure _____

Description of work _____

Owner's name _____ Phone _____

Owner's address _____

In accordance with the provisions of Section R112 of the *International Residential Code for One- and Two-Family Dwellings* (IRC), I hereby appeal to the Board of Appeals the determination made by the building official relative to the interpretation of Section _____, in order that I might construct the above structure or portion thereof as proposed and shown on the attachments.

Appellant is advised to submit any documentation in support of the appeal. An application for appeal shall be based on a claim that the true intent of the code has been incorrectly interpreted, the provisions of the code do not fully apply, or an equally good or better form of construction is proposed. The board has no authority to waive requirements of the code. Appellant and any interested party may appear to present reasons for granting an appeal at the time of the scheduled meeting.

_____

Signature of owner or appellant Date

Meeting date _____

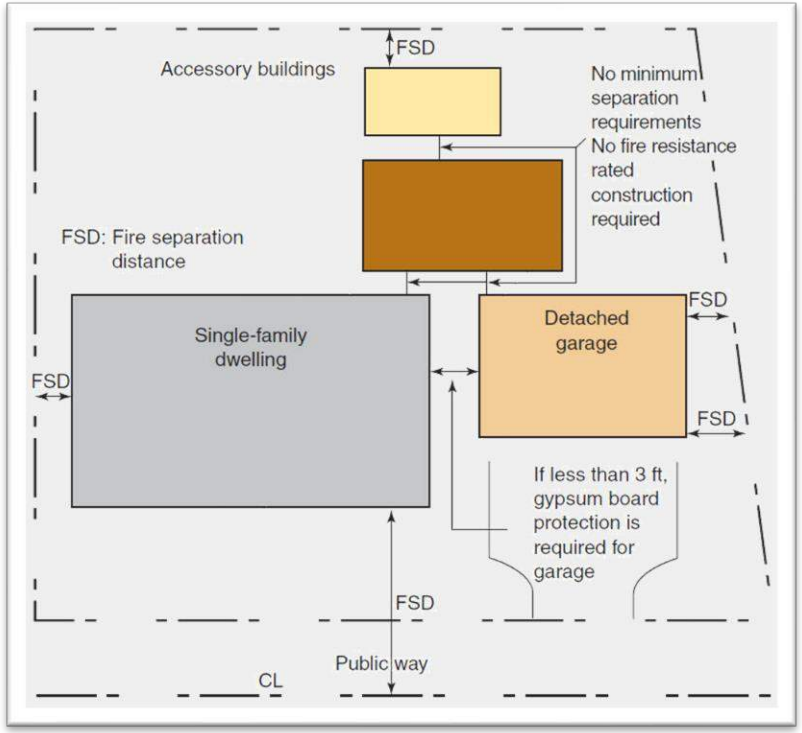
Time _____

Location _____

Site Development

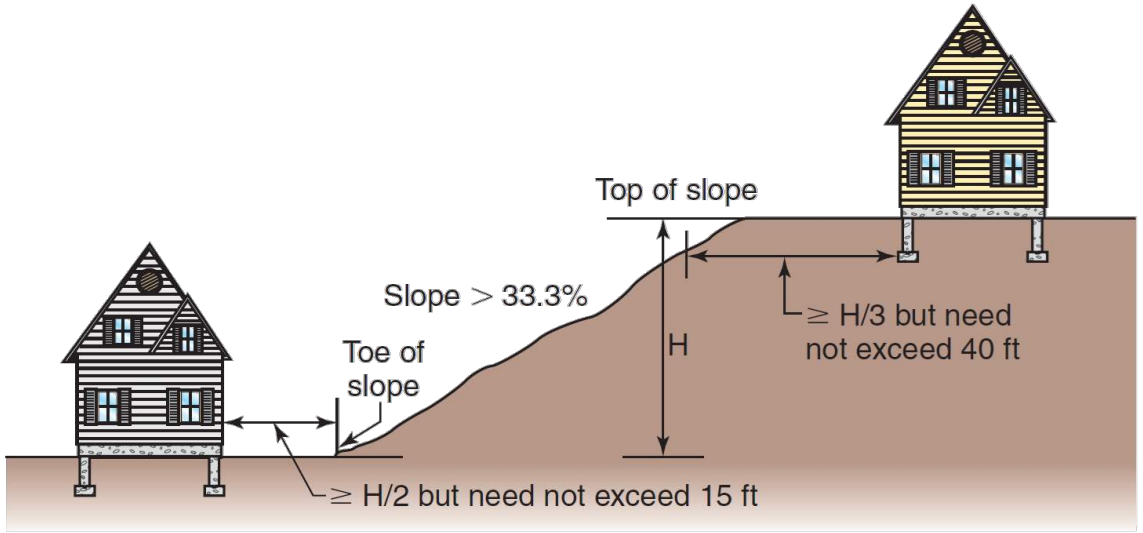
Location on Property

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



Site Preparation

- Two basic provisions
  - Soil characteristics related to foundation support and stability
  - 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

Load-bearing Values & Properties of Soils

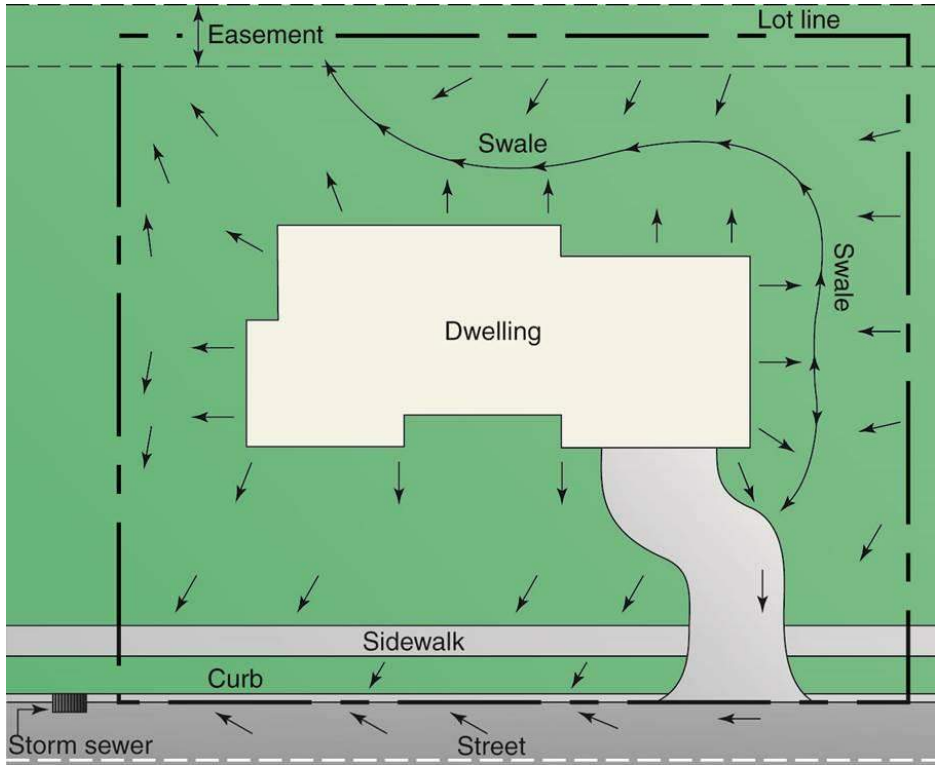
Unified Soil Classification System Symbol	Soil Description	Load Bearing Pressure (psf)	Drainage Characteristics	Frost Heave Potential	Volume Change Potential Expansion
GW	Well-graded gravels, gravel sand mixtures, little or no fines	3000	Good	Low	Low
GP	Poorly graded gravels or gravel sand mixtures, 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 mixtures	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

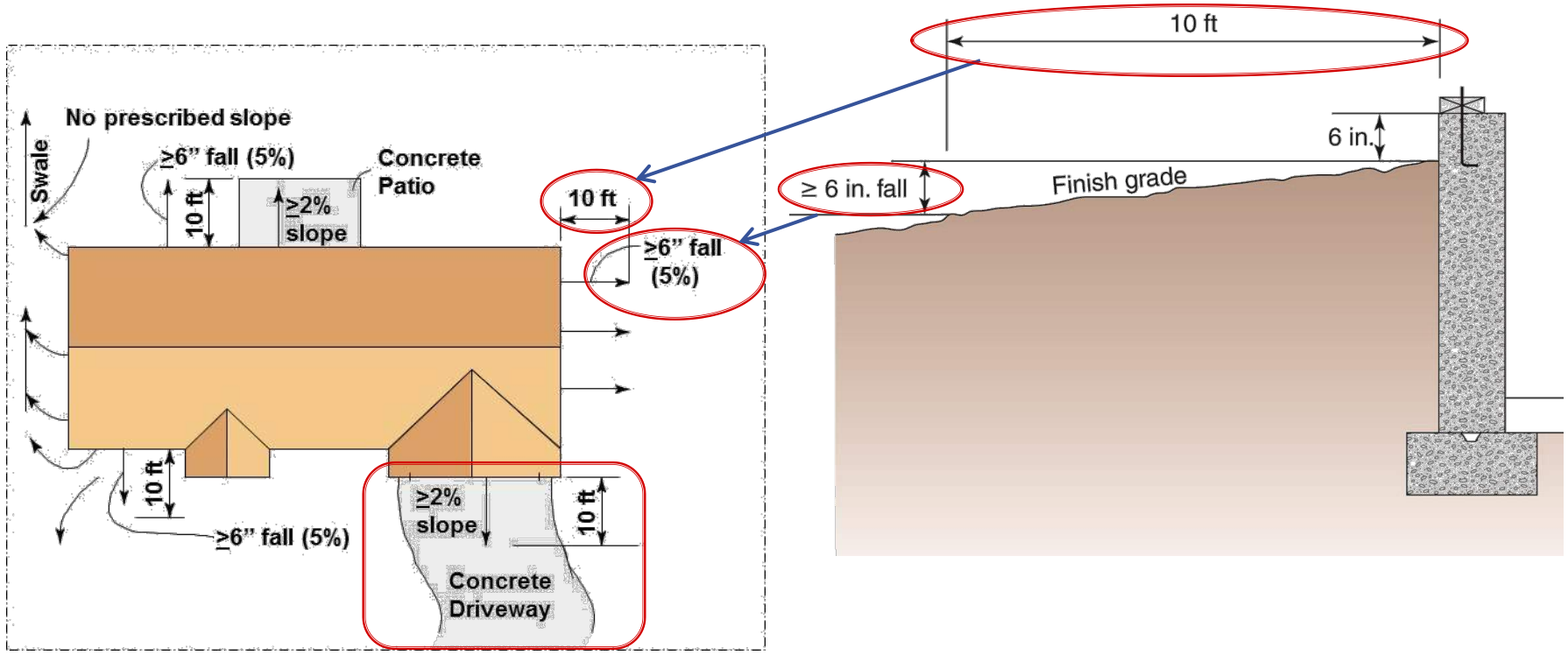
- Engineered fill is required for
  - Over-excavation to remove unsuitable soils
  - Additional material to raise footing elevation above existing undisturbed soil
- Engineered fill must be
  - Designed by a registered design professional
  - Installed and tested as specified in design requirements

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 foundation need 2% slope



Storm Drainage



Structural

Climatic & Geographic Design Criteria

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

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

Climatic & Geographic Design Criteria

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

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

Climatic & Geographic Design Criteria

Flood Hazards	Air Freezing Index	Mean Annual Temp
Date NFIP, Etc.	1197	51° F

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

Climatic & Geographic Design Criteria

Manual J Design Criteria						
Elevation	Altitude Correction Factor	Coincident Wet Bulb	Indoor Winter Design Relative Humidity	Indoor Winter Design Dry-Bulb Temp.	Outdoor Winter Design Dry-Bulb Temp.	Heating Temp. Difference
Latitude	Daily Range	Summer Design Grains	Wind Velocity Cooling	Indoor Summer Design Dry-Bulb Temp.	Outdoor Summer Design Dry-Bulb Temp.	Cooling Temp. Difference

Prescriptive and Performance

- Prescriptive requirements
  - Specific set of rules to follow
- Performance requirements
  - Expectation that systems will function 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 code limits or
    - Are not included in the code
- Wood framing alternative
  - *Wood Frame Construction Manual* published by American Wood Council
    - WFCM addresses wind speeds up to 195 mph
    - IRC wind speeds <140 mph

Live Loads

USE	LOAD (psf)
Attics without storage	10
Attics with limited storage	20
Habitable attics and attics served by fixed stairs	30
Sleeping areas	30
Areas other than sleeping areas and stairs	40
Balconies (exterior) and decks	40
Passenger vehicle garages	50

Minimum Uniformly Distributed Loads

Live Loads

USE	LOAD (lbs)	NOTES
Guard in-fill components	50	Horizontally applied on area of 1 ft^2
Handrails	200	Applied in any direction
Guards	200	Applied downward and outward if not acting as a handrail
Stairs	300	300-lb concentrated load / 4 in^2
Passenger vehicle garages	2,000	Applied on 4.5” x 4.5” area for elevated garage floors

Minimum Concentrated Loads

Dead Loads

- Average dead loads included in prescriptive tables
  - Footings
  - Floors
  - Walls
  - Roofs

DESCRIPTION	WEIGHT (PSF)
Roof dead load (framing, sheathing, asphalt shingles, insulation, drywall)	10
Exterior wall (2 × 4 framing, sheathing, siding, insulation, drywall)	11
Floor (joist, sheathing, carpeting, drywall)	10
Concrete wall, 8 in. thick	100
10 in. thick	125
12 in. thick	150
Solid CMU (density 125 pcf) wall, 8 in. thick	81
Hollow CMU (density 125 pcf) wall, 8 in. thick, grout at 48" o.c.	44

Deflection

- Allowable deflection in structural framing members
  - Studs
  - Joists
  - Beams
  - Rafters

STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters, slope > 3/12, no finished ceiling attached to rafters	L/180
Rafters, slope > 3/12, gypsum board ceiling attached to rafters	L/240
Gypsum board ceilings	L/240
Plaster ceilings	L/360
Floors	L/360
All other structural members	L/240

[Ref. Table R301.7]

Floor Joist Deflection

- Floor joist span is 14’
- Allowable deflection is L/360

  L = 14’ x 12” = 168”

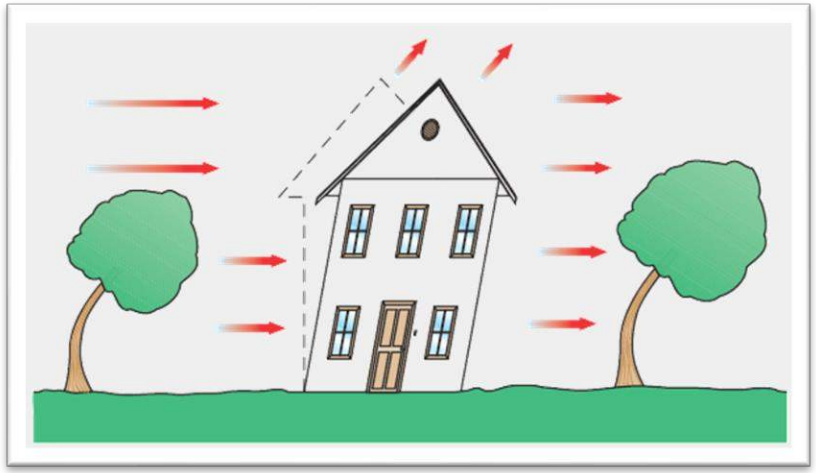
  168 ÷ 360 = 0.47

  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

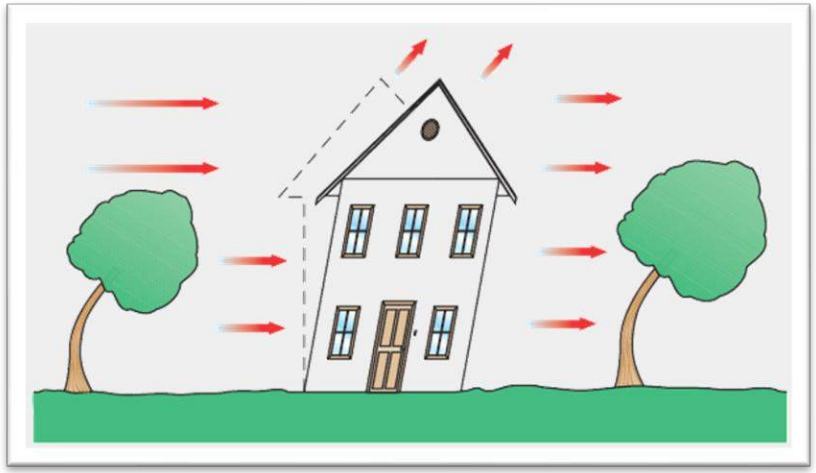
Wind Loads 1

- IRC conventional framing limits wind speed to 140 mph
  - 130 in hurricane prone areas
- AWC – *Wood Frame Construction Manual* (WFCM)
- ICC 600 – *Standard for Residential Construction in High-Wind Regions*



Wind Loads 2

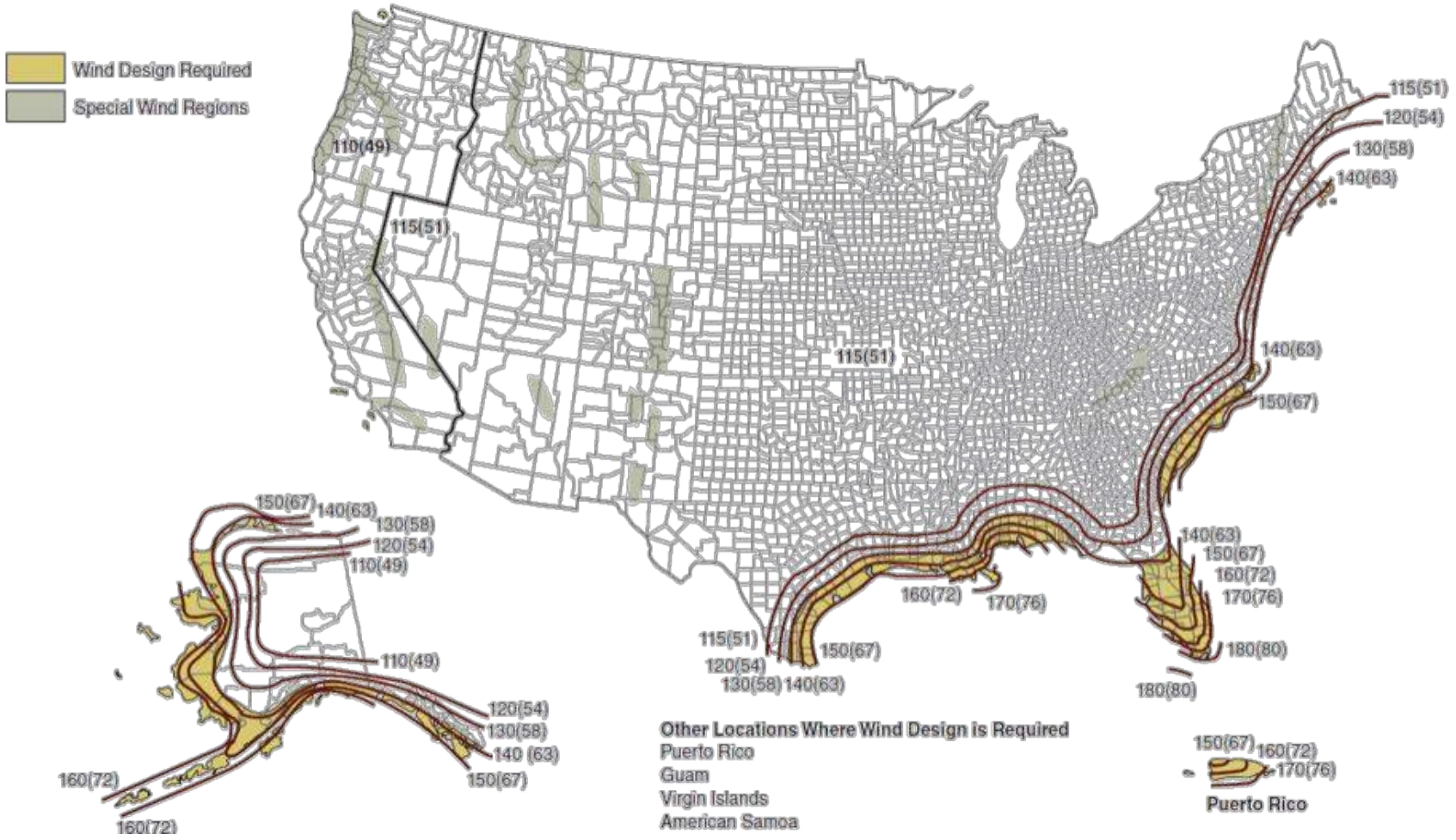
- AISI S230 – *Standard for Cold-formed Steel Framing- Prescriptive Method for One- & Two-Family Dwellings*
- IBC – *International Building Code*
- ASCE 7 – *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*



Wind Exposure Category

- Exposure B
  - Wind protection with trees and buildings
- Exposure C
  - Open terrain with scattered obstructions
- Exposure D
  - Flat areas exposed to open water and others for ≥ 5,000 ft

Hurricane-prone Regions



Snow Loads

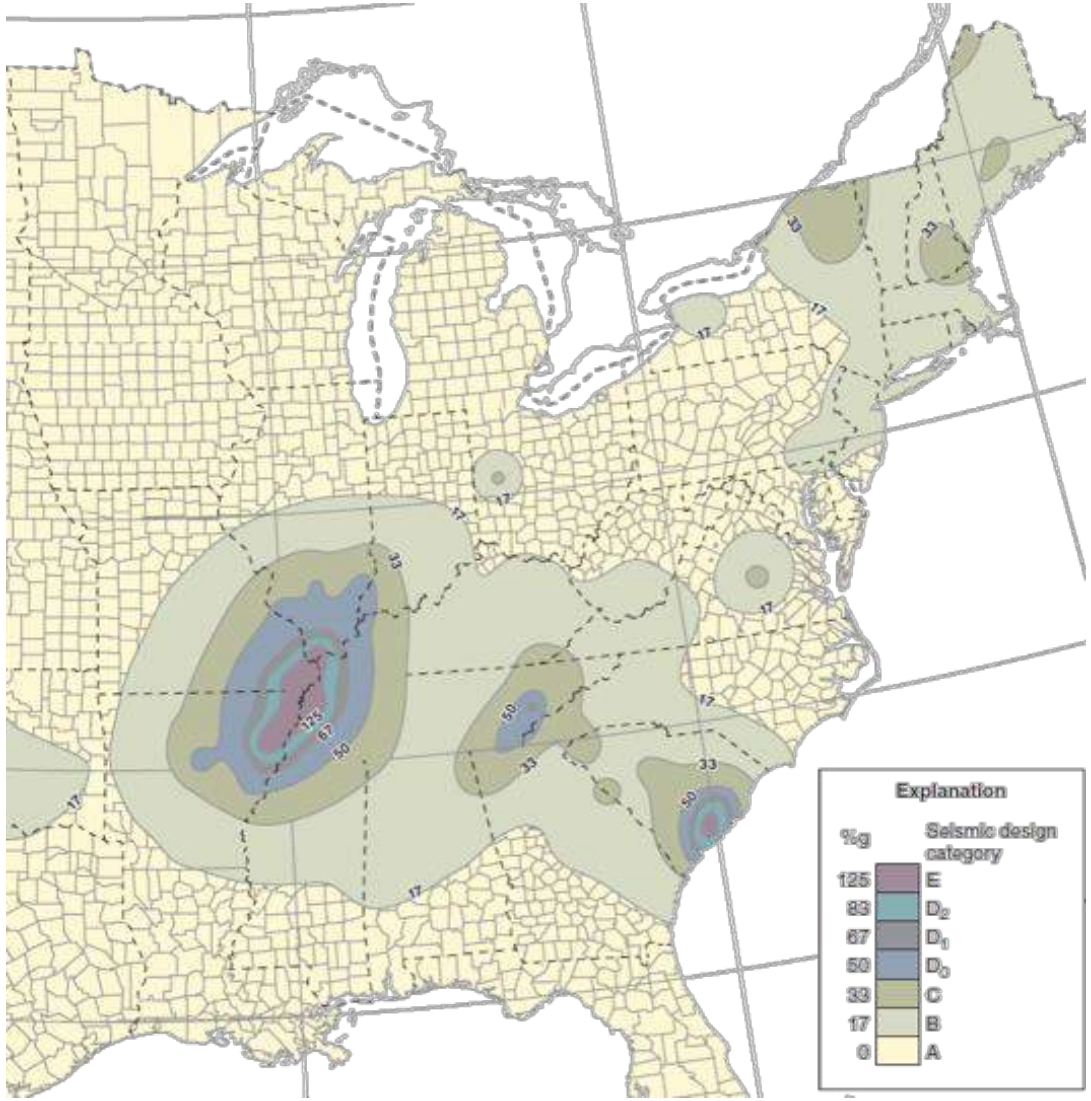
- Must be considered where applicable
- IRC conventional framing tables are limited to <70 psf

Earthquakes

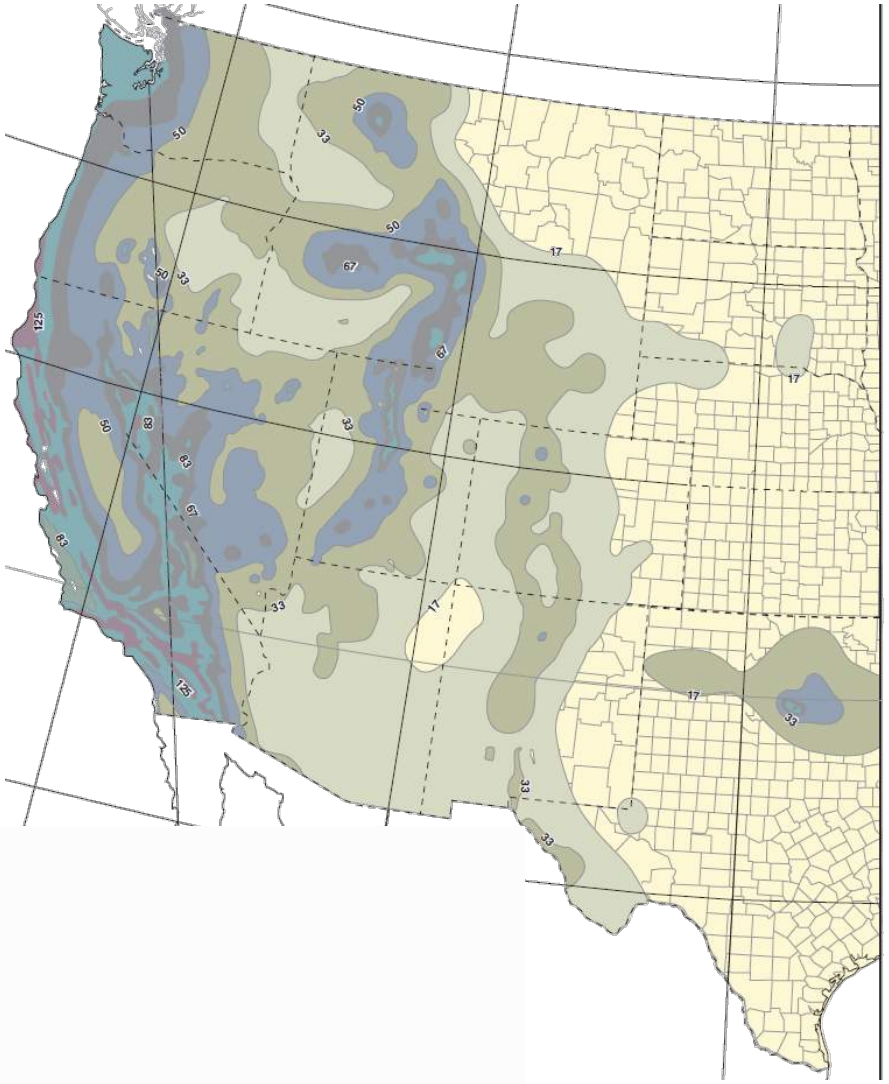
- IRC assigns Seismic Design Category (SDC) to building sites relative to anticipated intensity and frequency of earthquakes

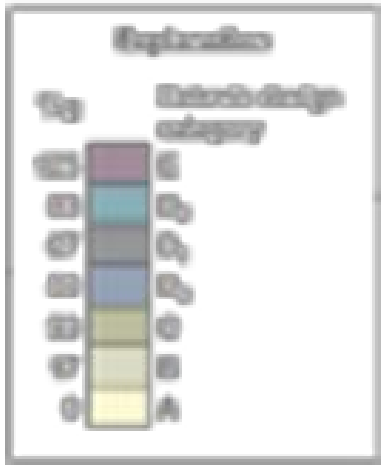
SDC	1- and 2-Family Dwellings	Townhouses
A & B	No seismic requirements	No seismic requirements
C	No seismic requirements	Seismic Requirements Apply
D_0, D_1, D_2	Seismic Requirements Apply	
E	Engineered Design Required	

Earthquakes



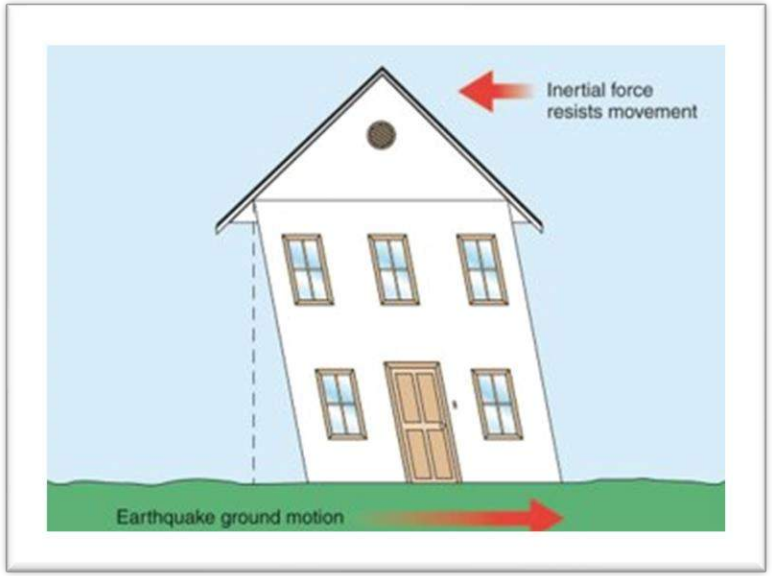
Earthquakes



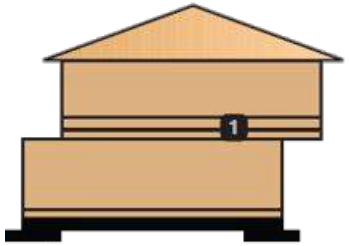


Earthquakes

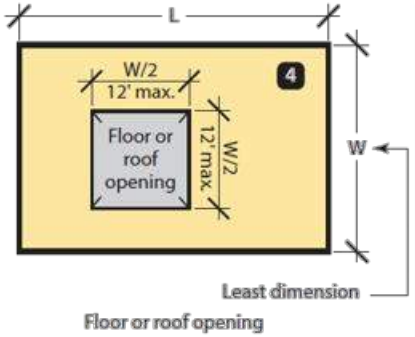
- Regularly shaped buildings
  - Uniform distribution of forces
  - More predictable response characteristics
- Irregularly shaped buildings
  - Force concentrations
  - Less effective resisting earthquake load effects



Earthquakes

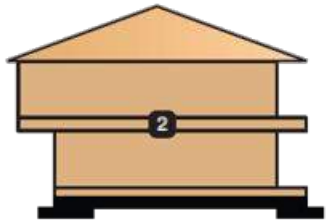


Setbacks and cantilevers

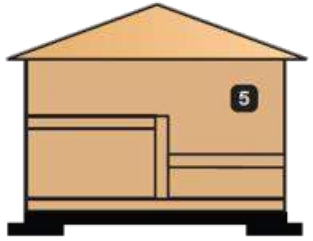


Floor or roof opening

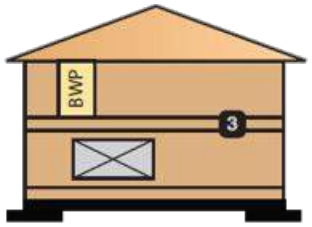
Brick and wood-framed walls combined.



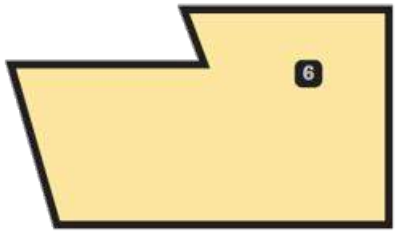
Unsupported floor or roof



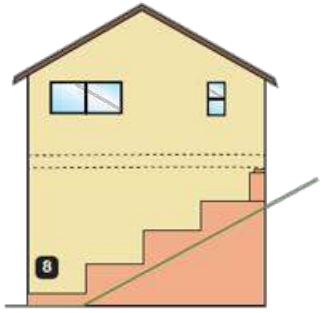
Vertical floor offset



Braced wall panel above opening

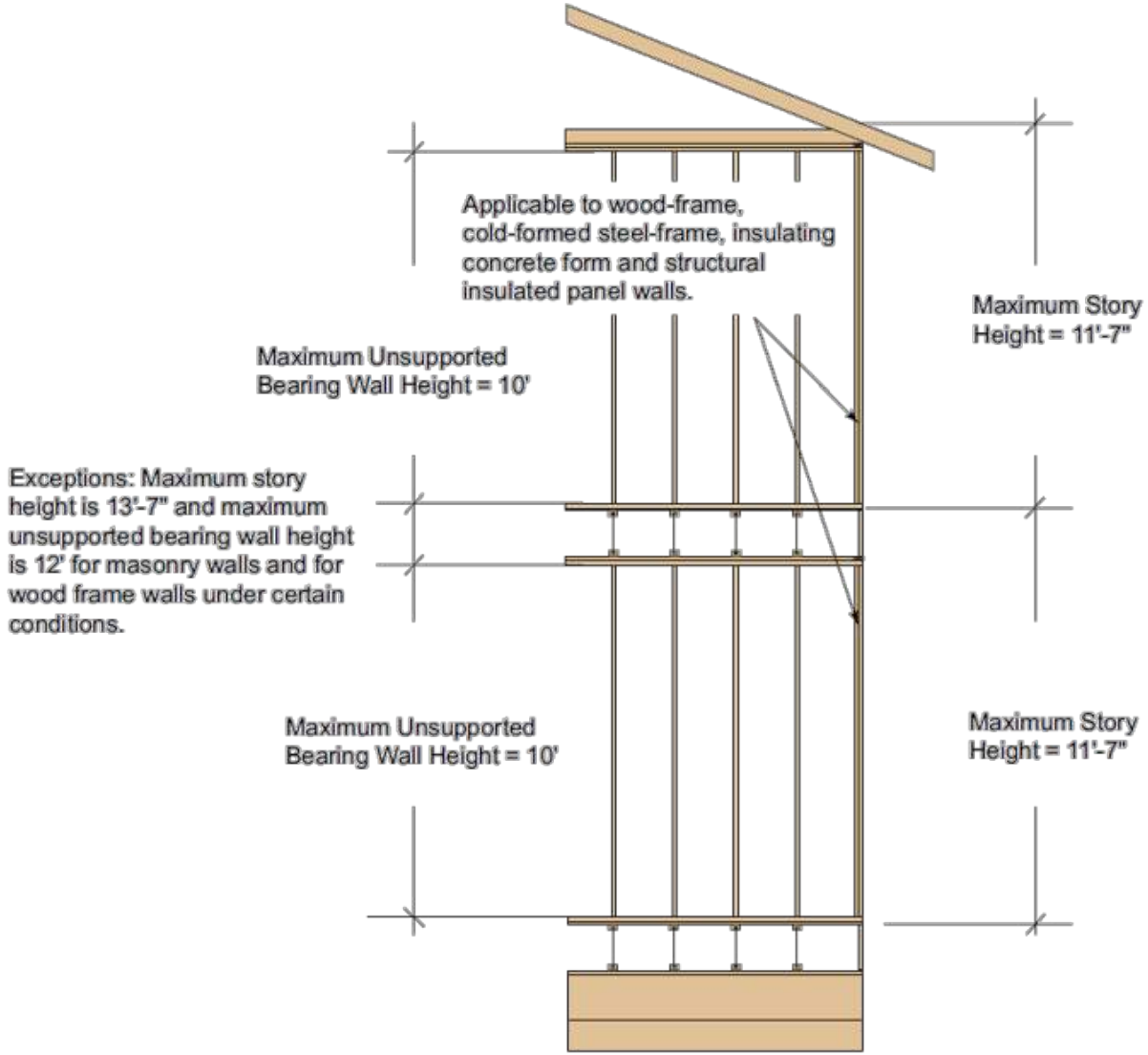


Nonperpendicular walls



Hillside irregularity

Story Height

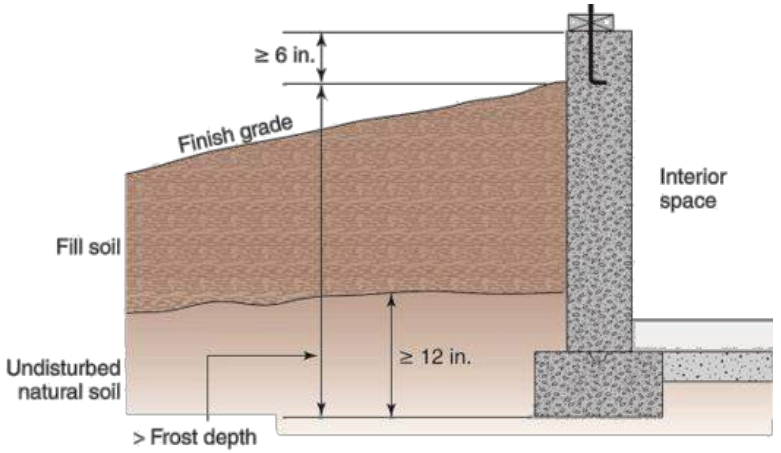


Foundation Materials

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

Footings

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

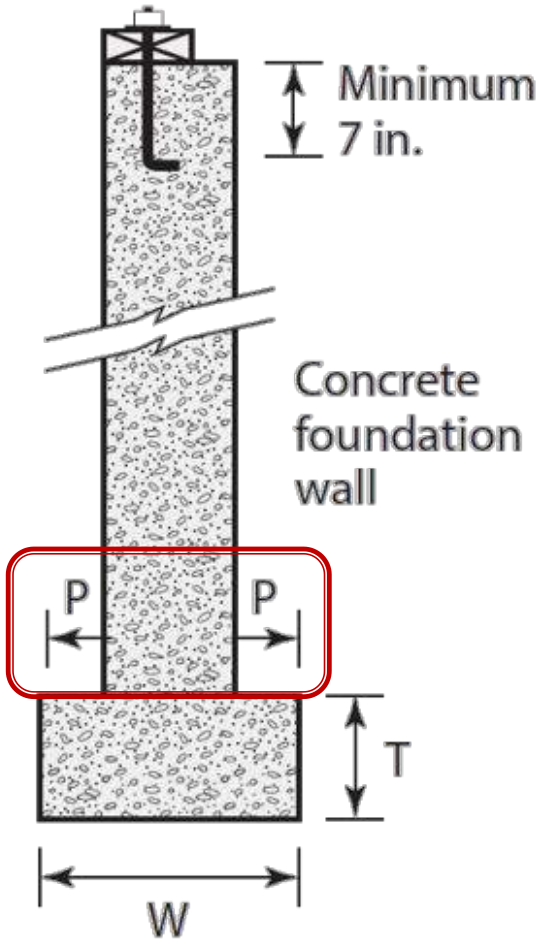


Concrete Footing Size

Conventional Light-Frame Construction				
Ground Snow Load = 30 psf	Type of Foundation	Soil Bearing (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	16 x 6	12 x 6	12 x 6
2-story	Slab-on-grade	13 x 6	12 x 6	12 x 6
	With crawl space	16 x 6	12 x 6	12 x 6
	Plus basement	19 x 6	14 x 6	12 x 6

Concrete Footing Size

- Projection - P ≥ 2” and ≤ T
- Thickness - T ≥ 6”
- Width - W per table



APPLICATION

Footing size

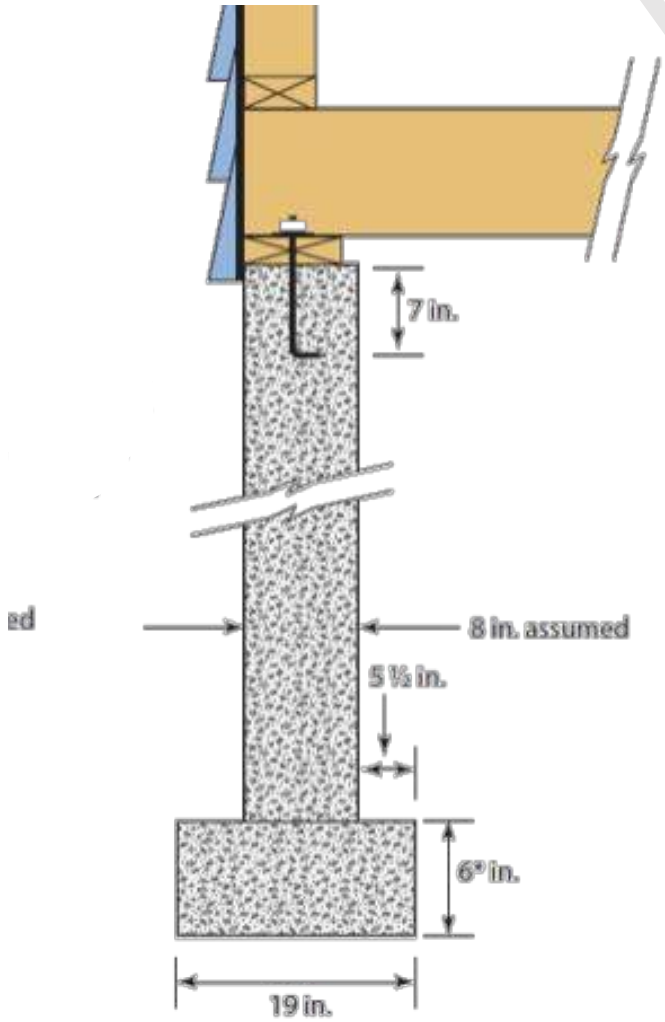
- Determine minimum width (W), projection (P) and thickness (T) of a continuous spread footing
- Given
  - 2-story dwelling with basement
  - 1500 psf assumed soil bearing capacity
  - 30 psf snow load
  - Conventional light-frame construction
    - With siding
    - With brick veneer

APPLICATION

Footing Size

Ground Snow Load	Foundation	Load bearing value of soil
30 psf	Light Frame w/ Siding	1,500 psf
2-story	Plus basement	19 x 6

$P \leq T$

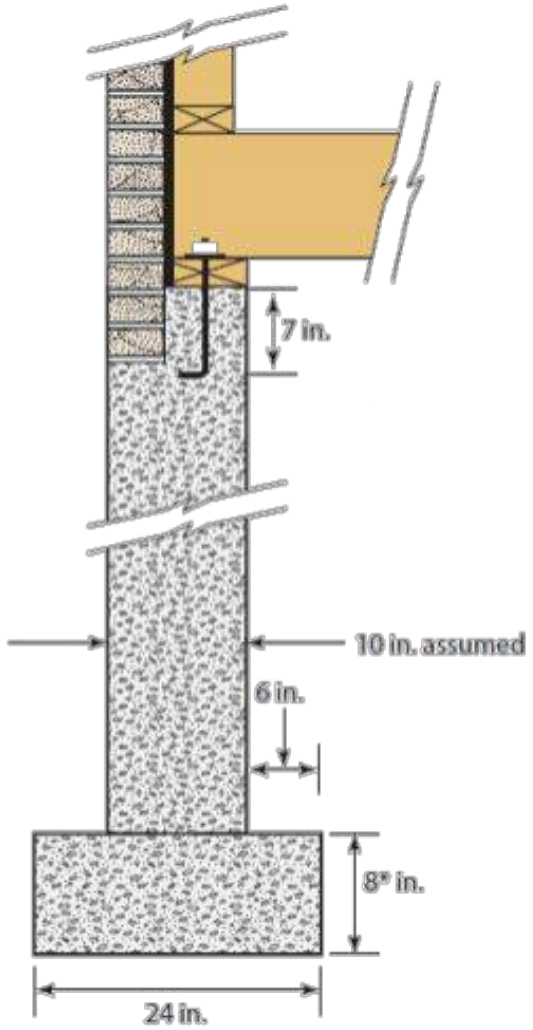


APPLICATION

Footing Size

Ground Snow Load	Foundation	Load bearing value of soil
30 psf	Light Frame w/ Brick	1,500 psf
2-story	Plus basement	24 x 8

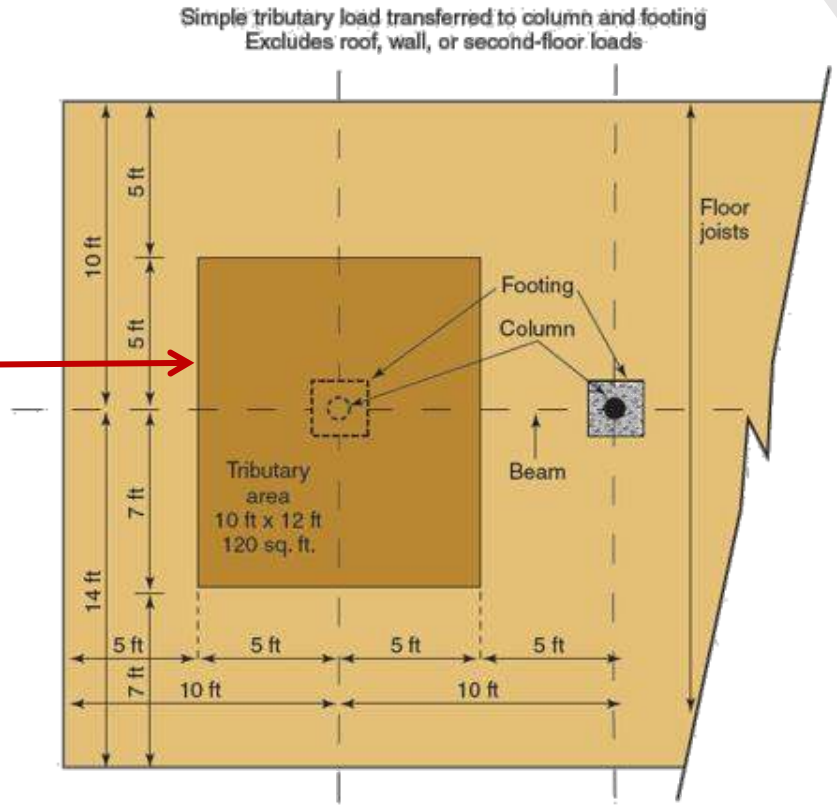
$P \leq T$



APPLICATION

Isolated Footing Size

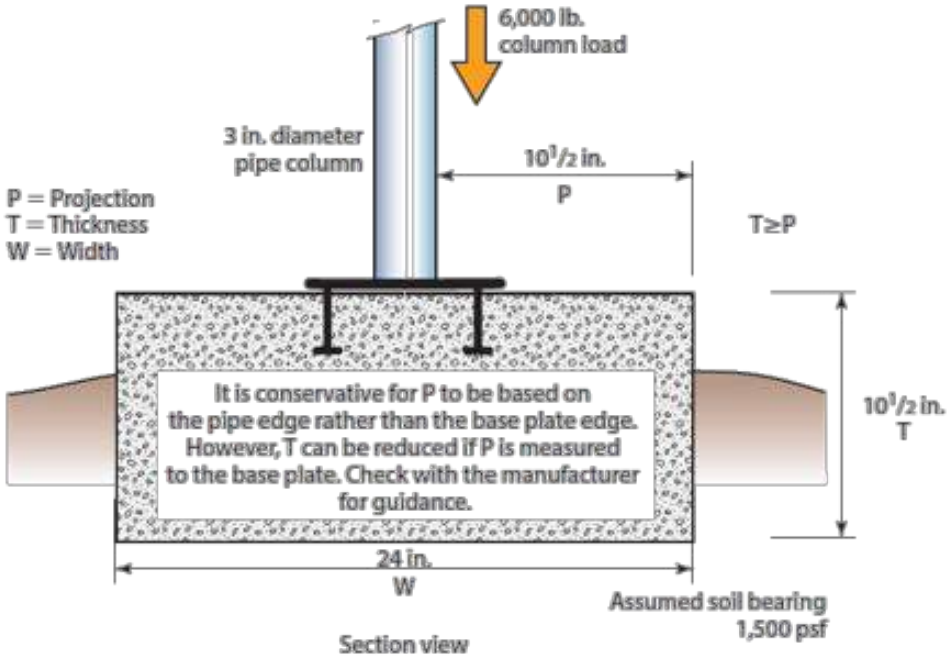
- Given
  - Column supports tributary floor area of 120 ft^2 at 50 psf
  - 1,500 psf assumed soil-bearing capacity
- Determine minimum footing size



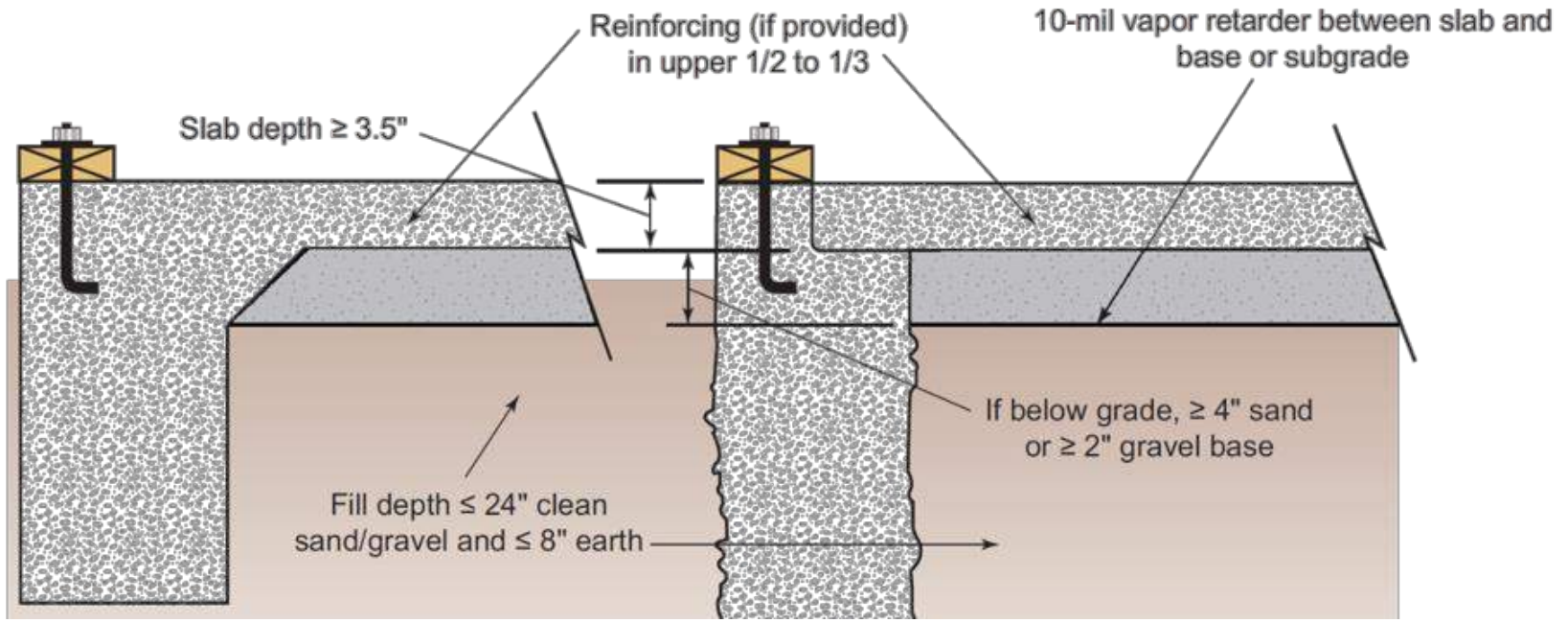
APPLICATION

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

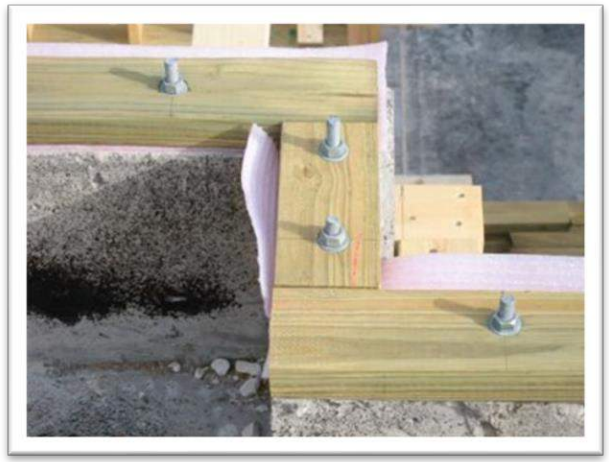


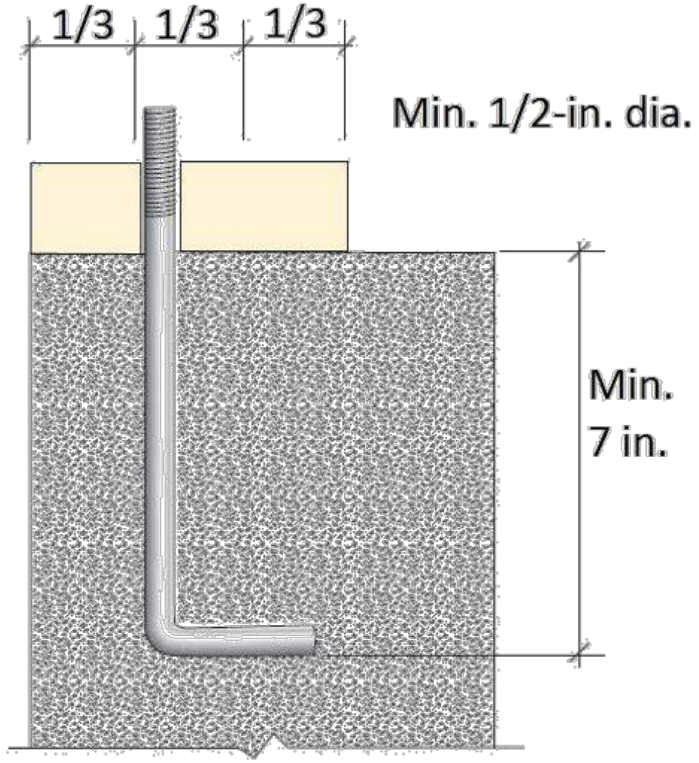
Concrete Slabs



Foundation Anchorage

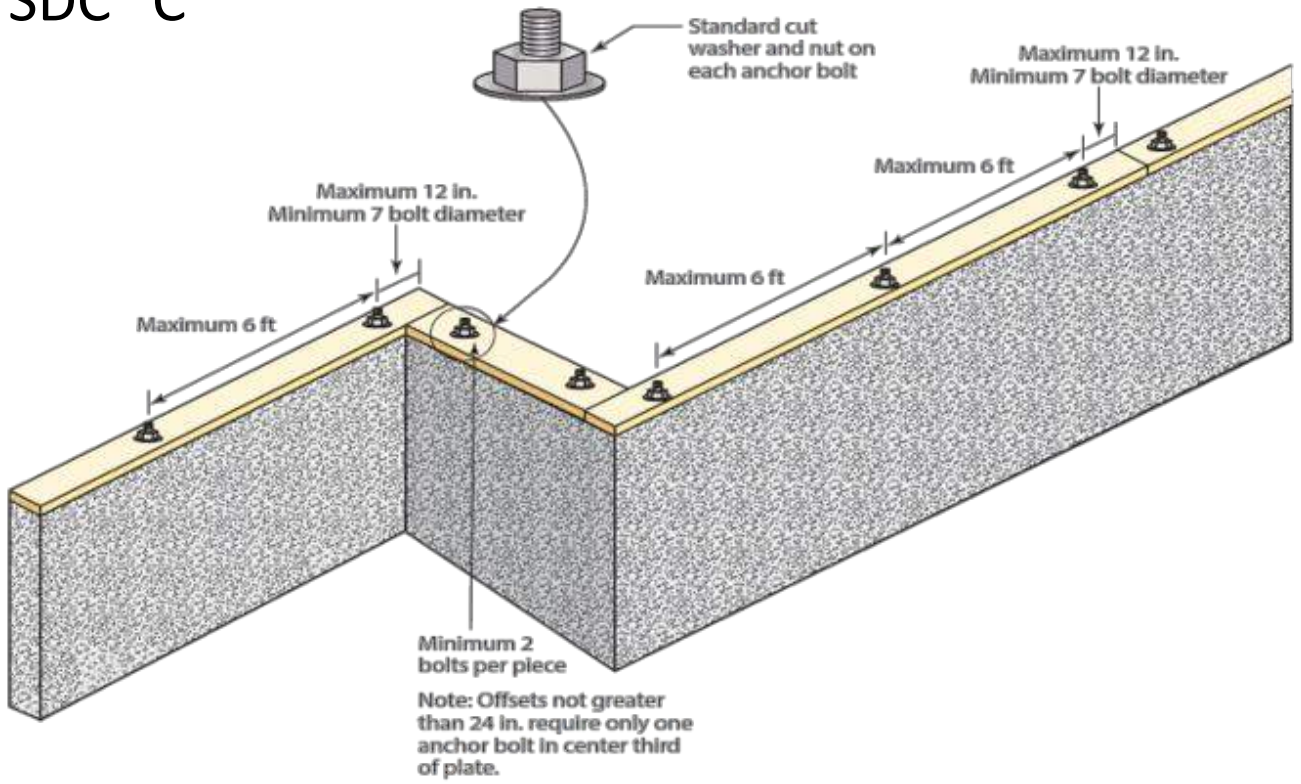
- Anchor Bolts





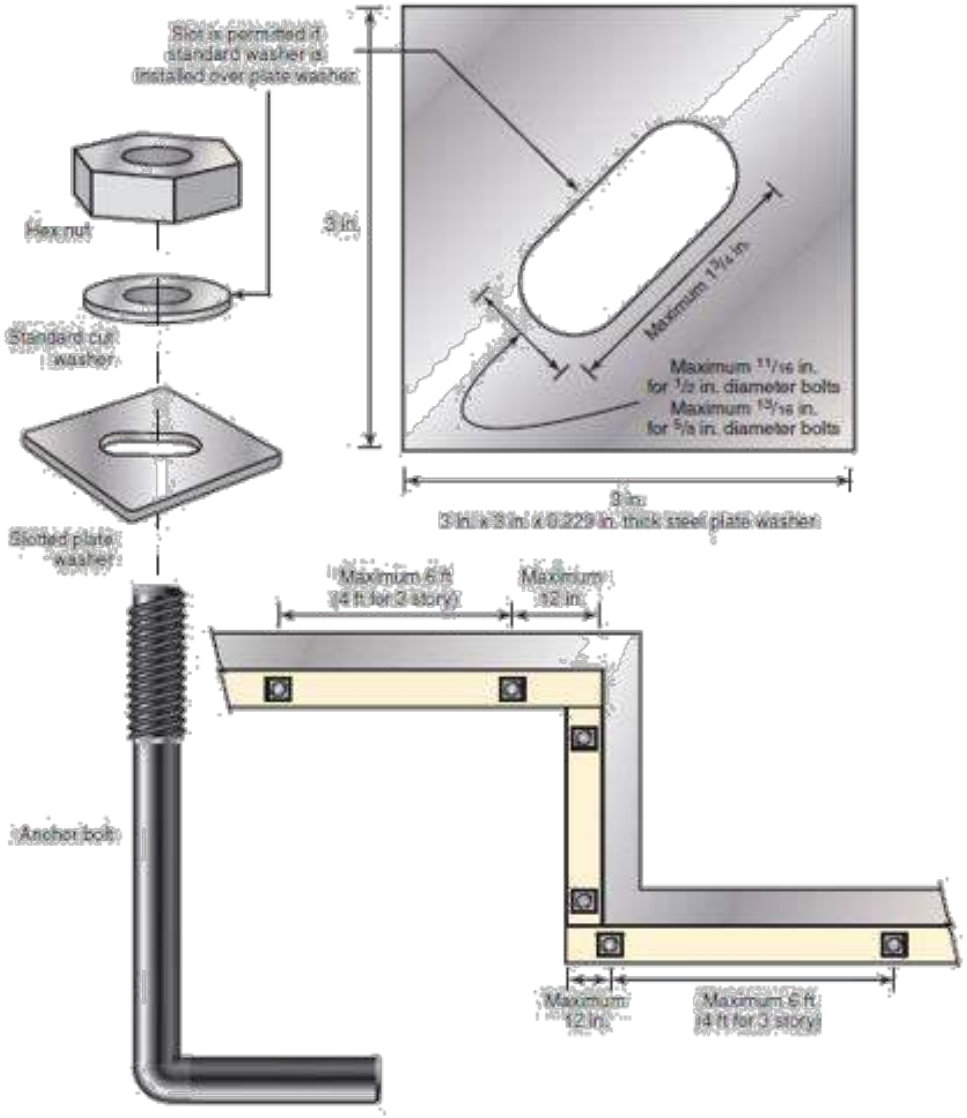
Foundation Anchorage

- Wood sill plate to foundation
  - All buildings in SDC “A” and “B”
  - Dwellings in SDC “C”



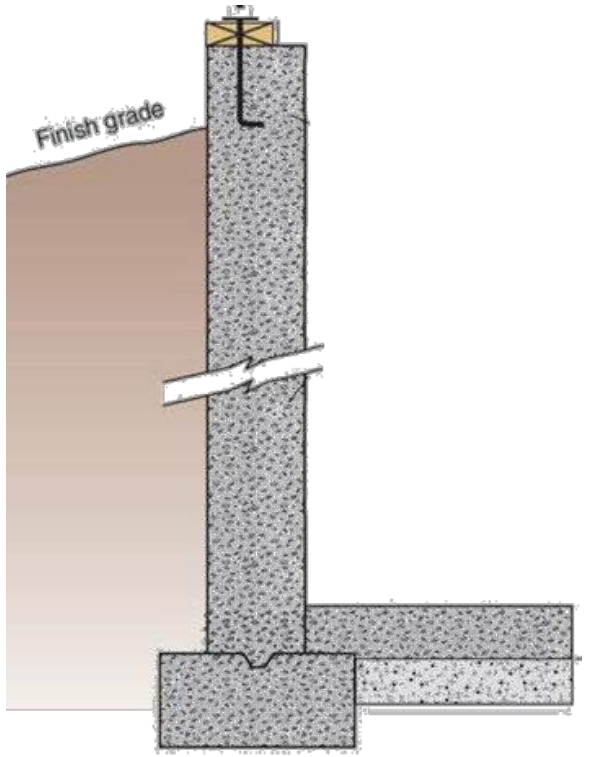
Foundation Anchorage

- Wood sill plate for seismic
  - Dwellings and townhouses in SDC D_0, D_1 and D_2
  - Townhouses in SDC C



Concrete Foundation Walls

- Foundation walls must be constructed to resist lateral loads
- Thickness and vertical reinforcement determined by
  - Soil Type
  - Foundation Height
  - Height of unbalanced backfill

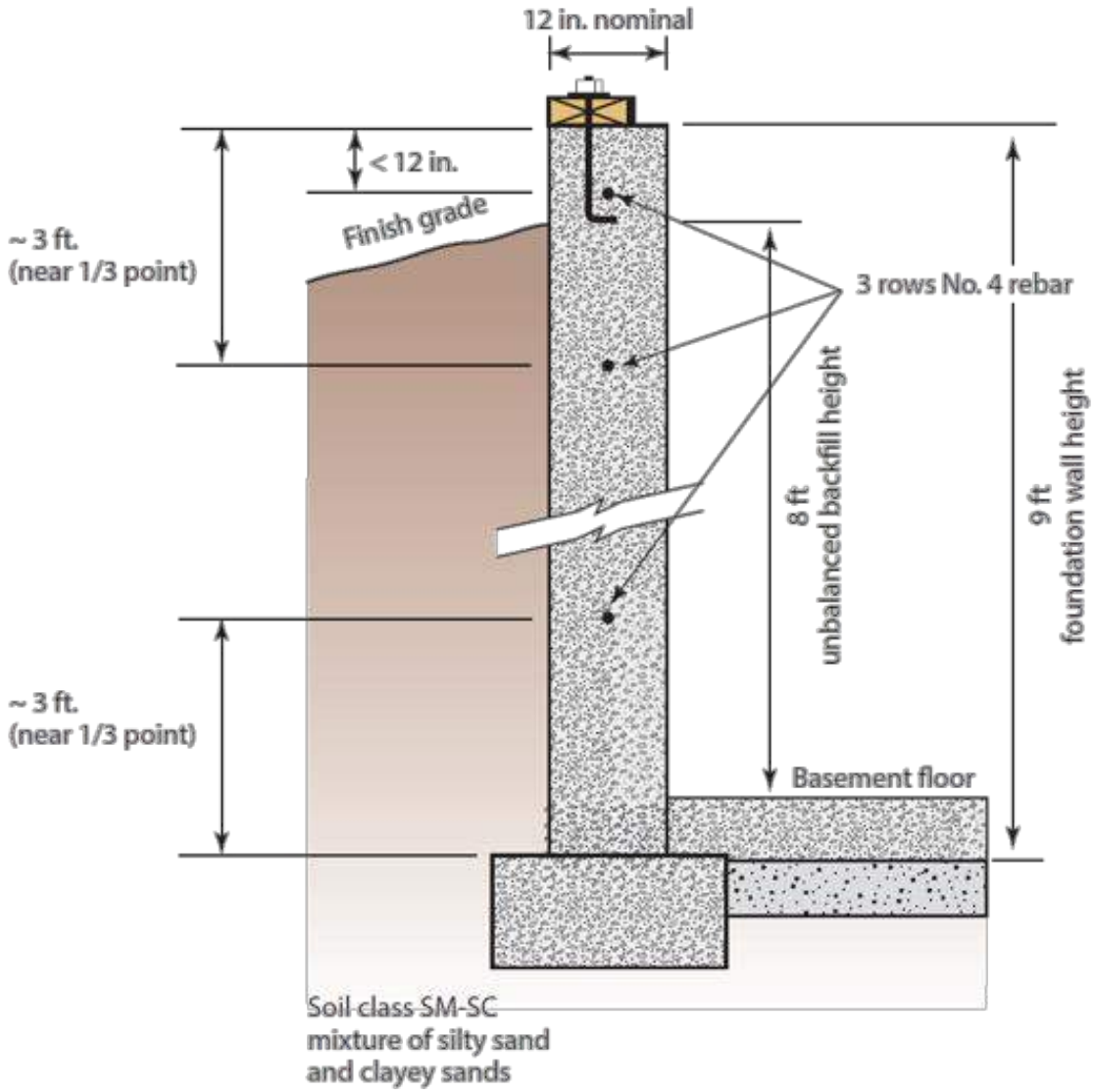


Concrete Foundation Walls

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

- Horizontal reinforcing required for basement walls
  - Table R404.1.2(1)
- Vertical reinforcing required
  - Tables R404.1.2(2) through R404.1.2(9)

Horizontal Reinforcing



APPLICATION

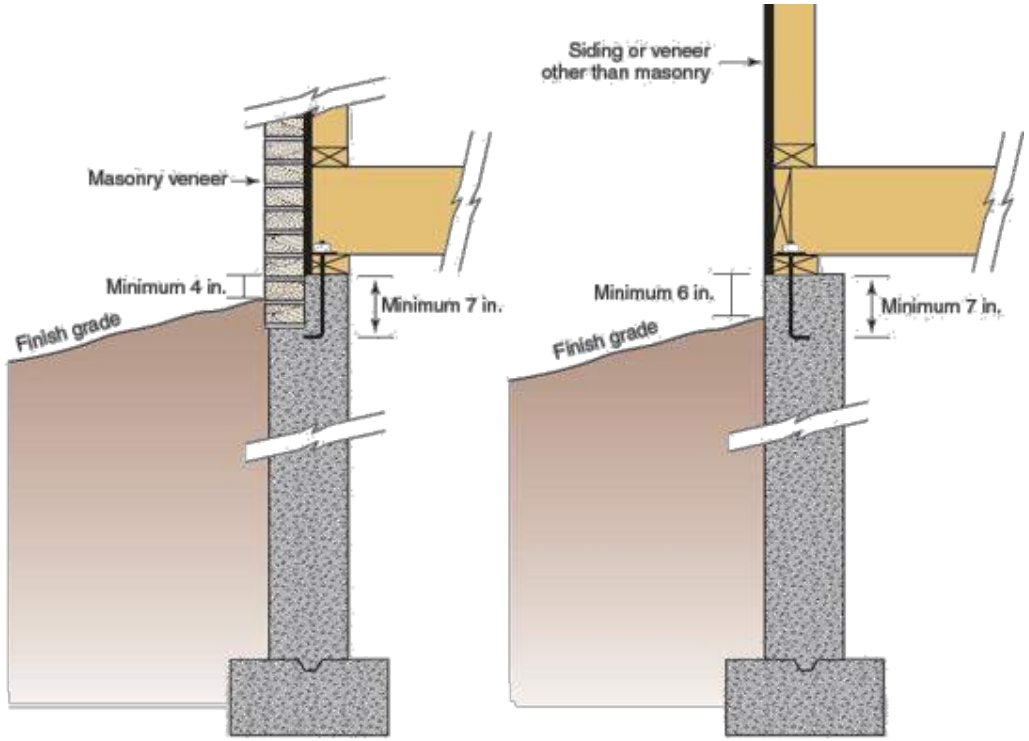
Vertical Reinforcing

- Soil class = CL inorganic sandy clay
- 10″ nominal thickness
- Wall height = 9′
- Unbalanced backfill height = 8′
- Vertical Reinforcement
  - No. 6 bars at 39 inches o.c.

Wall Ht.	Unbalanced Backfill Ht.	Soil class		
		SC, ML-CL and inorganic CL		
		8″	10″	12″
9′	6′	6 @ 39	NR	NR
	7′	6 @ 38	5 @ 37	NR
	8′	6 @ 29	6 @ 39	4 @ 48

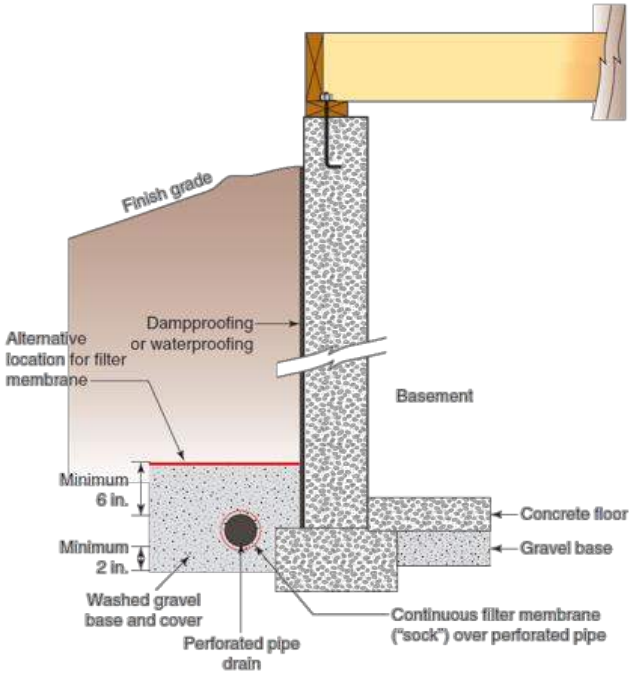
Height Above Finished Grade

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



Moisture Protection

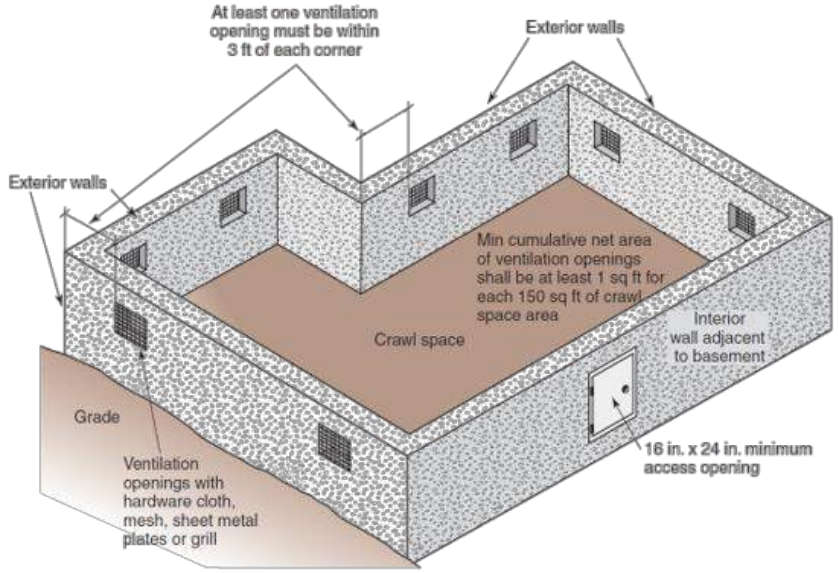
- Drainage by perforated pipe or other drain system
  - At or below basement/crawl space floor
  - Exception for areas with well-drained soils



- Dampproofing materials applied to foundation exterior
- Waterproofing
  - High-water table
  - Other severe soil-water conditions
  - Impervious materials

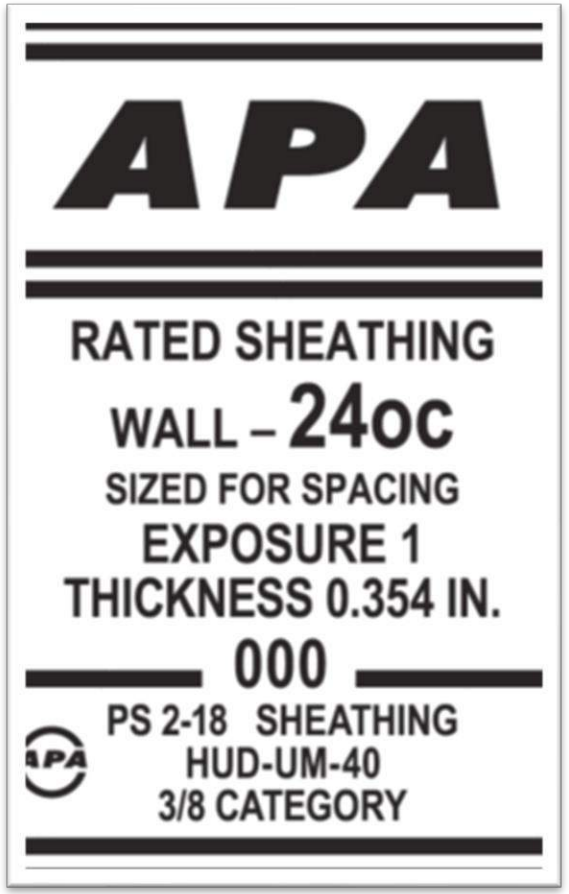
Underfloor Space

- Ventilation required
  - Circulate air and Dissipate condensation
- Method of ventilation
  - Foundation openings
  - Mechanical exhaust ventilation
  - Connection to conditioned air supply of dwelling
  - Dehumidification
- 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

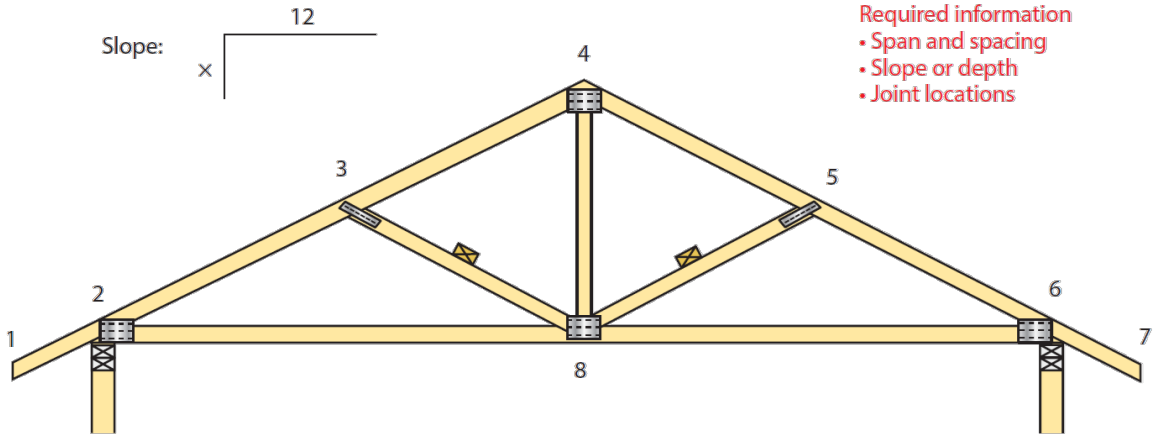


Engineered Wood Products

- Metal-plate-connected wood trusses
- I-joists
- Glued-laminated timber
- Structural composite lumber (SCL)
  - Laminated veneer lumber (LVL)
  - Parallel strand lumber (PSL)
  - Laminated strand lumber (LSL)

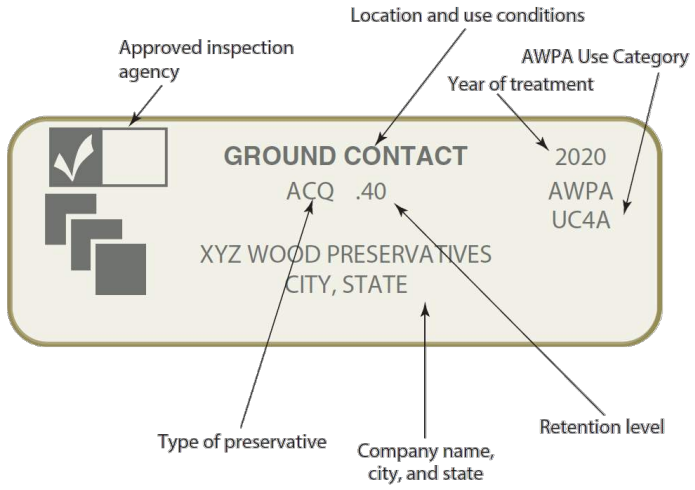
Wood Trusses

- Design submitted to building official for approval
- Includes many things such as:
  - Design loads
  - Slope or depth
  - Span and spacing
  - Etc.

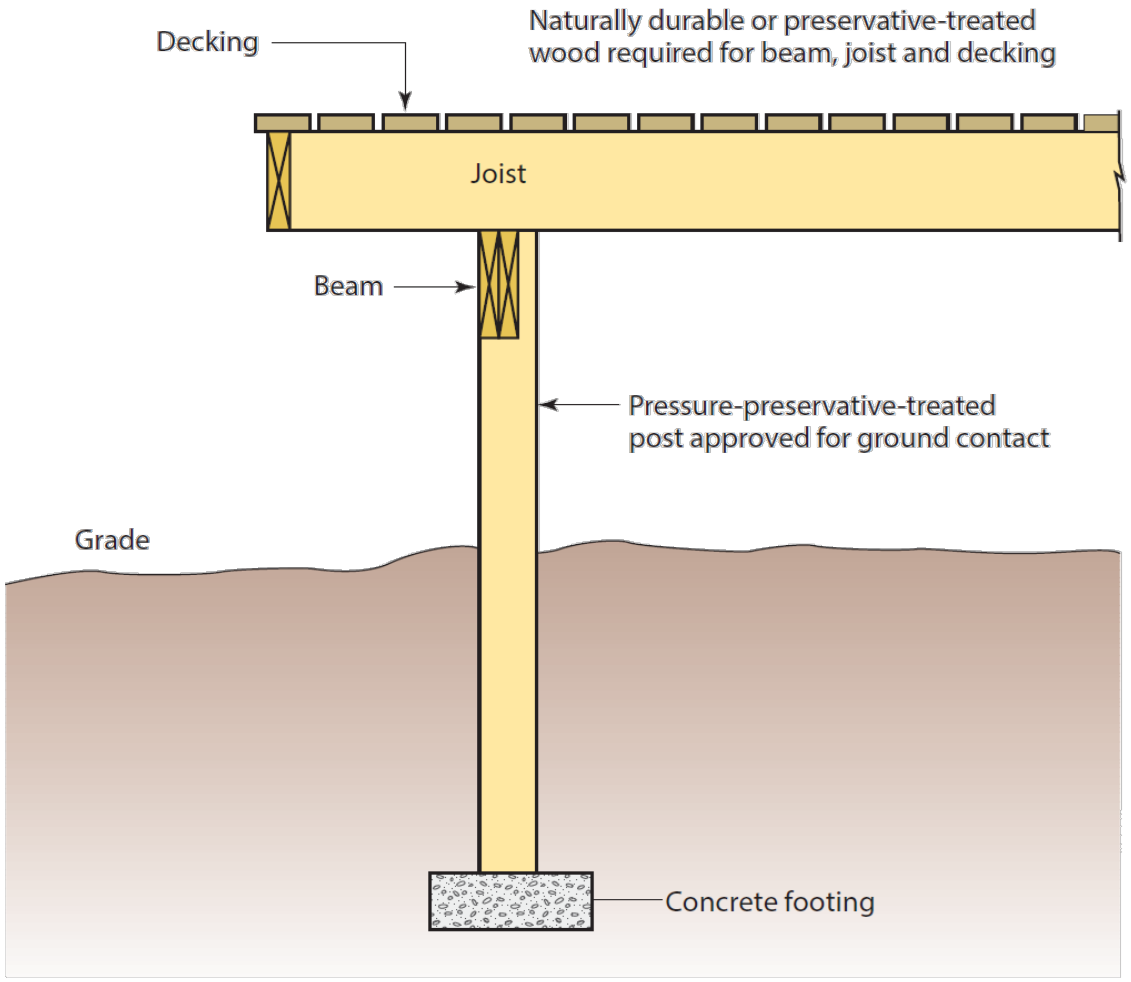


Wood Treatment

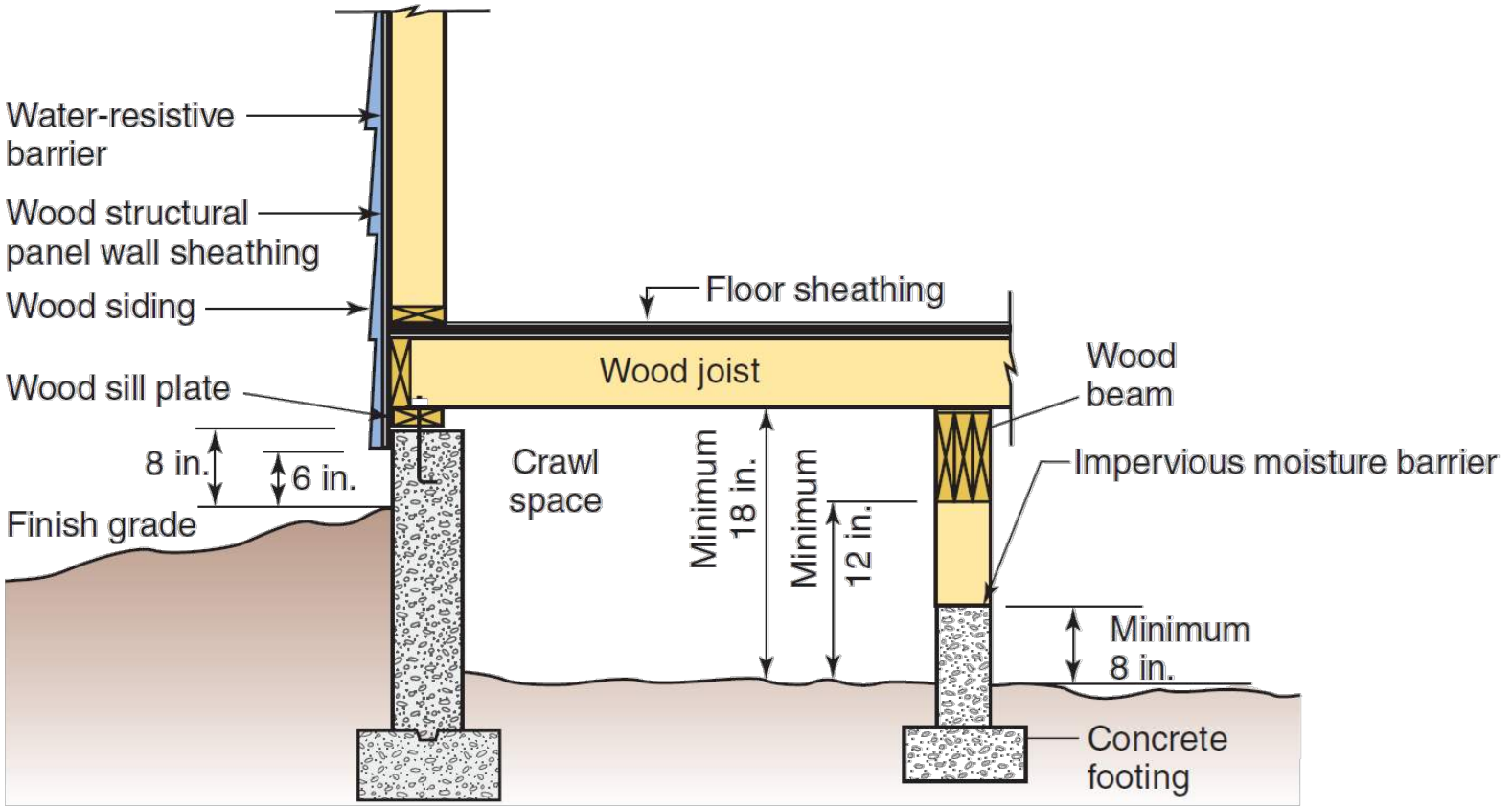
- Wood in locations subject to decay requires
  - Treatment with preservatives or
  - Naturally durable wood
    - Redwood, Cedar, Black locust, Black walnut



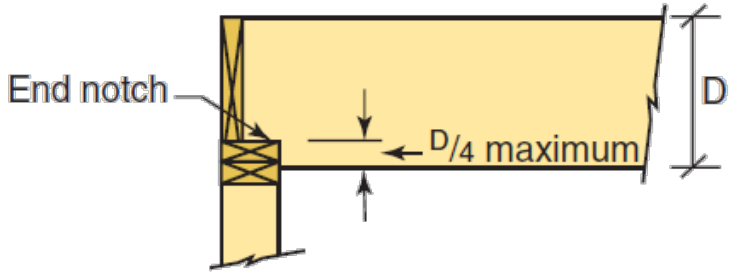
Protection Against Decay

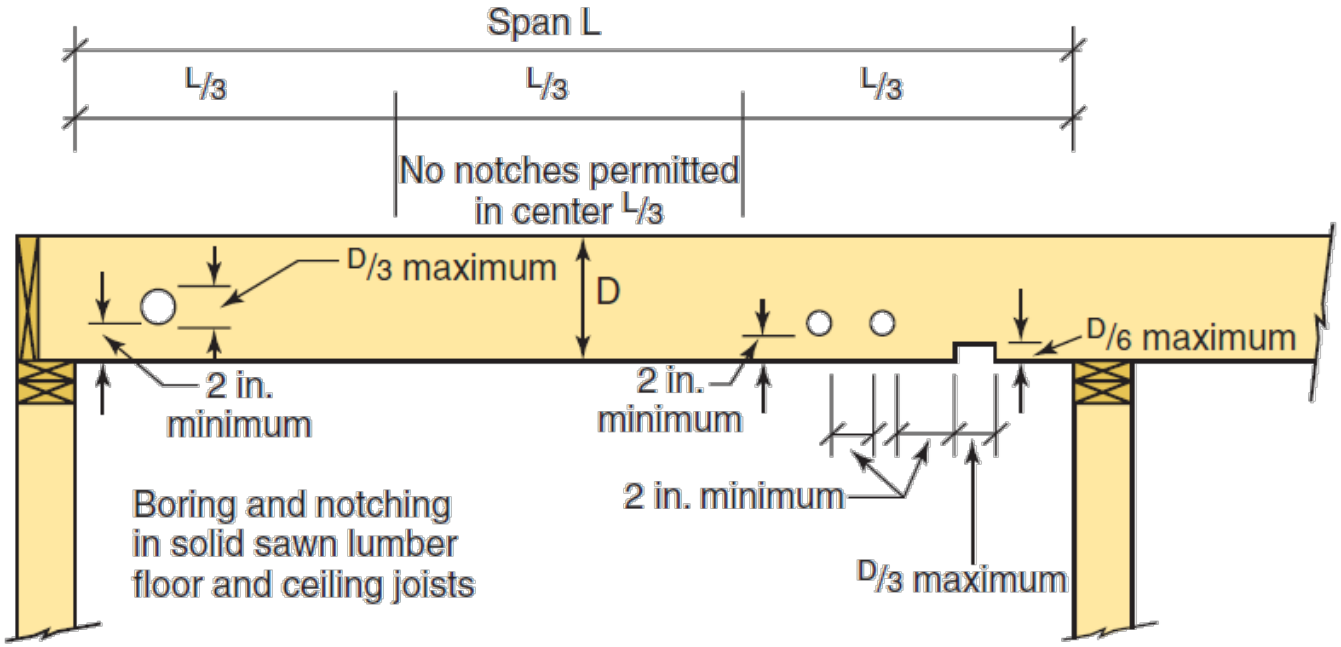


Protection Against Decay

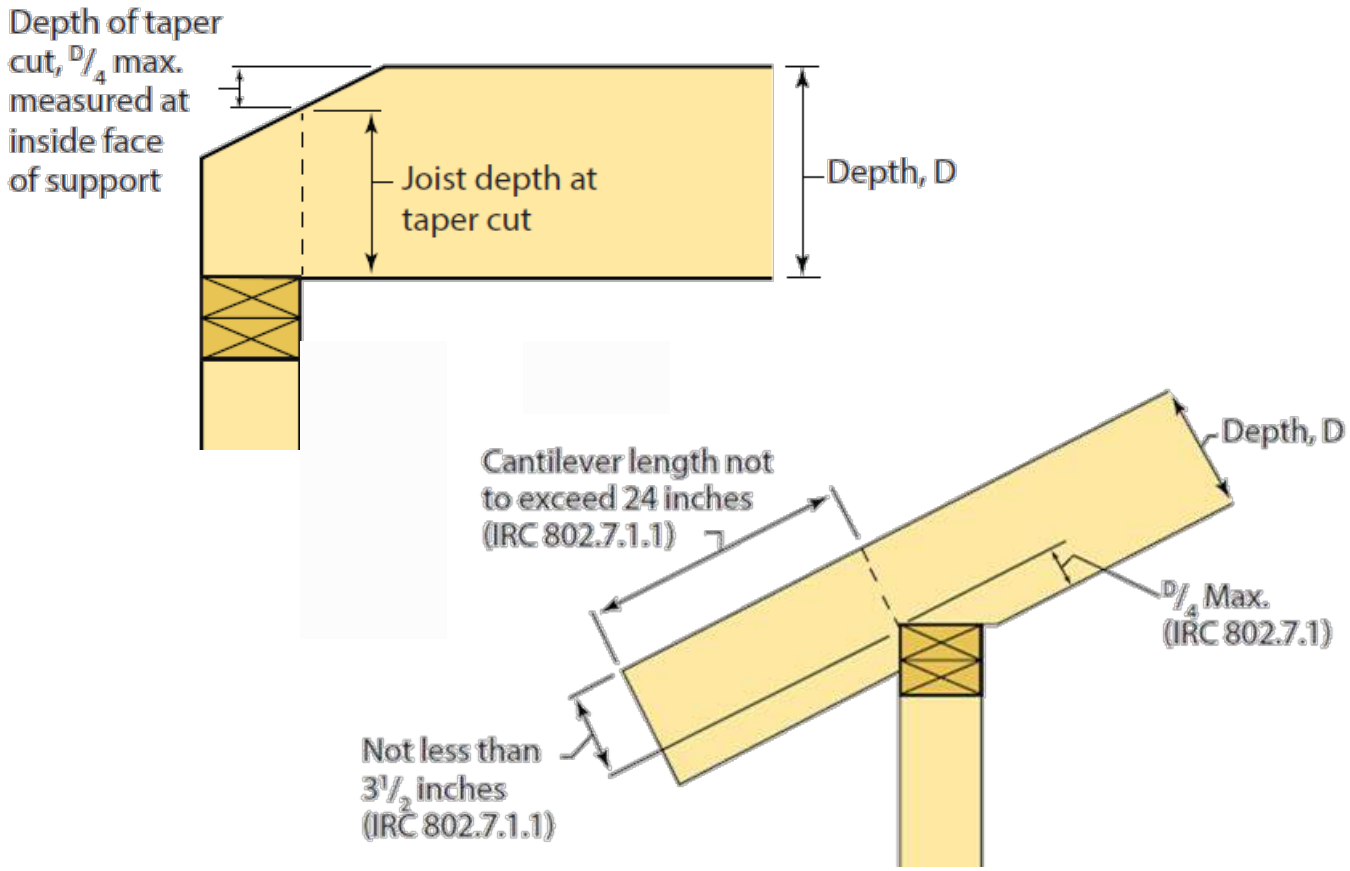


Boring and Notching



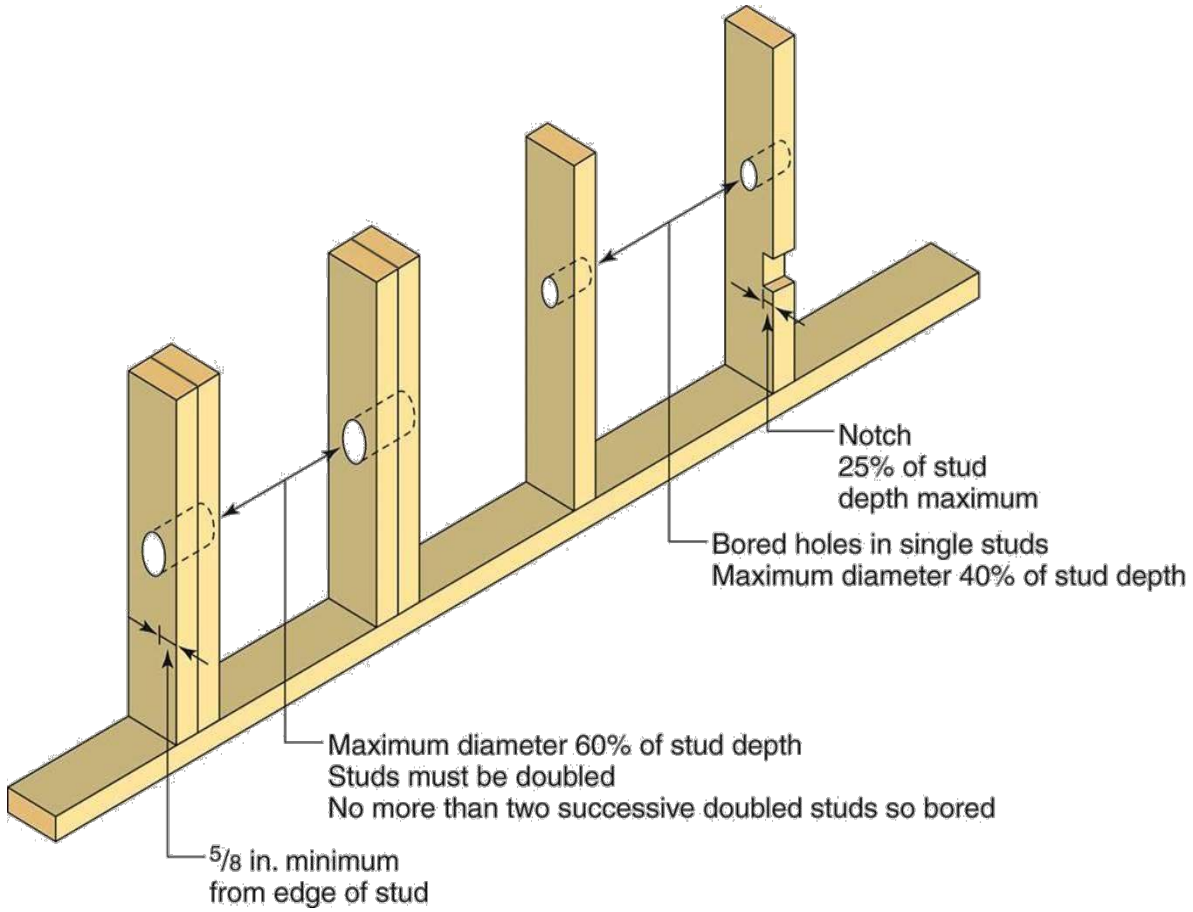


Boring and Notching



Boring and Notching

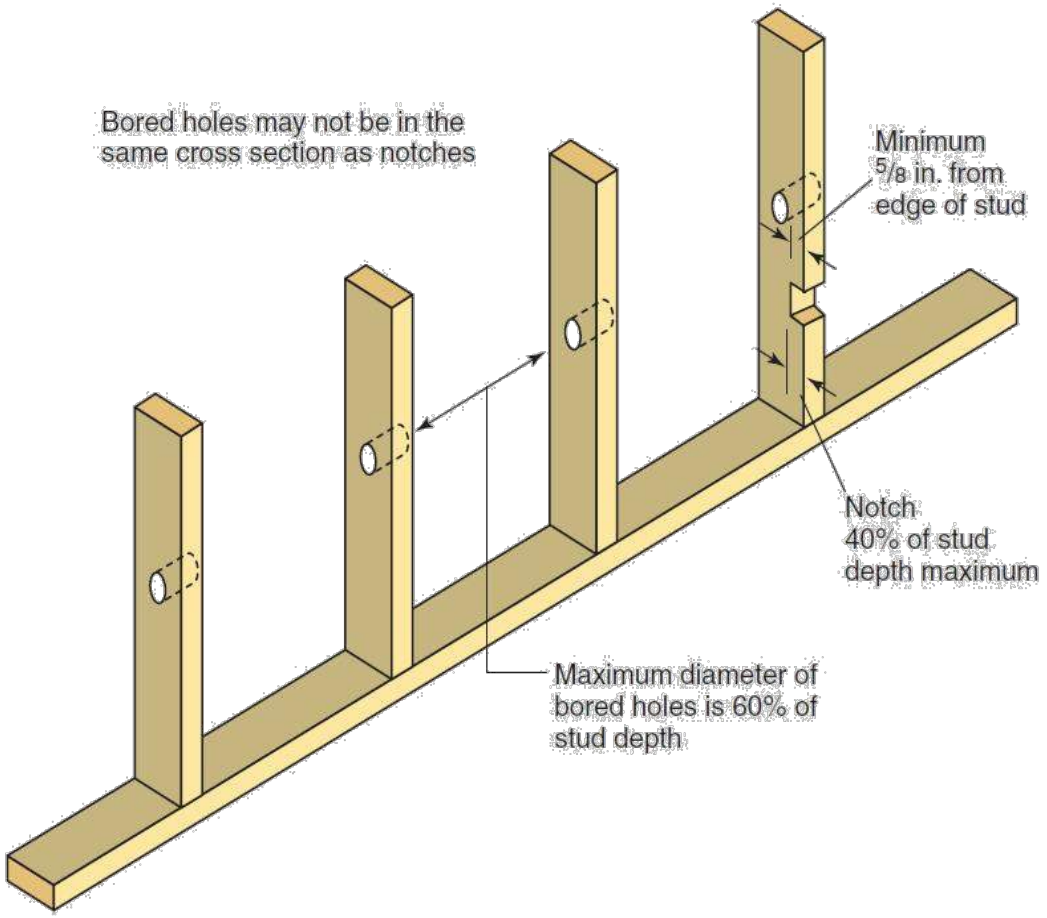
- Bearing walls



Boring and Notching

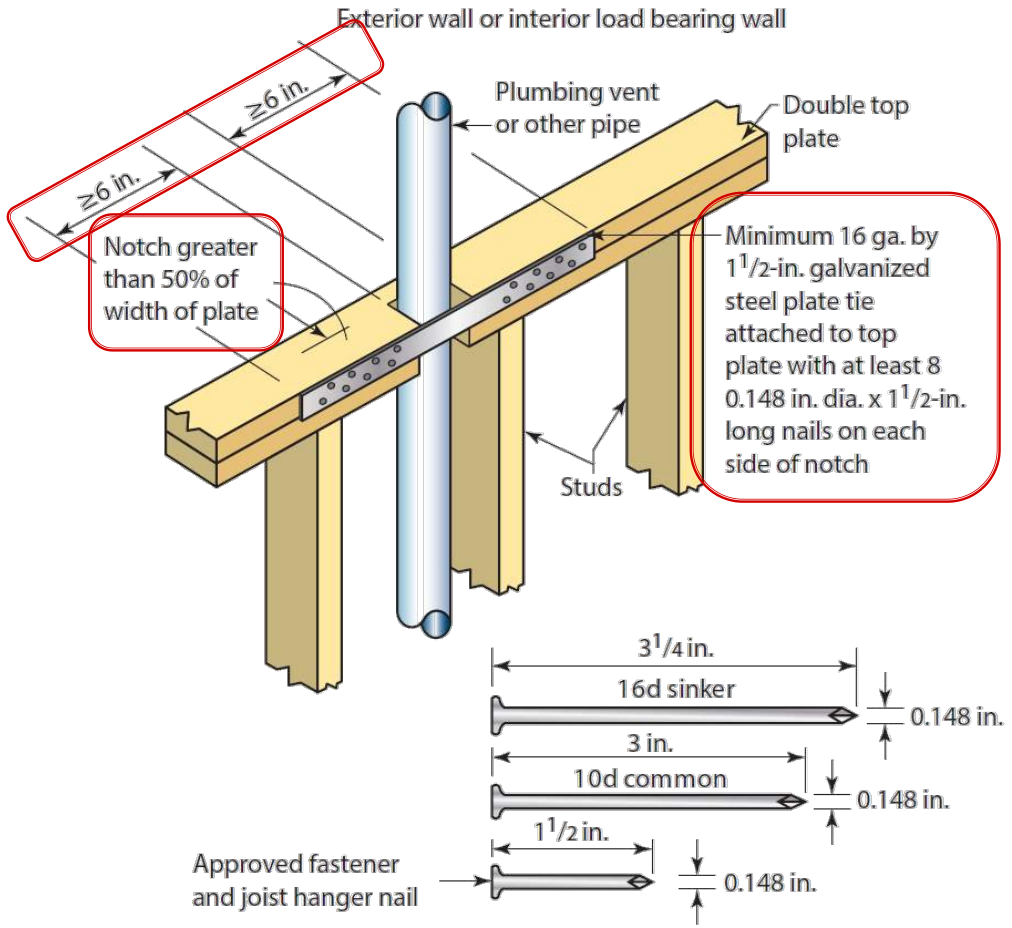
- Nonbearing Walls

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



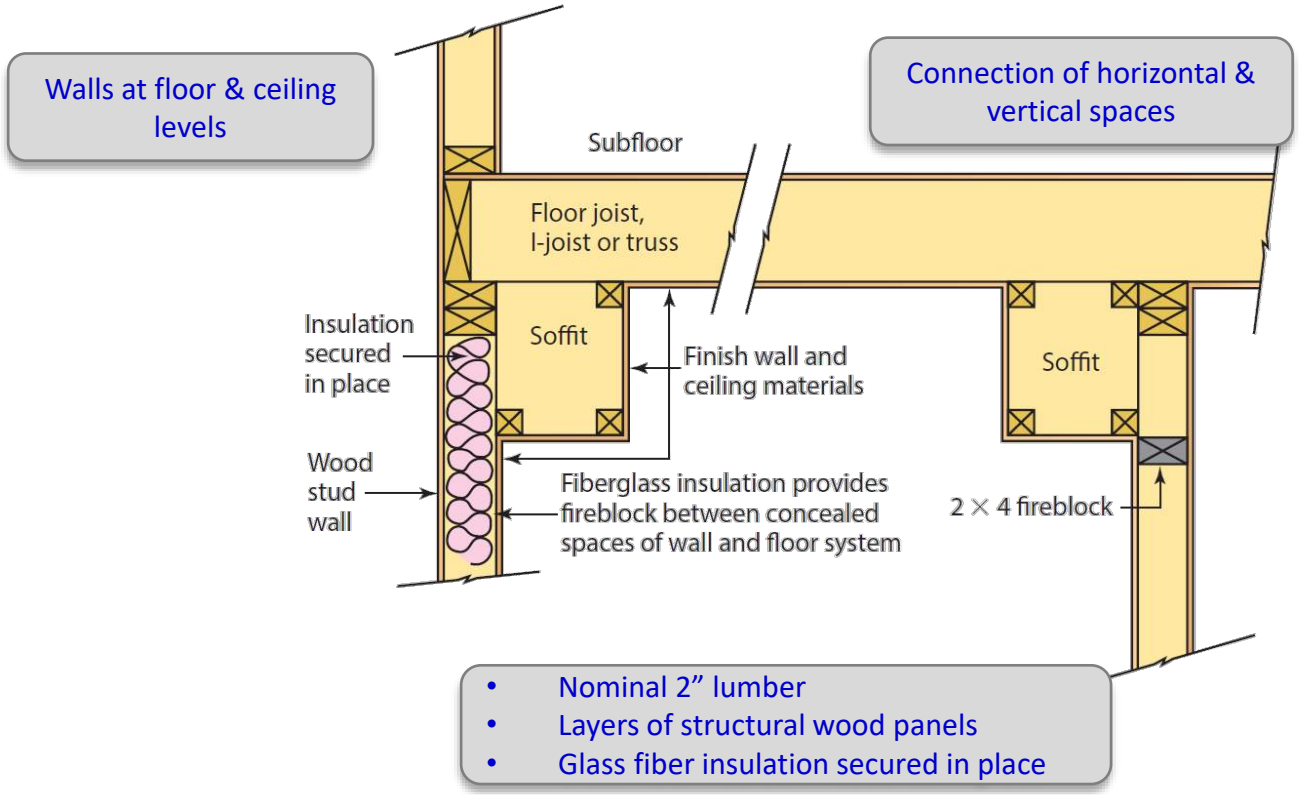
Boring and Notching

- Bearing wall top plate



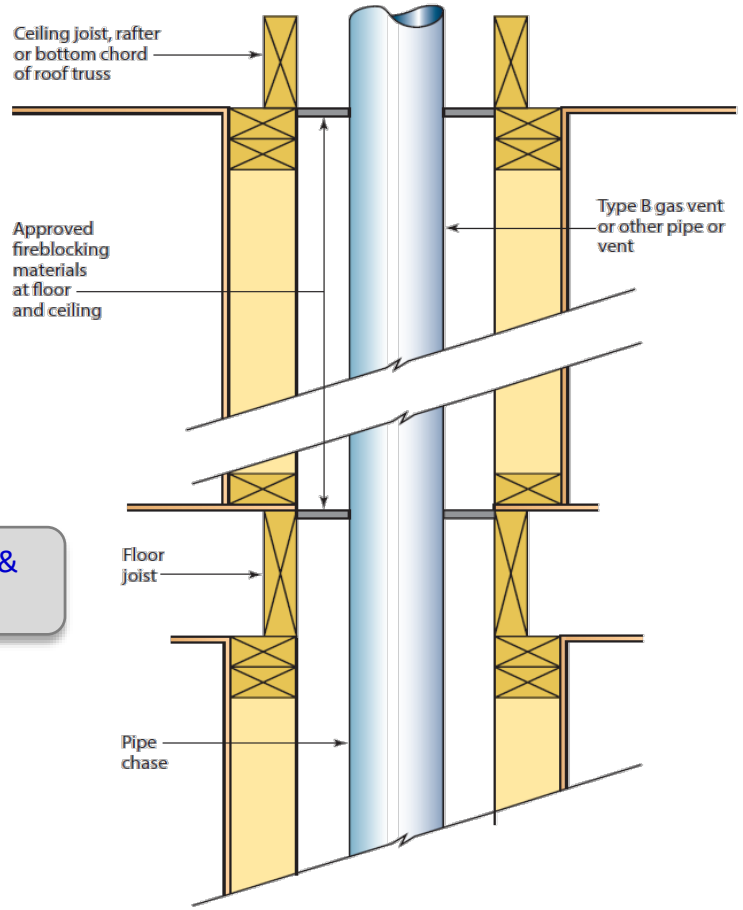
Fireblocking

- Stop fire spread in wood frame construction concealed spaces



Fireblocking

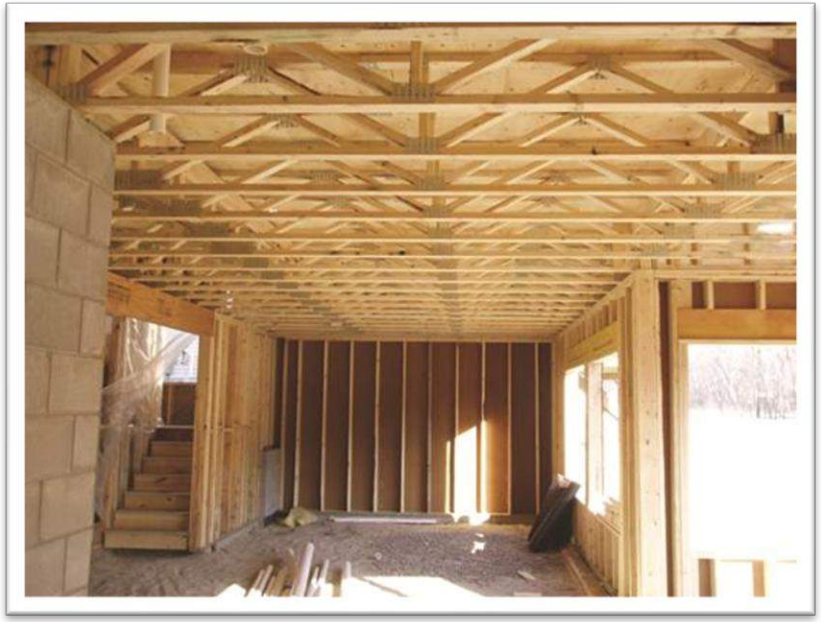
- Stop fire spread in wood frame construction concealed spaces



Vents & ducts at floor & ceiling levels

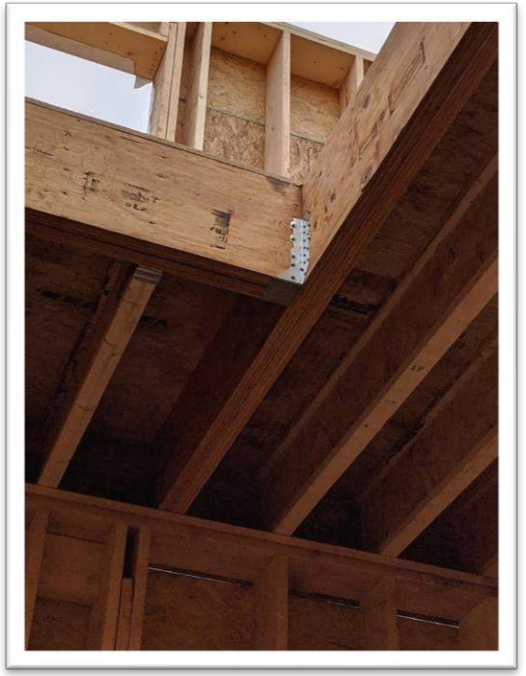
Draftstopping

- Divide concealed floor assembly spaces into areas of $\leq$1000 ft^2
- Materials
  - 1/2” gypsum board
  - 3/8” wood structural panels
  - Other approved materials



Wood Floor Framing

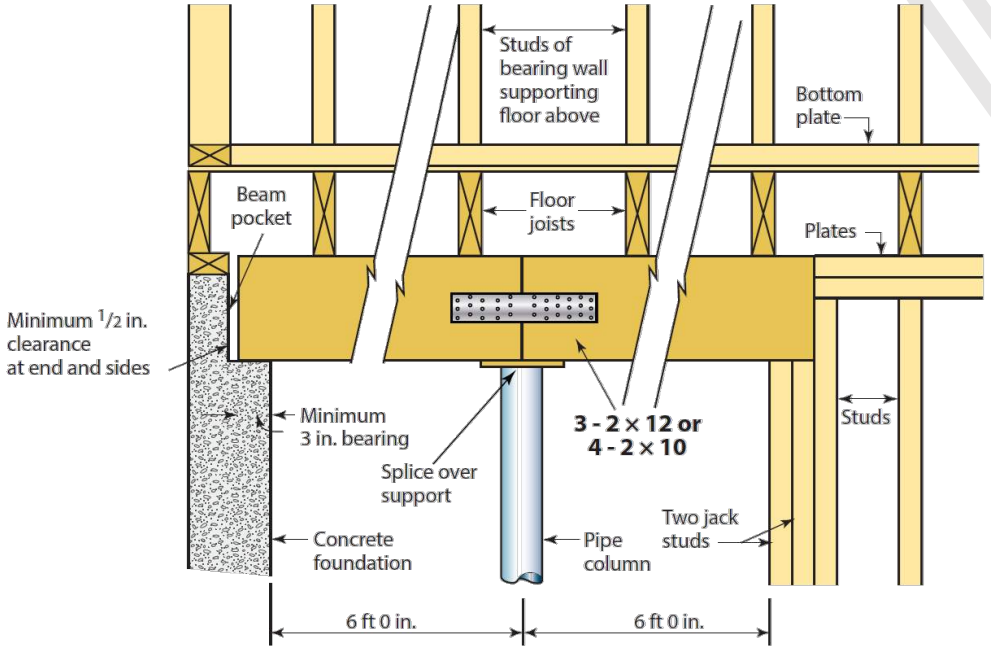
- Prescriptive tables
  - Beams and girders
    - No. 2 grade Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir
  - Floor joists
    - Specific grade and species of lumber
    - Live load 30 or 40 psf
    - Dead load 10 or 20 psf



APPLICATION

Beam Size and Bearing

1) Interior beam supporting 2 floors
2) #2 hem-fir lumber
3) Building width = 24’
4) Beam span = 6’



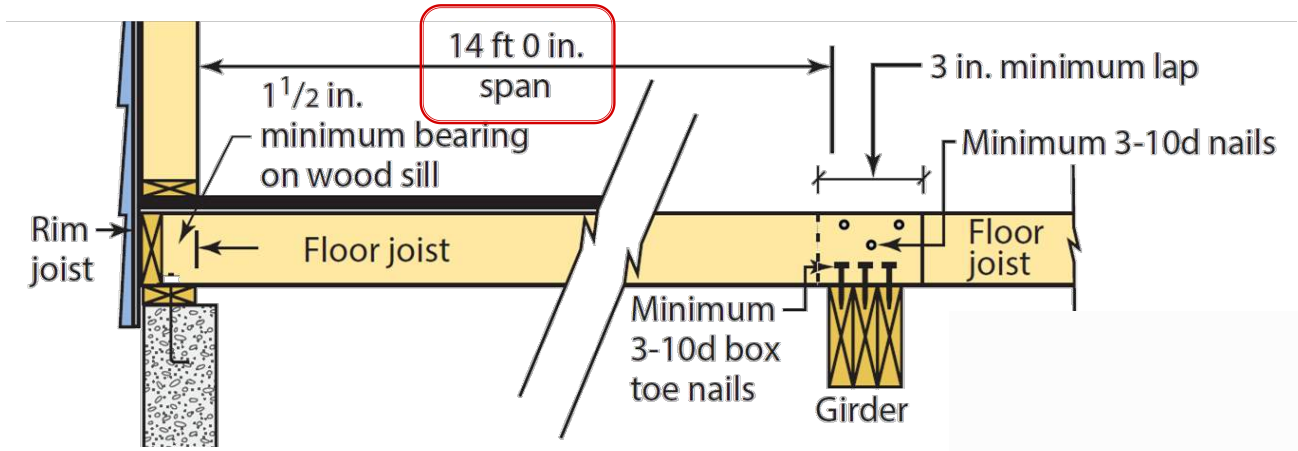
Girder supporting	Size	Building width (ft)		
Two floors		12	24	36
		Span (ft-in.)		
	3-2x12	8-8	6-5	5-4
	4-2x10	8-6	6-4	5-3

APPLICATION

Joist Size and Spacing

1) #2 Douglas fir-larch
2) Live load = 40 psf
3) Dead load = 10 psf

Joist Spacing	Joist Size	Span
12” o.c.	2 x 8	14’ – 2”
16” o.c.	2 x 10	15’ – 7”
24” o.c.	2 x 12	14’ – 9”



Fastener Schedule – Floor Framing

DESCRIPTION	NUMBER AND SIZE OF NAILS	SPACING, LOCATION AND METHOD
Joist to sill, top plate or girder	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	10d box (3" × 0.128") or 3" × 0.131" nails	6" o.c. toe nail
Band or rim joist to joist	4 - 10d box (3" × 0.128") or 4 - 3" × 0.131" nails	End nail
Built-up girders and beams, 2-inch lumber layers	10d box (3" × 0.128") or 3" × 0.131" nails	24" o.c. face nail at top and bottom staggered on opposite sides
	and 3 - 10d box (3" × 0.128") or 3 - 3" × 0.131" nails	Face nail at ends and at each splice

APPLICATION

Deck Footings

1) Determine minimum round concrete footing size for corner and interior posts of a 20’ x 12’ deck
   a) LL = 40 psf and exceeds snow load
   b) Presumed soil bearing pressure = 2,000 psf

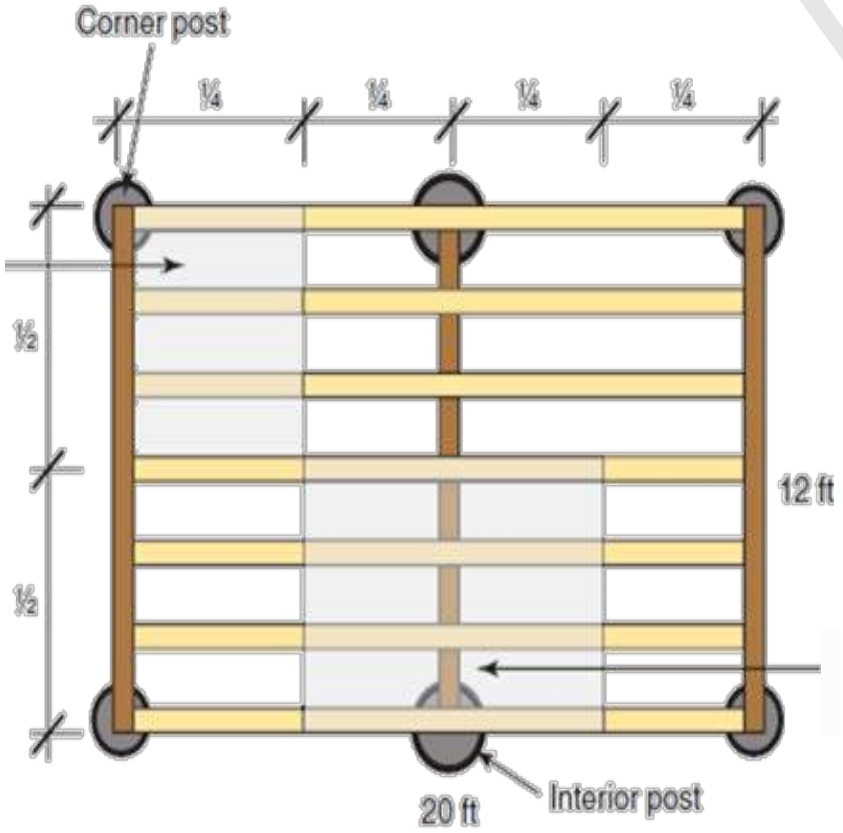
TABLE 6-5 Minimum Cconcrete Footing Size for Decks

LIVE OR GROUND SNOW LOAD (psf)	TRIBUTARY AREA (ft^2)	SOIL BEARING CAPACITY (psf)					
		1,500			2,000		
		Side of a Square Footing	Diameter of a Round Footing	Thickness	Side of a Square Footing	Diameter of a Round Footing	Thickness
40 Live Load	40	16	14	6	14	12	6
	60	19	17	6	17	15	6
	80	22	20	7	19	17	6
	100	25	22	8	21	19	6
	120	27	24	9	23	21	7

APPLICATION

Deck Footings

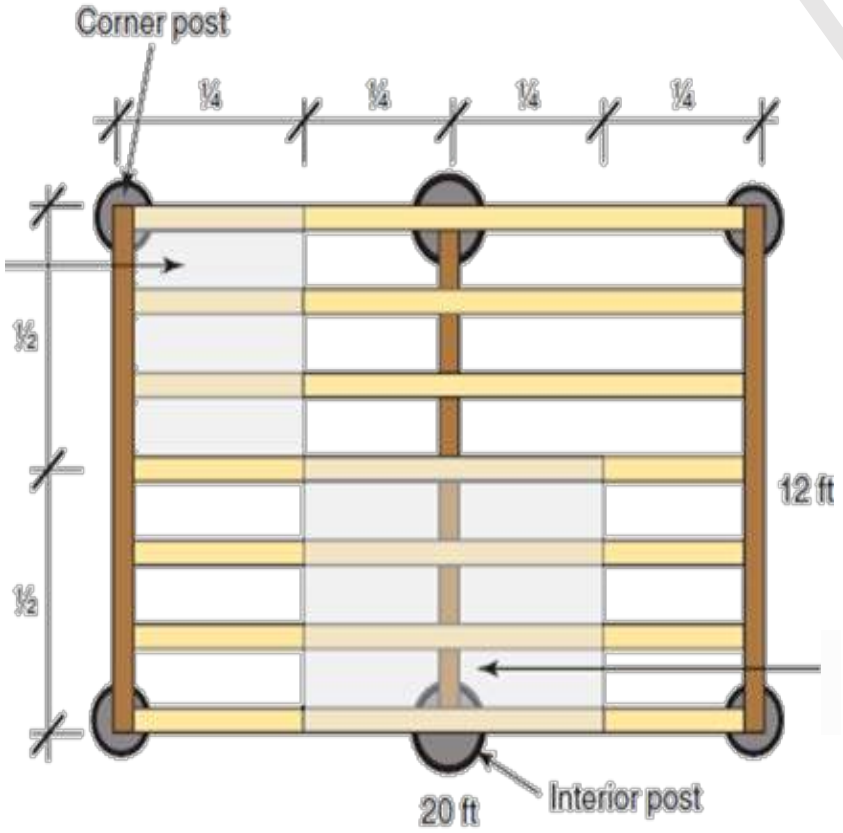
- Tributary area – Corner post
  - Length is ¼ of total length = 20’ × ¼ = 5’
  - Width is ½ of total width = 12’ × ½ = 6’
  - Area = 5’ × 6’ = 30 ft^2



APPLICATION

Deck Footings

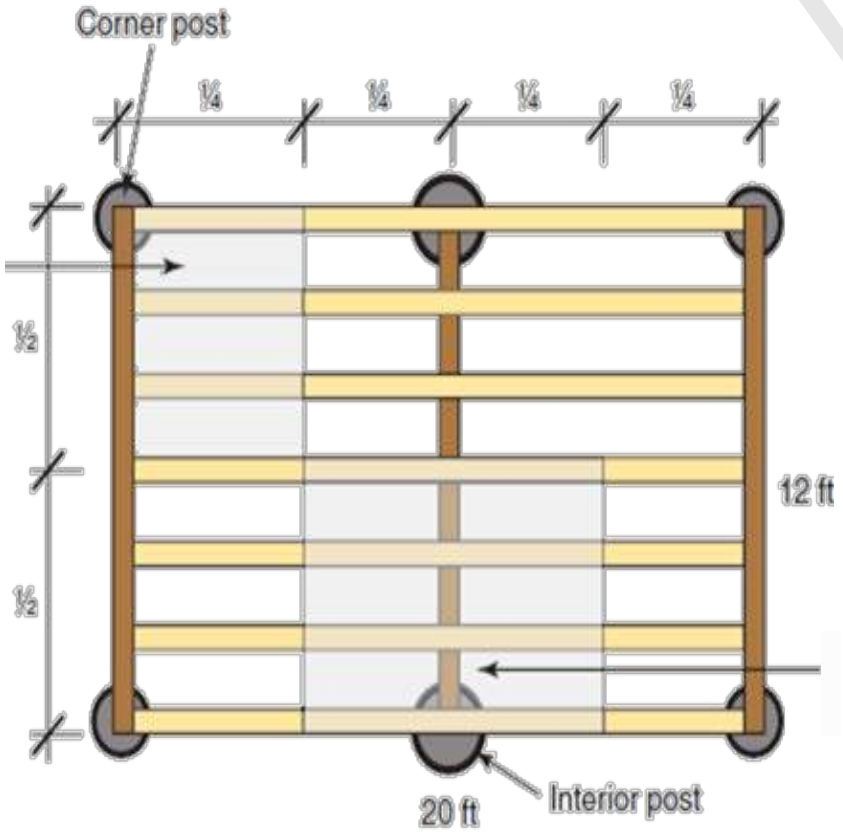
- Tributary area – Interior post
  - Length is ½ of total length = 20’ × ½ = 10’
  - Width is ½ of total width = 12’ × ½ = 6’
  - Area = 10’ × 6’ = 60 ft^2



APPLICATION

Deck Footings

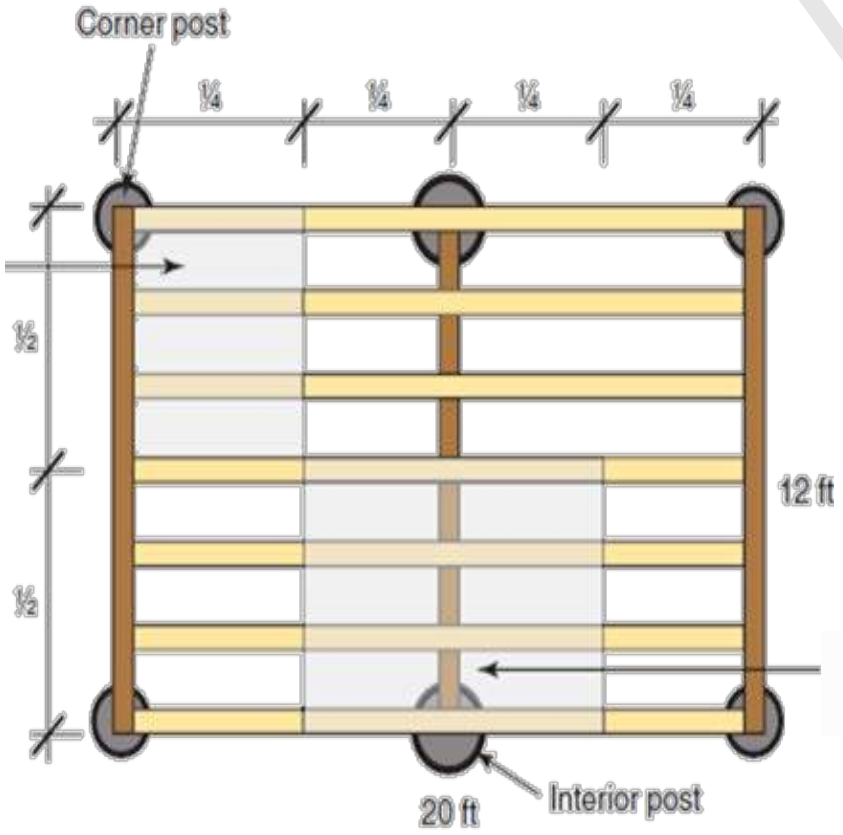
- Footing size – Corner post
  - Min. 14” diameter (12” interpolated)
  - Min. 6” thick



APPLICATION

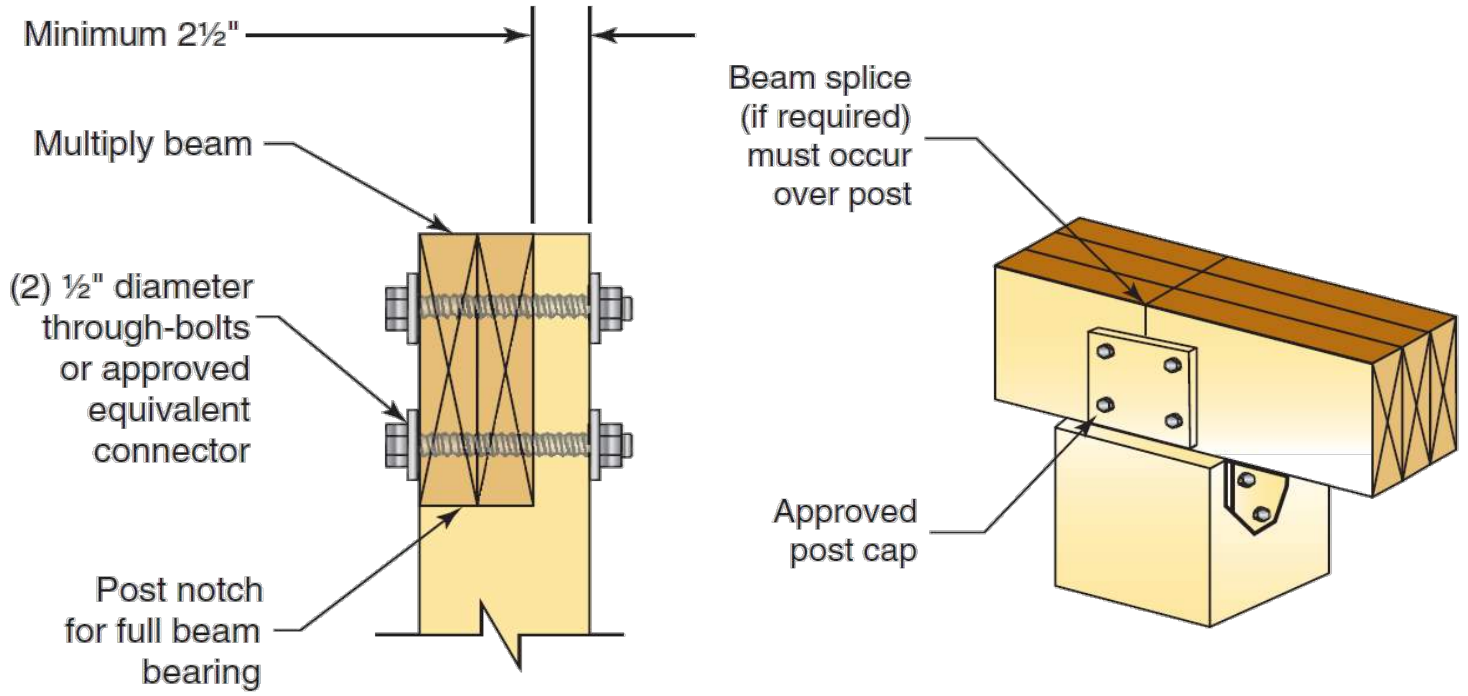
Deck Footings

- Footing size – Interior post
  - Min. 17” diameter
  - Min. 6” thick

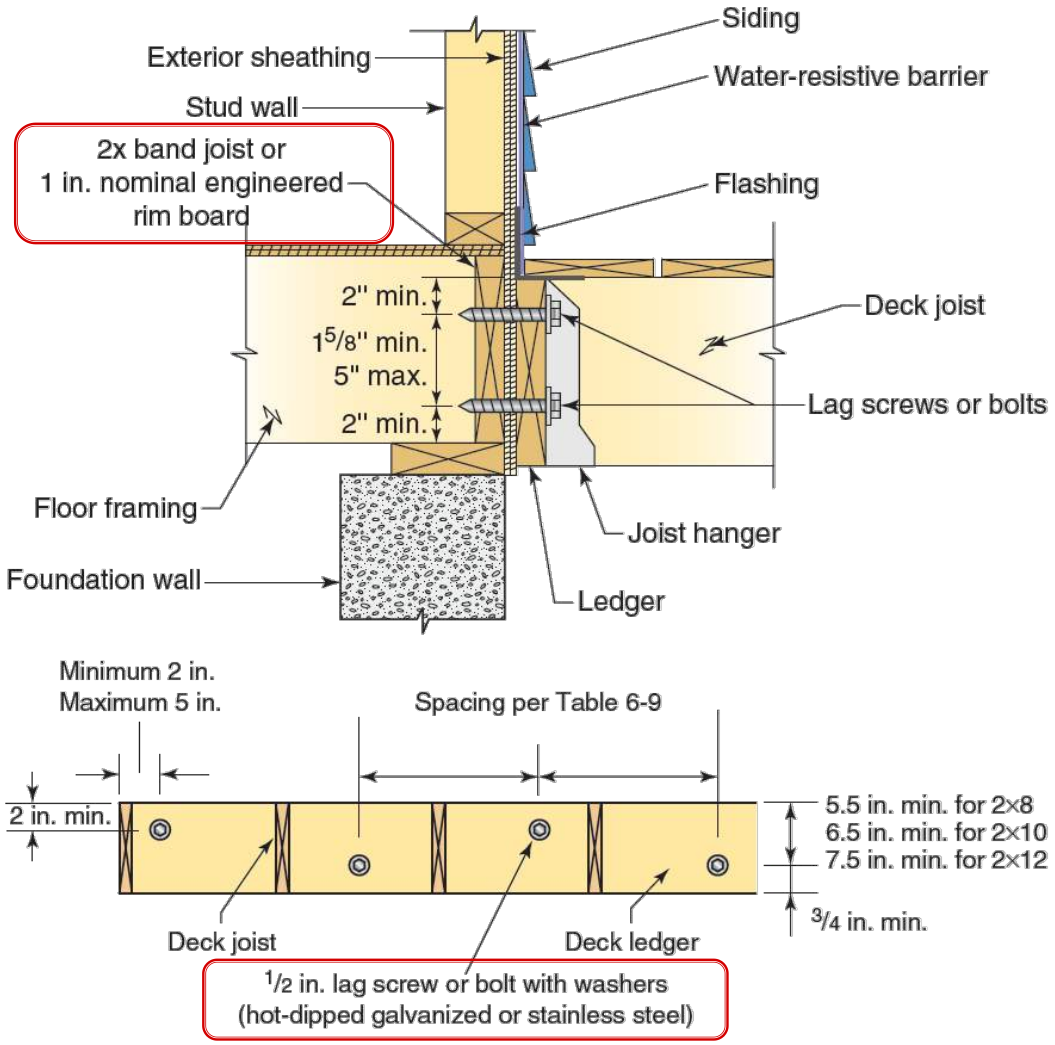


Deck Joists and Beams

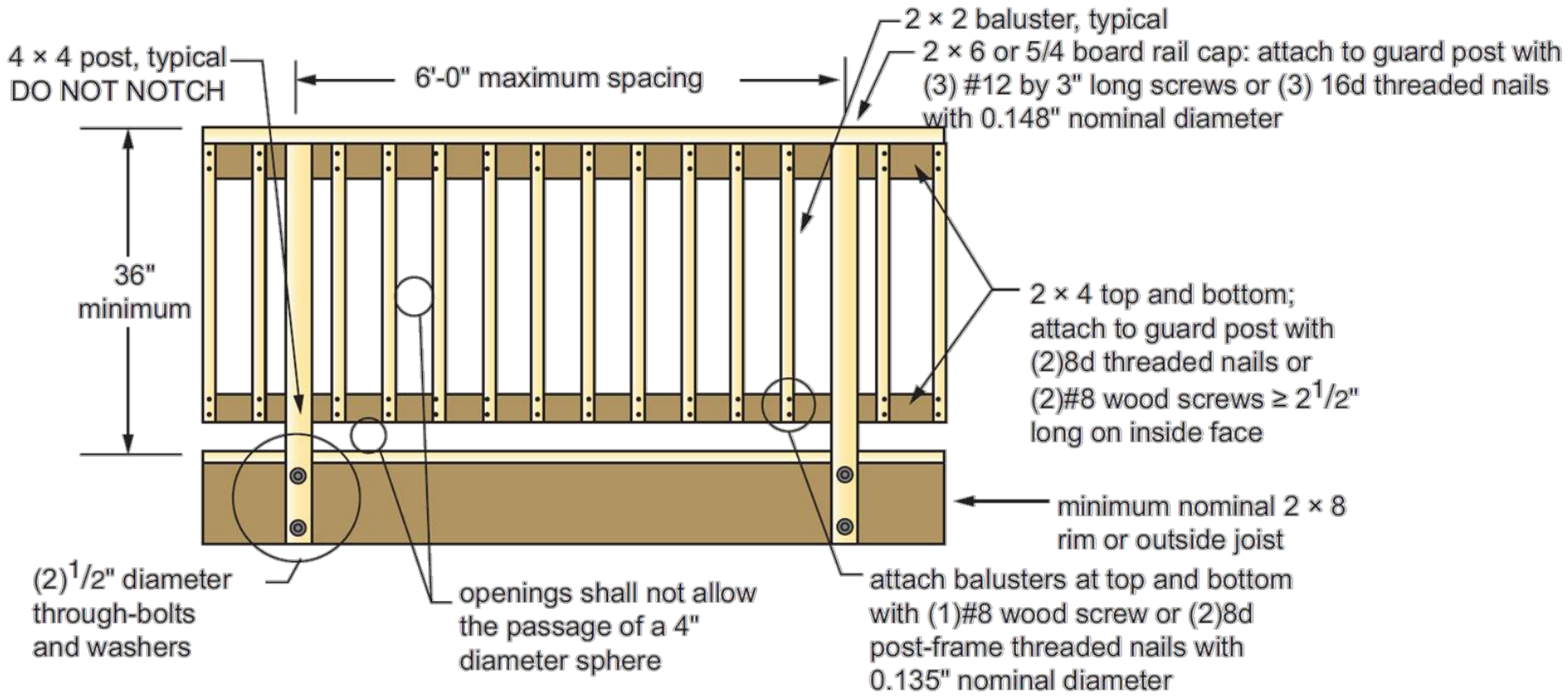
- Prescriptive methods for joists and beams
  - Spans & bearing requirements



Deck Attachment

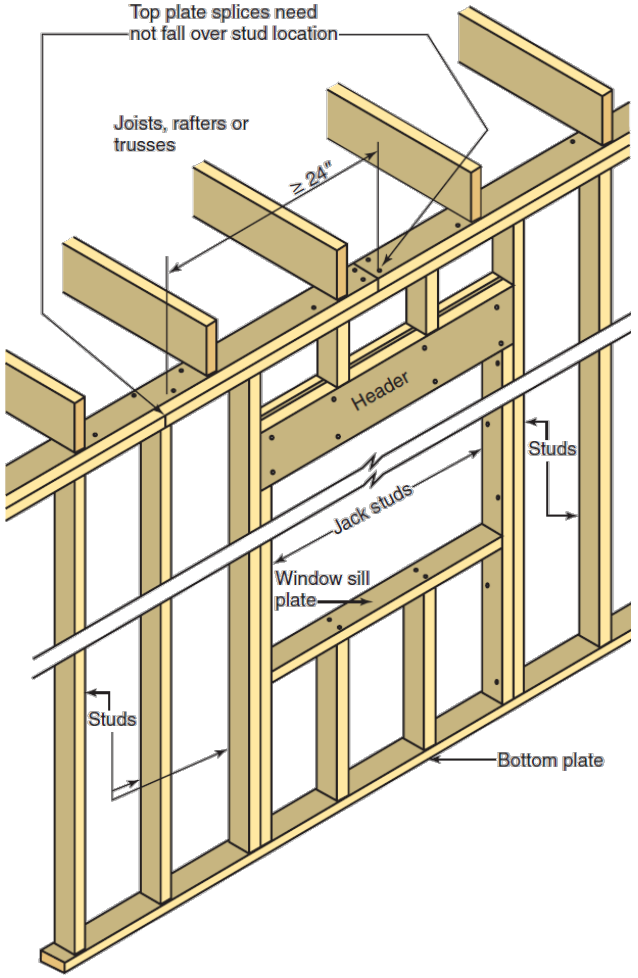


Deck Guards



Wall Framing

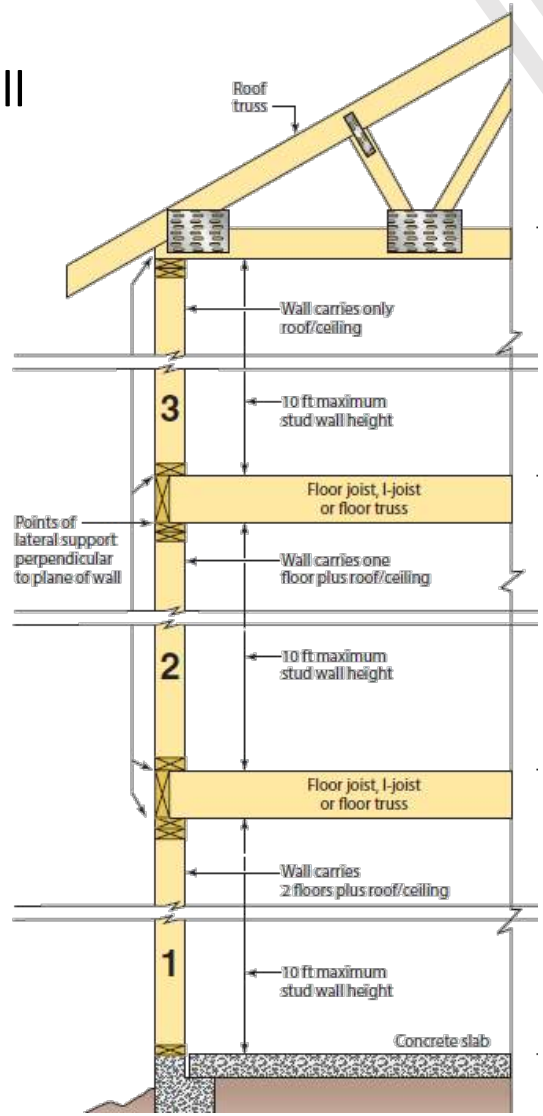
- Size and spacing of studs is related to
  - Number of floors supported
  - Roof-ceiling assembly



APPLICATION

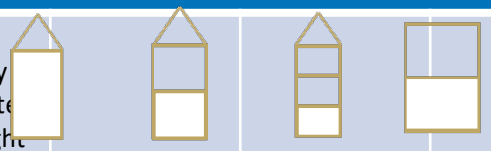
Stud Size and Spacing

1) Determine stud size, height and spacing in an exterior bearing wall
2) Given
   a) 3 stories of wood framing
   b) Standard- or stud-grade lumber



APPLICATION

Stud Size and Spacing

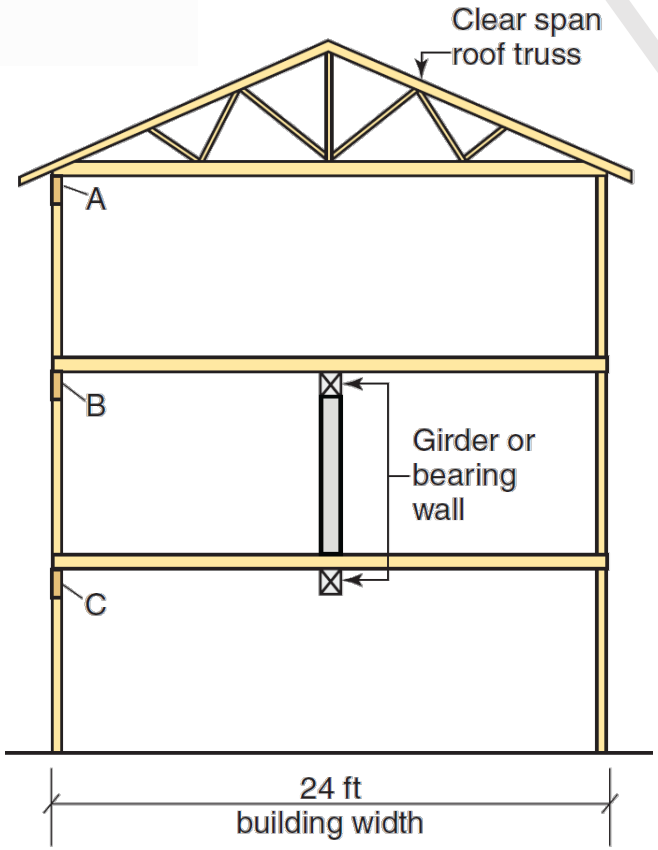
Stud Size (inches)	Bearing Walls					Nonbearing Walls	
	Laterally Unsupported Stud Height					Laterally Unsupported Stud Height	Maximum Spacing
2 x 4	10’	24”	16”	--	24”	14’	24”
2 x 6	10’	24”	24”	16”	24”	20’	24”

Story	Minimum stud size	Maximum spacing
3	2 × 4	24 in.
2	2 × 4	16 in.
	2 × 6	24 in.
1	2 × 6	16 in.

APPLICATION

Exterior Wall Headers

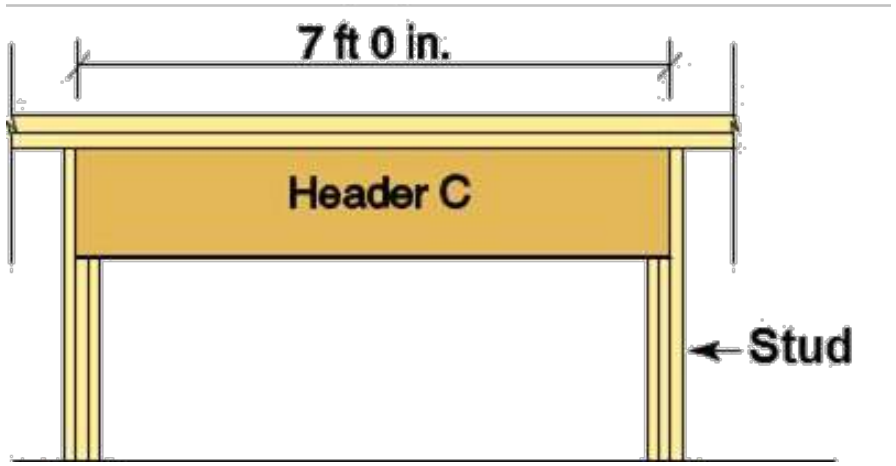
- Given
  - #2 Douglas fir-larch
  - Clear span roof truss
  - Center bearing floor framing
  - Building width = 24’
  - Header span = 7’
  - Ground snow load = 30 psf
  - Wind = 115 mph Exp C



APPLICATION

Exterior Wall Headers

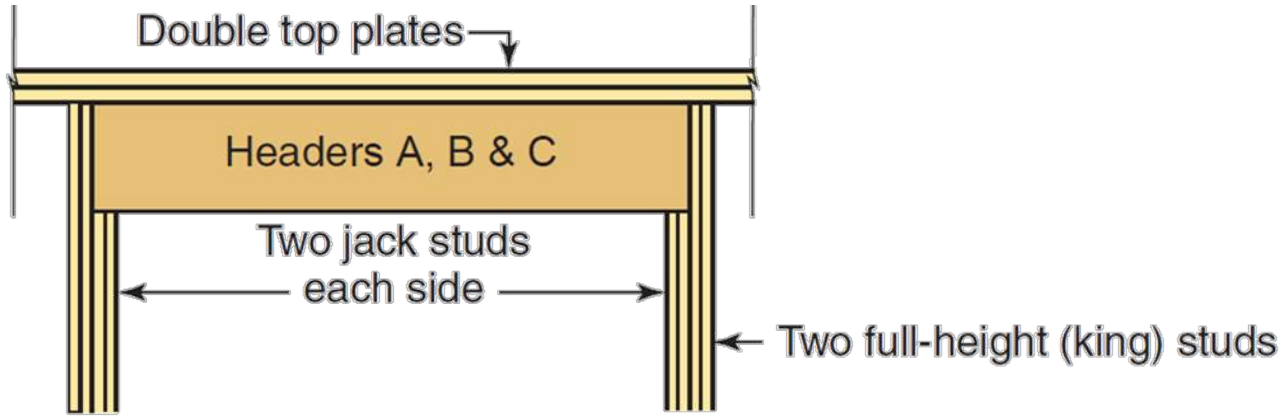
Ground snow load = 30 psf Building width = 24 feet			
Supporting	Size	Span	Jack studs
Roof, ceiling, two center-bearing floors	3-2x10	5-11	2
	3-2x12	7-0	2



APPLICATION

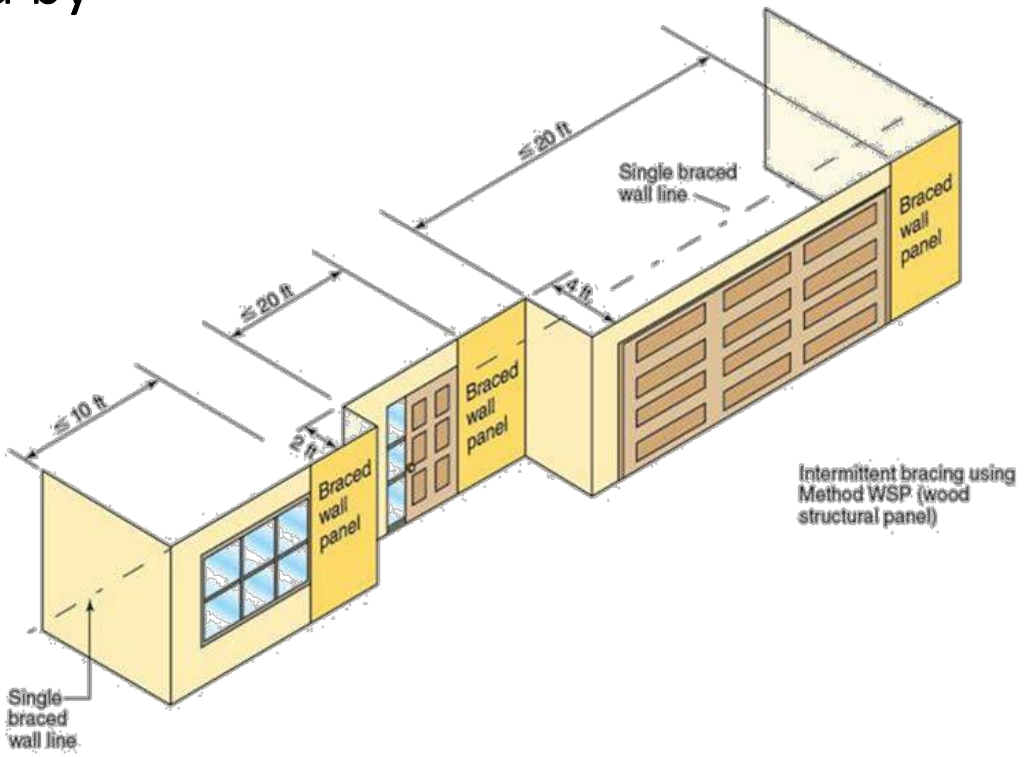
Exterior Wall Headers

MAXIMUM HEADER SPAN (FEET)	ULTIMATE DESIGN WIND SPEED AND EXPOSURE CATEGORY	
	≤ 115 MPH, EXPOSURE B	< 140 MPH, EXPOSURE B OR < 130 MPH, EXPOSURE C
4	1	1
6	1	2
8	1	2



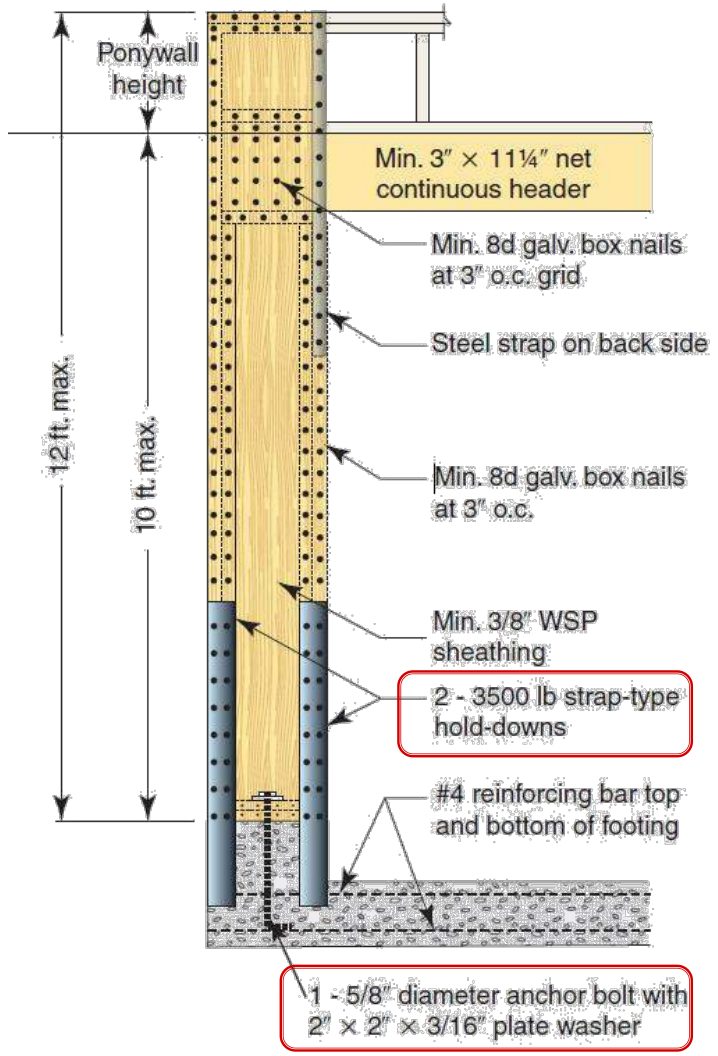
Wall Bracing

- Provides resistance to lateral racking, primarily wind and seismic forces
- Bracing amount/location determined by
  - Number of stories
  - Seismic design category
  - Design wind speed
  - Bracing method



Method PFH Braced Wall Panels

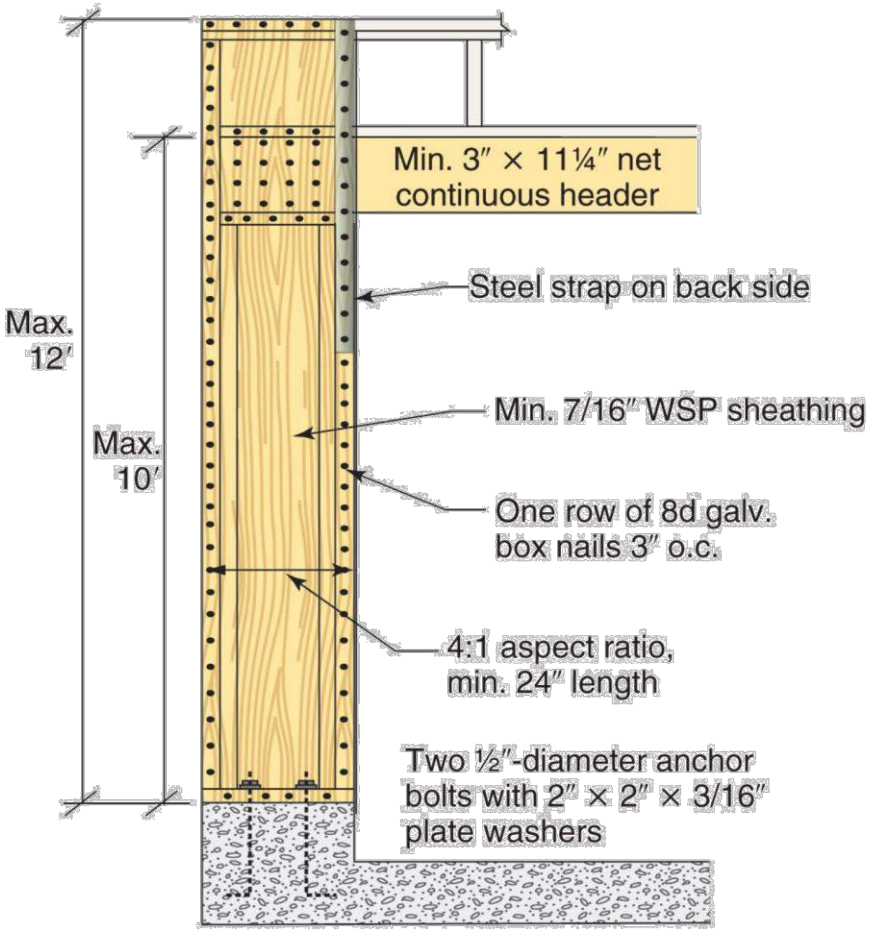
- Portal Frame with Hold-Downs



Method PFG Braced Wall Panels

Portal Frame with anchor bolts at garage doors

- SDC A, B and C



Ceiling Joists

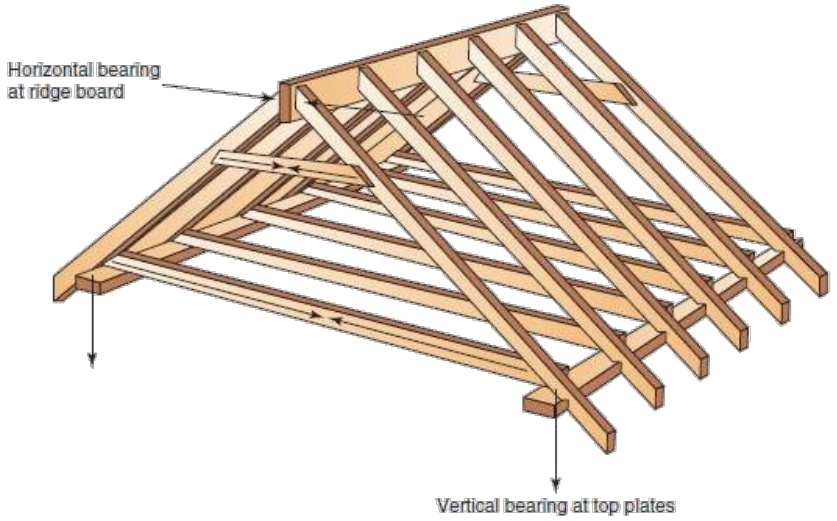
- Ceiling joists
  - Support ceiling materials
  - Serve as rafter ties to resist outward thrust of rafters at top of bearing walls
  - Require adequate connection to rafters and top of wall

Ceiling Joists

- Ceiling joist spans for
  - Attics without storage
  - Attics with limited storage
    - Attics with fixed stair access require joists sized as floor joists

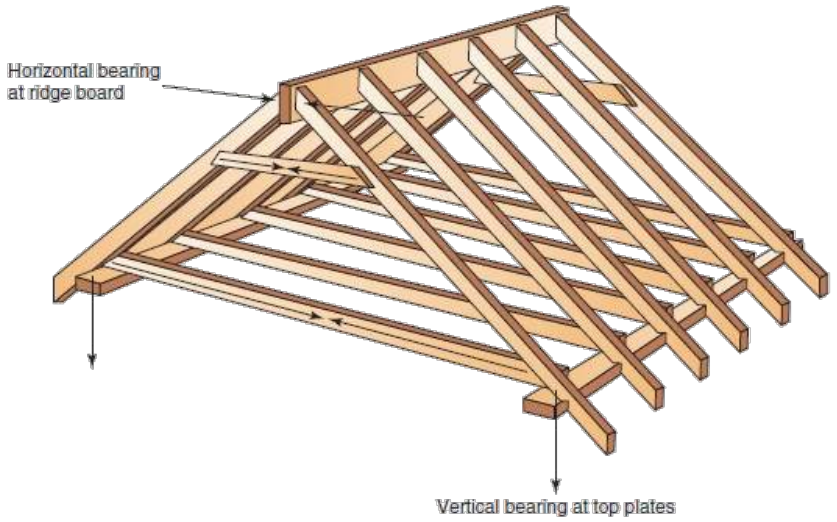
Rafters

- Rafter spans based on
  - Snow load of geographic area
  - Roof live load of 20 psf where snow load <30 psf
  - Whether ceiling material is attached to bottom of rafter



Rafters

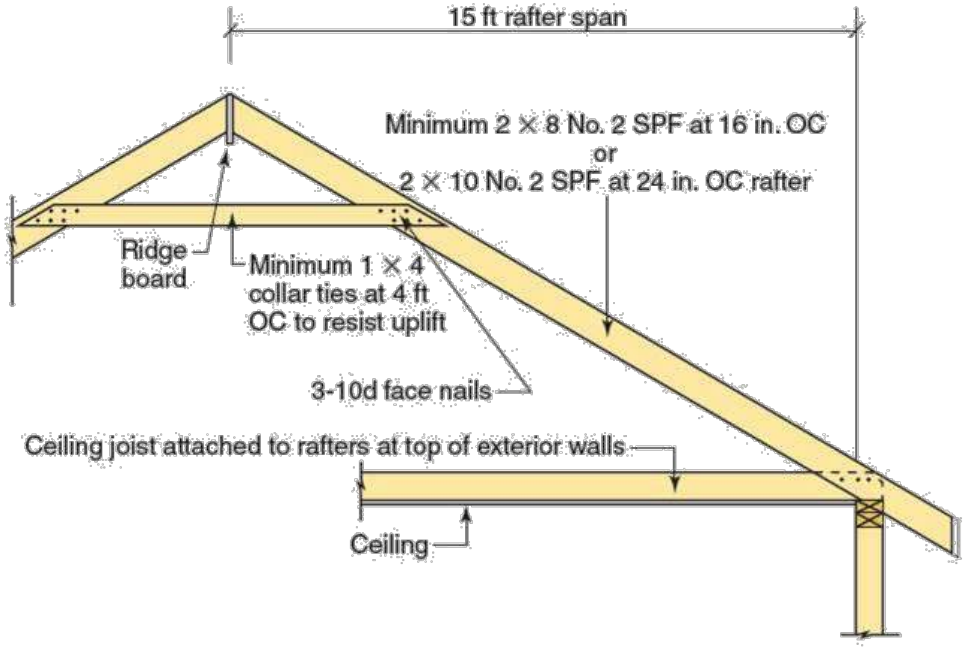
- Connection to ceiling joists
  - Rafters are connected to ceiling joists at top plate or
  - 2x4 rafter ties are required to resist outward thrust on walls



APPLICATION

Rafter Size and Spacing

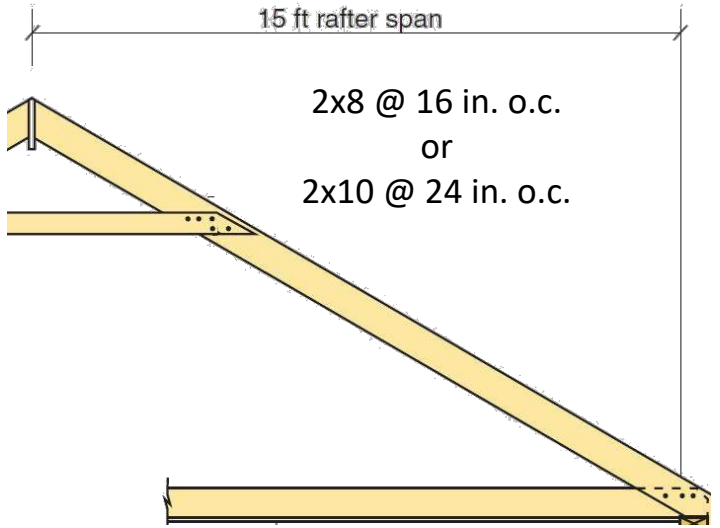
- Given
- #2 Spruce-pine-fir lumber
- Span = 15’
- Ground snow load = 30 psf
- Dead load = 10 psf
- Ceiling sheathing not attached to rafters



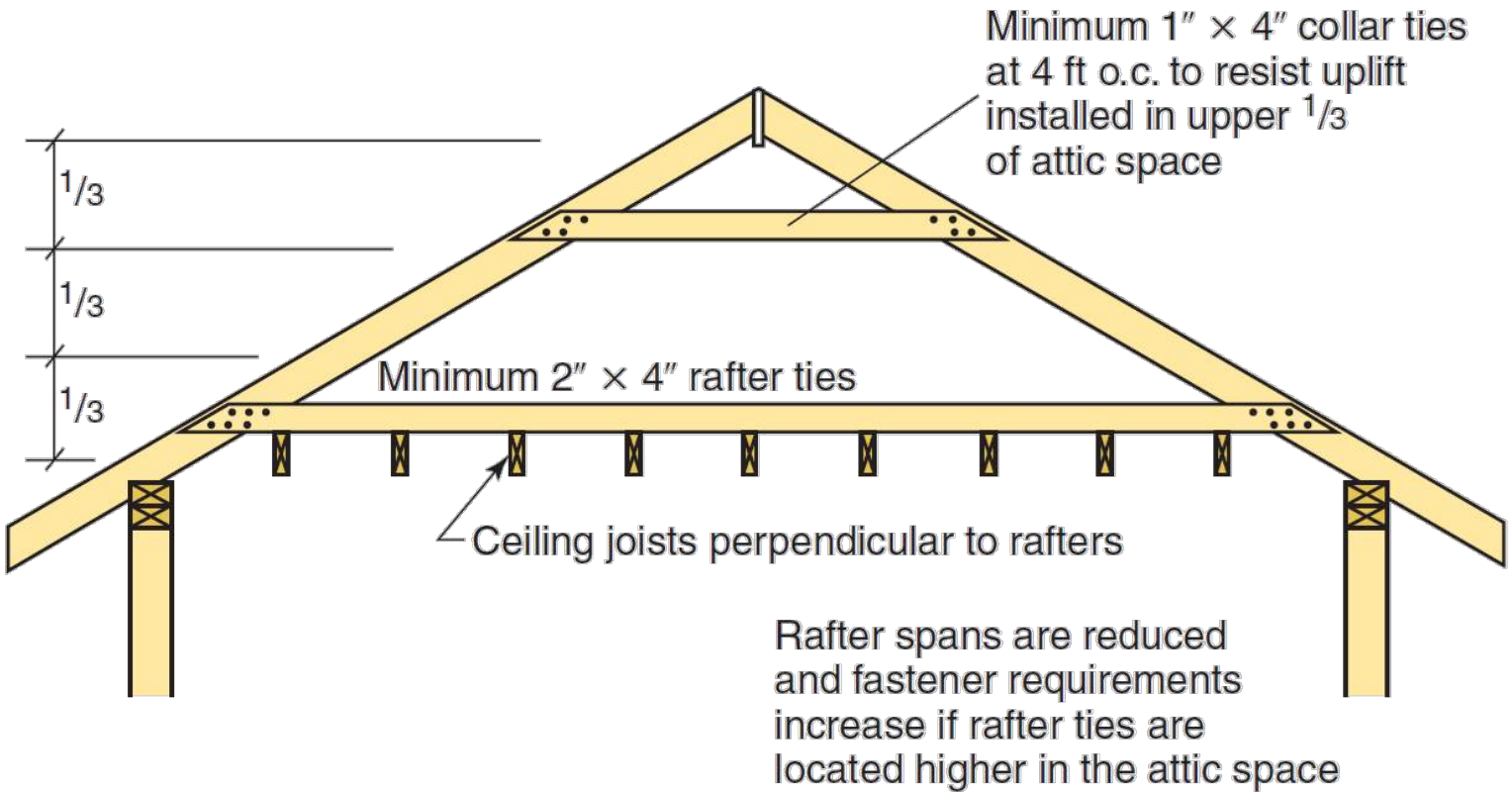
APPLICATION

Rafter Size and Spacing

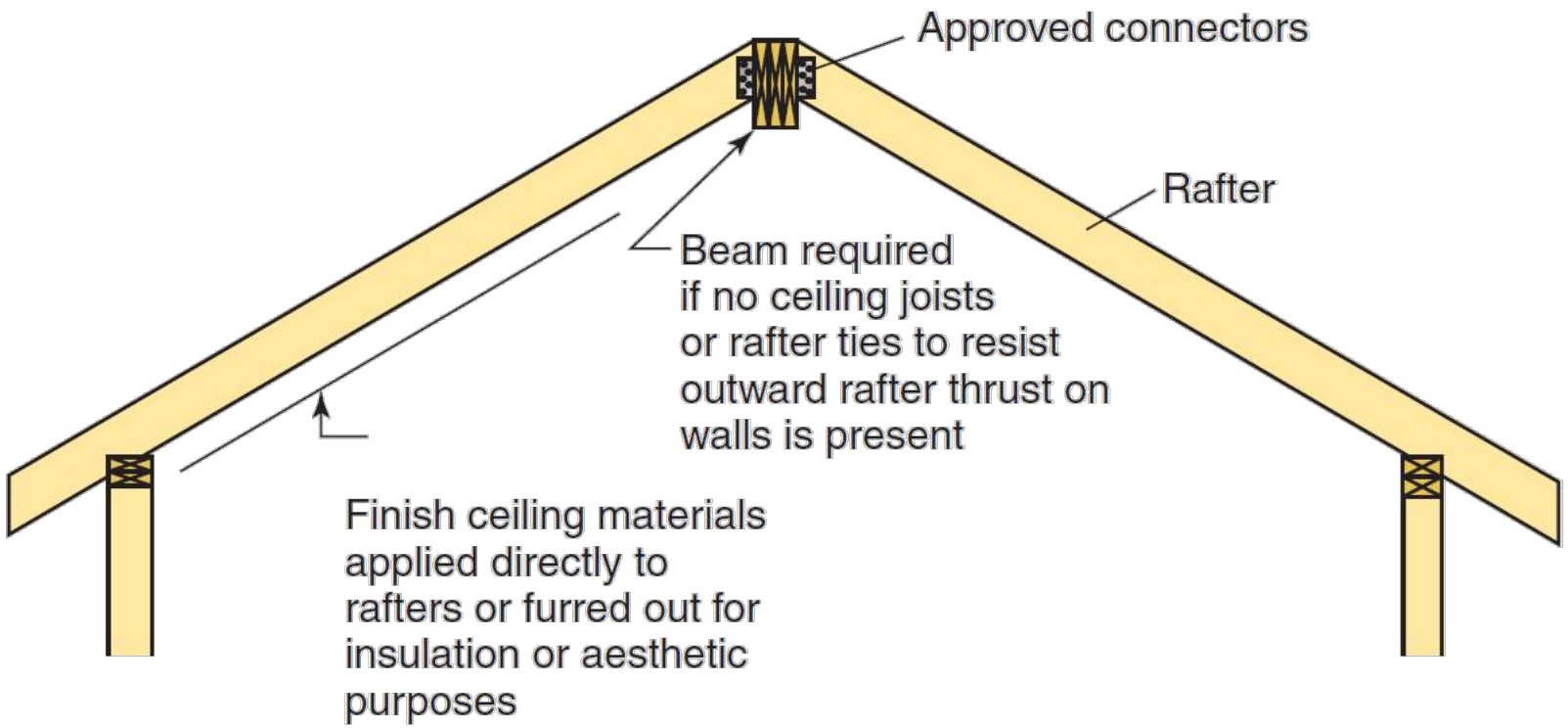
Rafter Spacing (inches)	Species and Grade	Dead Load = 10 psf		
		2 x 6	2 x 8	2 x 10
		Maximum rafter spans		
		ft - in	ft - in	ft - in
16	Spruce-pine-fir #2	11-11	15-1	18-5
24	Spruce-pine-fir #2	9-9	12-4	15-1



Rafter Ties and Collar Ties



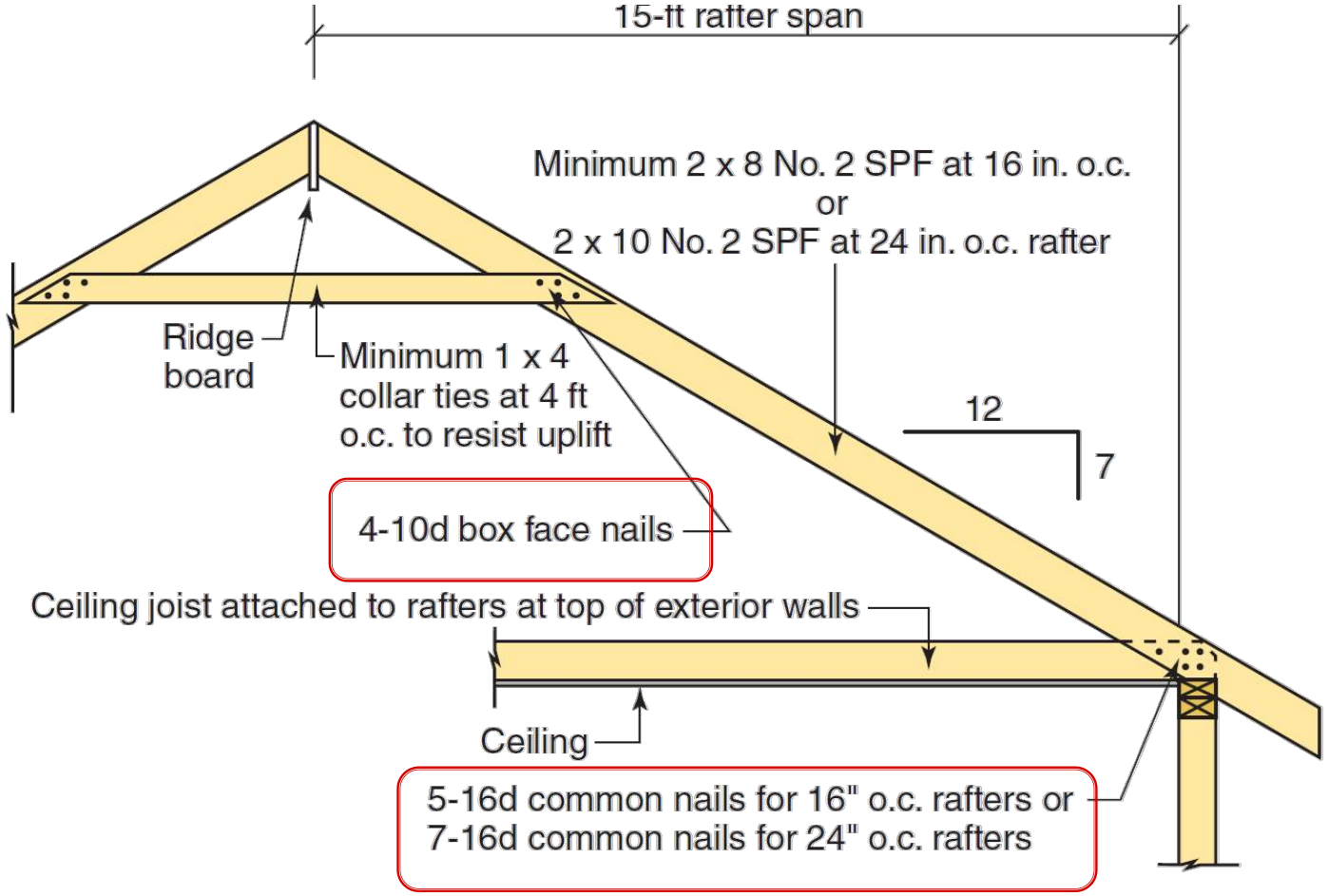
Ridge Beams



Fastener Schedule for Roof Framing

Description	Nails	Location
Rafter or roof truss to plate	4-10d box	Toenails: 2 on one side and 1 on opposite side
Roof rafters to 2x ridge beam	3-10d box	End nail
Ceiling joists to plate	3-10d box	Toenail
Collar tie to rafter	4-10d box	Face nail
Rafter/ceiling joist heel joint connection	Table R802.5.2(1)	Face nail

Fastener Schedule for Roof Framing

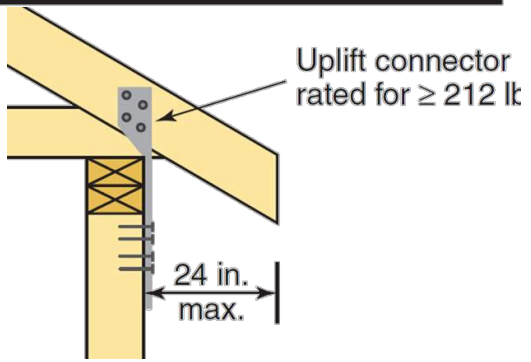


Roof Uplift Connections

- ≤200 lbs
  - Toenail connection
- >200 lbs
  - Connector required

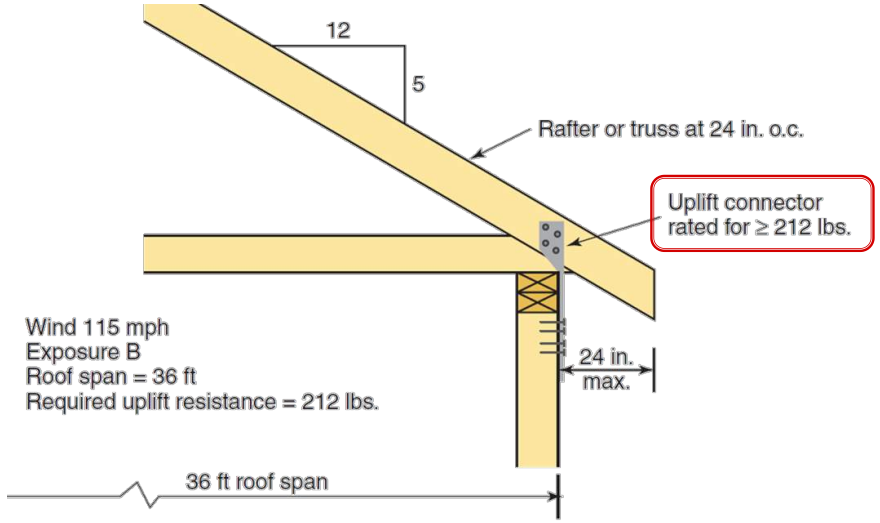
TABLE 6-17 Rafter or Truss Uplift Connection Forces from Wind (pounds per connection)

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B Ultimate Design Wind Speed (mph) 115 Roof Pitch	
		< 5:12	≥ 5:12
16 in. o.c.	28	132	117
	32	145	129
	36	160	141
24 in. o.c.	28	198	176
	32	218	194
	36	240	212



APPLICATION

Roof Uplift Connection



Uplift Load, lbs			
Rafter or Truss Spacing	Roof Span	Roof Pitch	
		< 5:12	≥ 5:12
24” o.c.	28’	198	176
	32’	218	194
	36’	240	212

Roof Sheathing

Span Rating	Minimum Nominal Panel Thickness (in.)	Maximum Span (in.)		Load (psf)	
		With Edge Support	Without Edge Support	Total Load	Live Load
Sheathing		Roof			
16/0	3/8	16	16	40	30
20/0	3/8	20	20	40	30
24/0	3/8	24	20	40	30
24/16	7/16	24	24	50	40

Excerpted from Table R503.2.1.1(1)

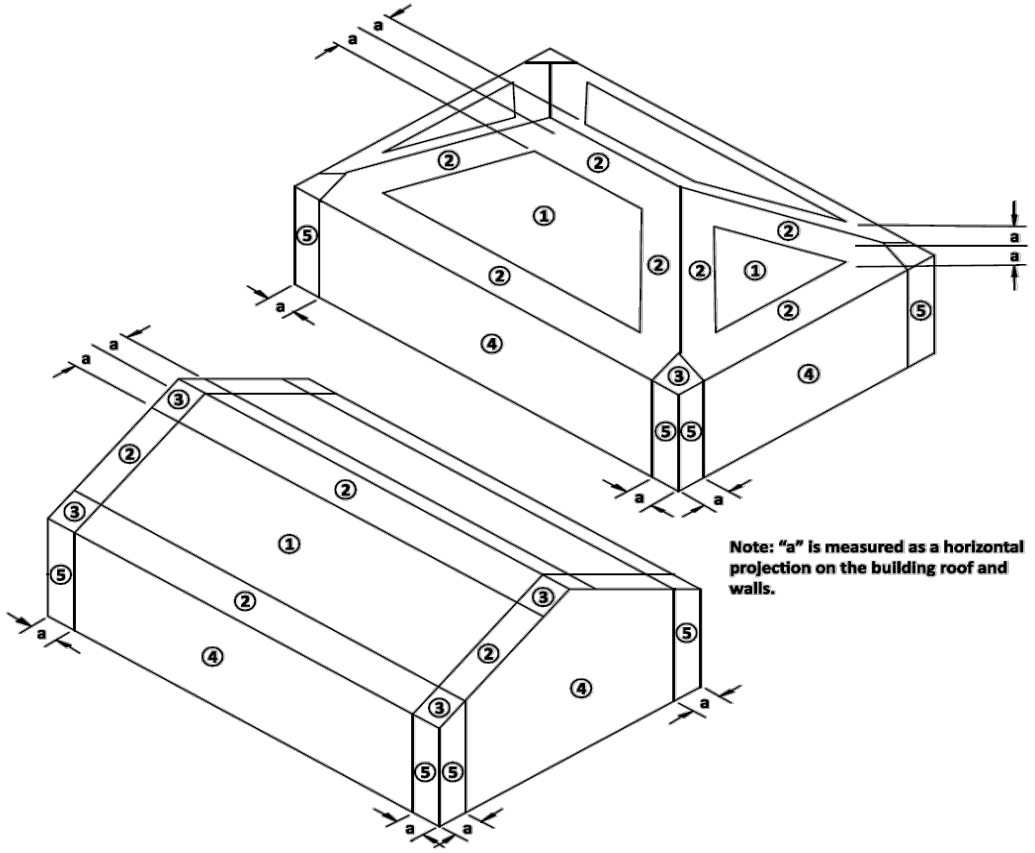
Roof Sheathing – Fastener Schedule

WSP Nominal Thickness (in.)	Nail	Edge (in.)	Field (in.)
3/8 – 1/2	8d common or RSRS-01 nail	6[f]	6[f]
19/32 – 3/4	8d common or RSRS-01 nail	6[f]	6[f]
7/8 – 1-1/4	10d common	6	12

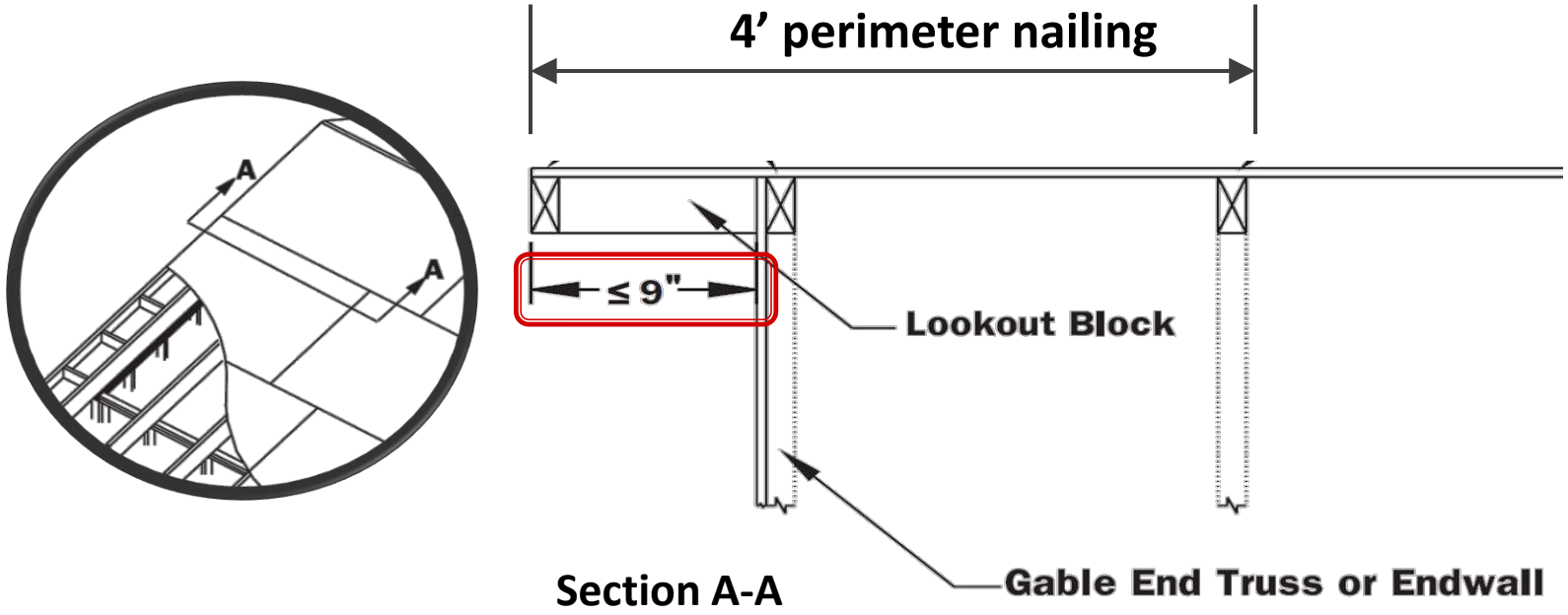
f. For WSP roof sheathing attached to gable end roof framing and to intermediate supports within 48” of roof edges and ridges, nails shall be spaced at 4” o.c. where the ultimate design wind speed is greater than 130 mph in Exposure B or greater than 110 mph in Exposure C.

Tighter Roof Sheathing Fastener Schedule

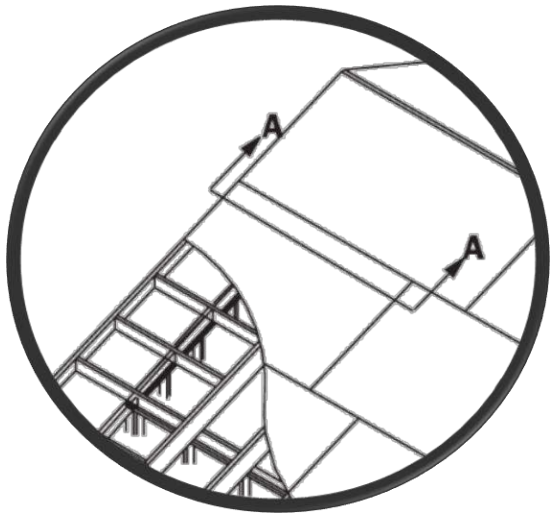
- Wind speed
  - >130 mph Exp B
  - >110 mph Exp C
- Framing w/i 48” of roof edge/ridge/eave
  - Including gable end roof framing
- Nails at 4” o.c.
  - Edge & field

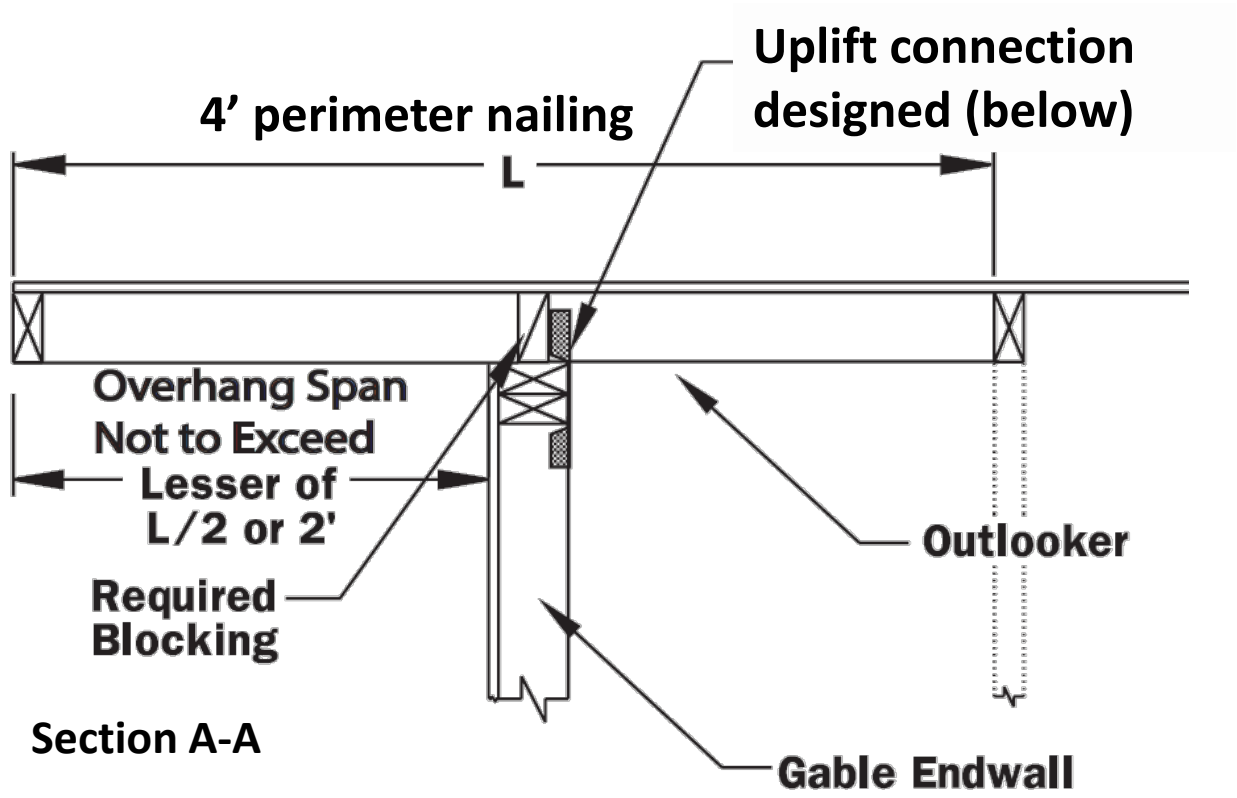


Roof Sheathing – Gable Endwall Limits



Roof Sheathing – Gable Endwall Limits





Section A-A

Attic Ventilation and Access

- Total net free ventilating area = 1/150 of attic area
  - Reduced to 1/300 with certain conditions
  - Unvented attics under certain conditions
- Access required when
  - Attic area >30 ft^2, and Attic height >30”
- Access opening
  - Minimum 22” x 30” and 30” headroom above the opening
  - Located in hallway or other accessible location

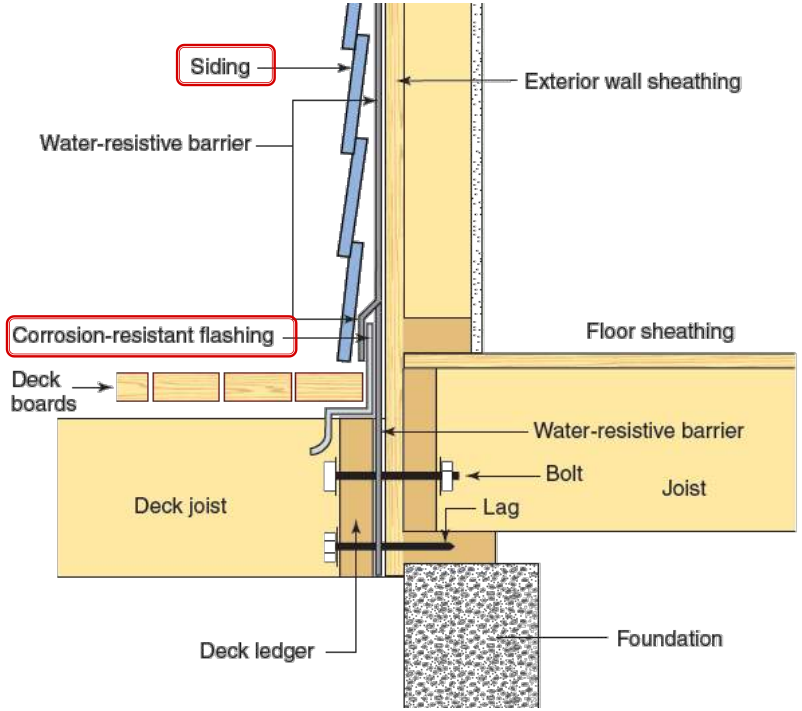
Finishes and Weather Protection

Interior Finishes

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

Exterior Wall Covering

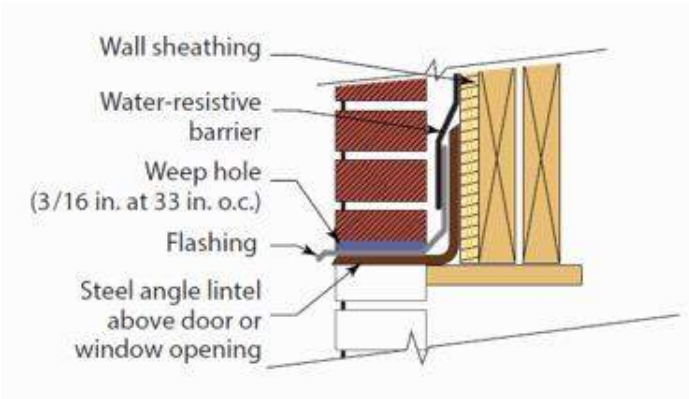
- Weather-resistant exterior wall assembly
  - Water-resistive barrier required over sheathing of all exterior walls
  - Flashing
  - Siding or veneer

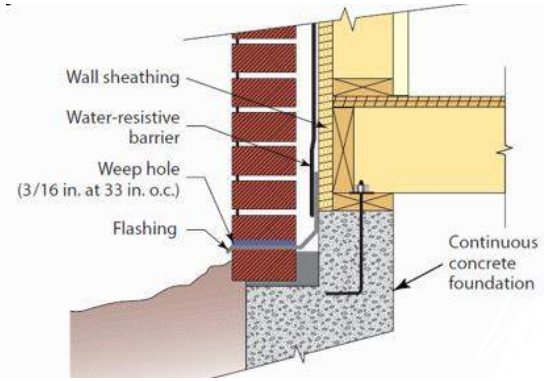


Masonry and Stone Veneer

- SDC A, B or C
  - < 3 stories and < 30’ above noncombustible foundations
  - Additional 8’ for gable end walls
  - 5” maximum thickness
  - Weight < 50 psf

- SDC D_0, D_1, or D_2
  - Reduced height, weight and thickness





APPLICATION

Steel Lintel Size

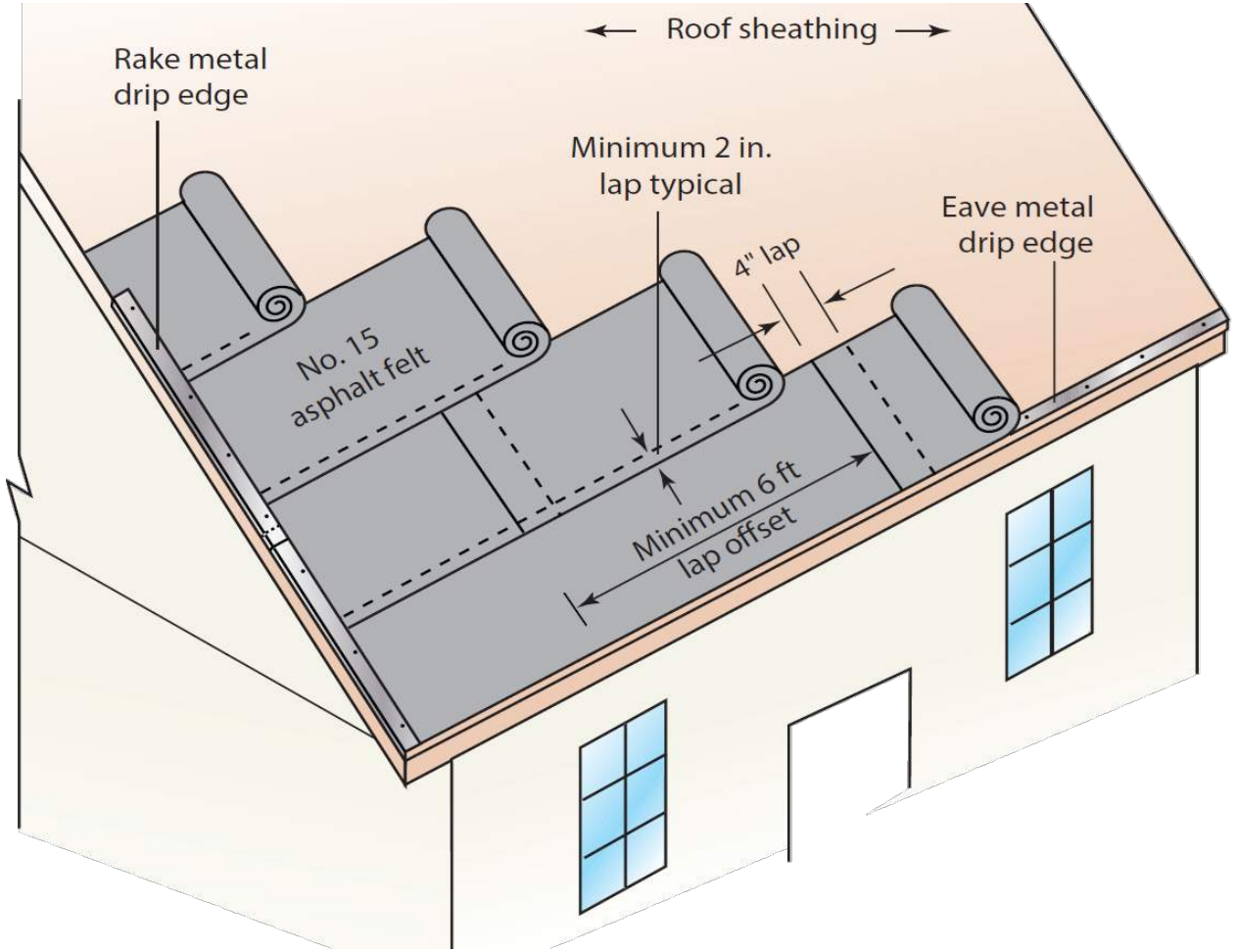
- Determine minimum size of a steel lintel supporting masonry veneer
  - Stories above = 1
  - Span = 6’0”

SIZE OF STEEL ANGLE (in.)	NO STORY ABOVE	ONE STORY ABOVE
3 × 3 × ¼	6′-0″	4′-6″
4 × 3 × ¼	8′-0″	6′-0″
5 × 3½ × 5⁄16	10′-0″	8′-0″
6 × 3½ × 5⁄16	14′-0″	9′-6″
2 – 6 × 3½ × 5⁄16	20′-0″	12′-0″

[Ref. Table R703.8.3.1]

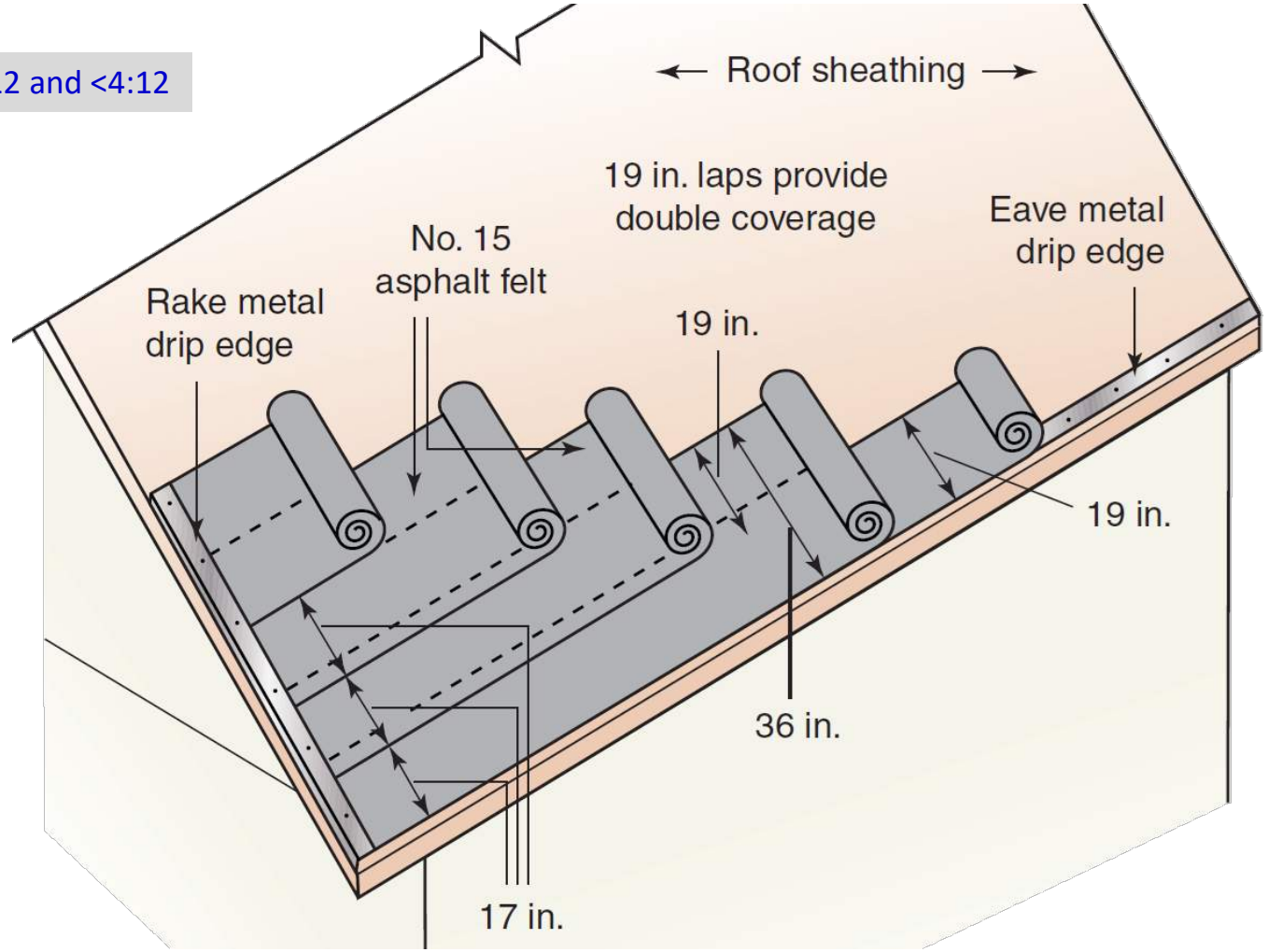
Note: Long leg of the angle shall be placed in a vertical position.

Underlayment for Asphalt Shingles



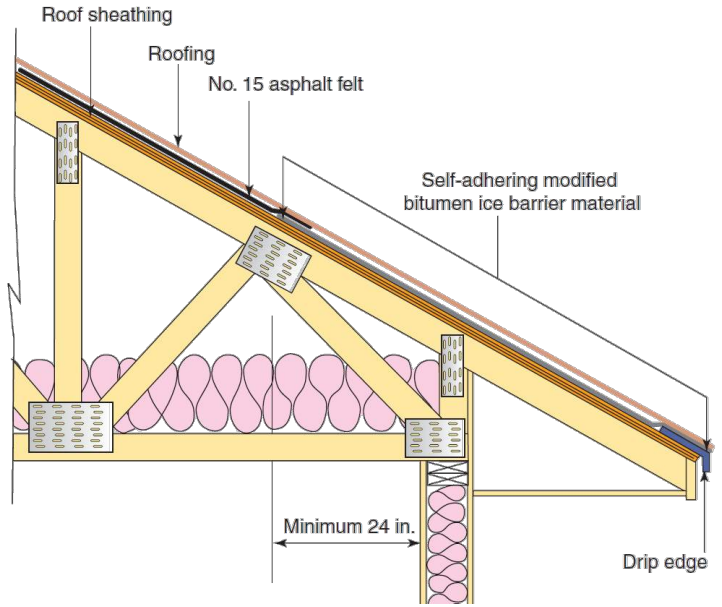
Underlayment for Asphalt Shingles

Slope ≥2:12 and <4:12

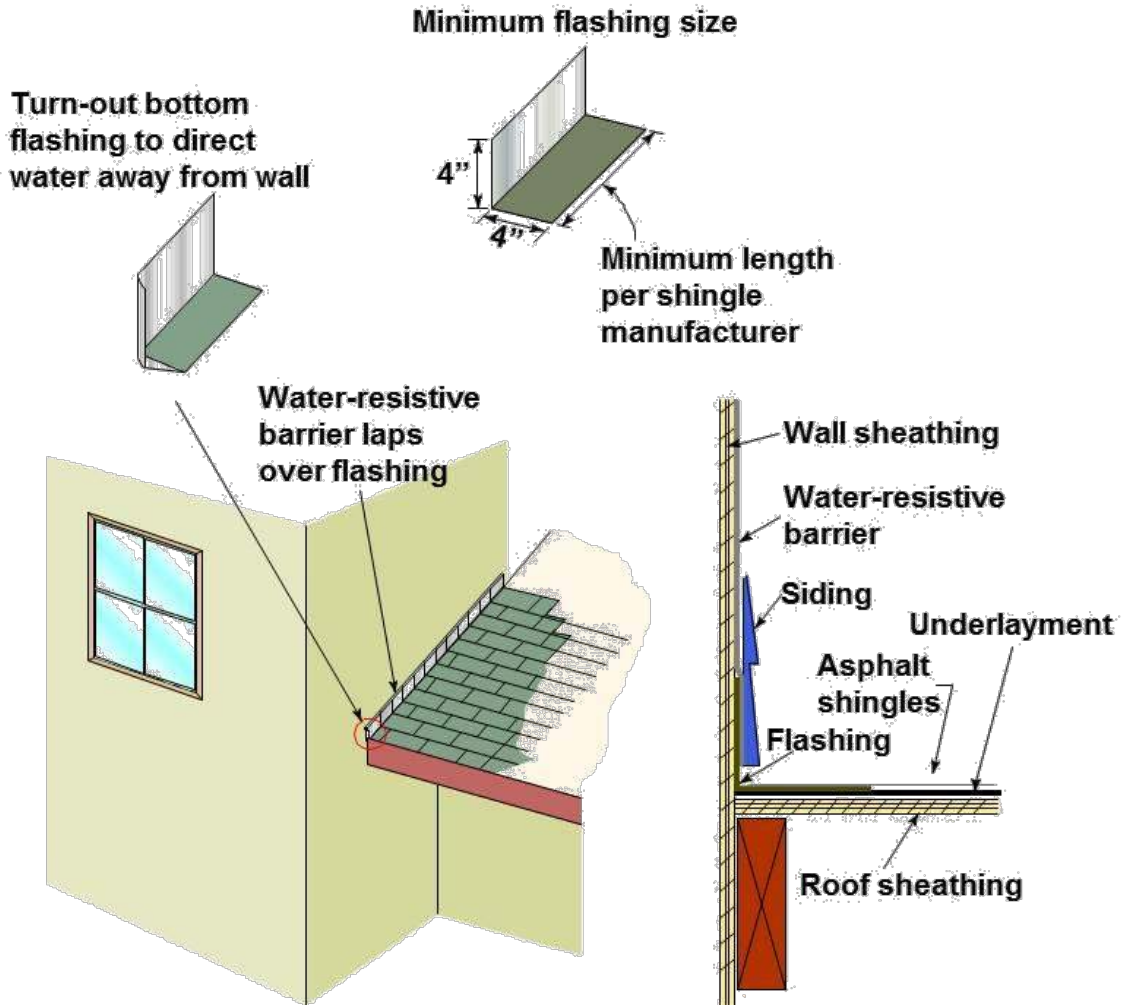


Ice Barriers

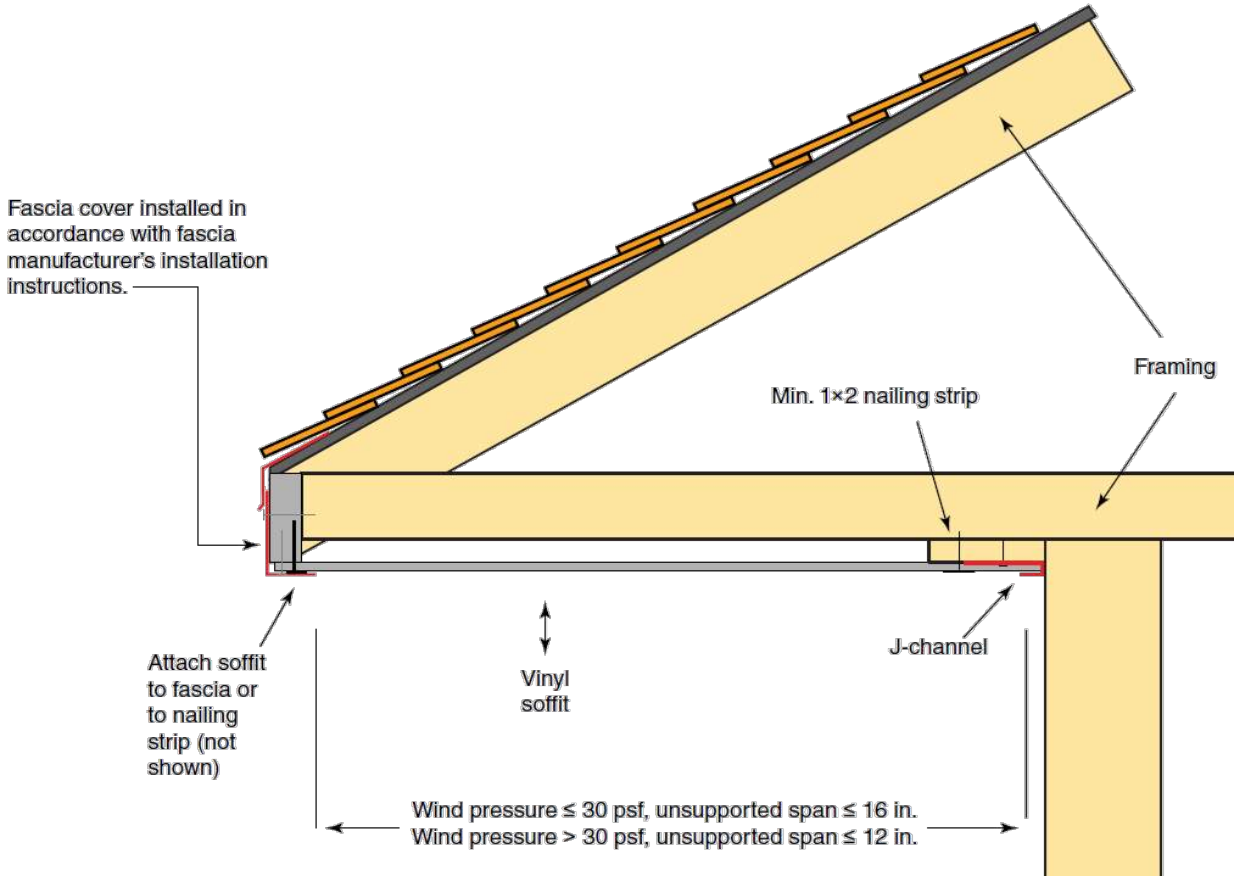
- Required where water damage due to ice dams at roof eaves occurs



Flashing



Soffits



Health and Safety

Ceiling Height

7’-0”

Generally, this is the height used.

6’-8”

- Bathrooms
- Laundry rooms
- Basements w/o habitable space

6’-6”

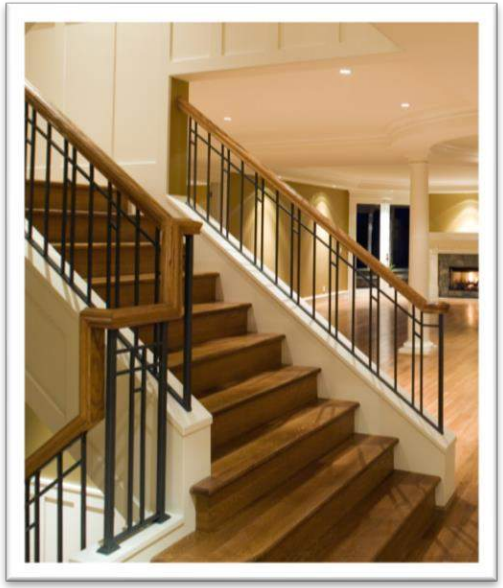
Beams ≥36” apart

6’-4”

- Basements with habitable space
  - Beams
  - Girders
  - Ducts
  - Other obstructions

Means of Egress

- Describes travel path from any location in a dwelling to exterior
  - Stairways, Ramps, Hallways
  - Doors
    - One side-swinging egress door to exterior
    - Minimum 32” x 78” clear opening
    - No size or type requirements for other doors
    - No limits on travel distance

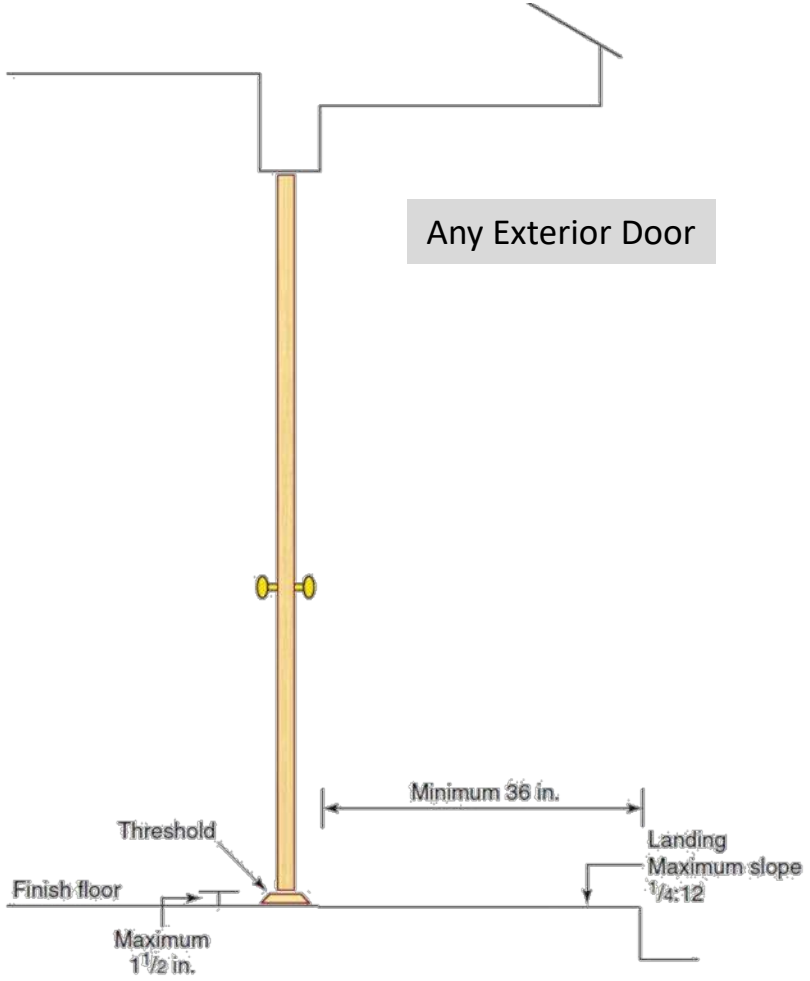


Means of Egress

- Provide safe path to exterior
  - Does not pass through garage
  - ½” gypsum board on enclosures under stairs
  - Egress components securely anchored to structure
  - Required egress door can be opened without key or special knowledge
  - Access to grade at required egress door

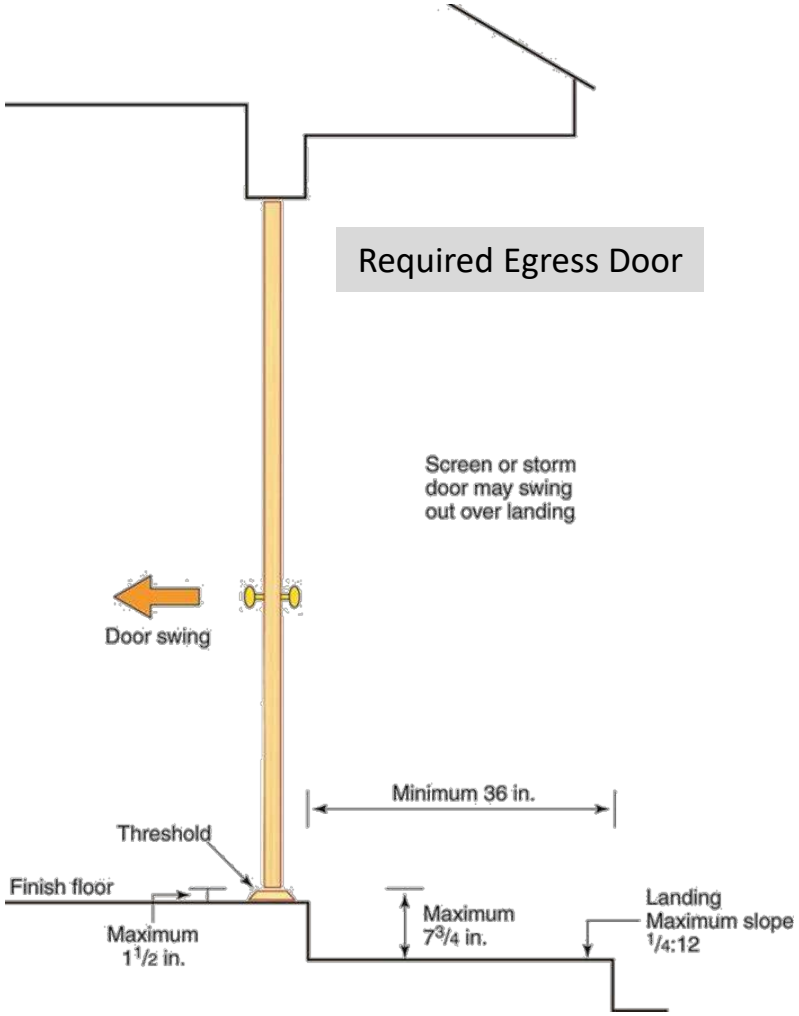
Landings at Exterior Doors

- Landing or floor on each side of exterior door
  - At least as wide as door
  - Landings or finished floors ≤ 1½" below threshold
  - ≥ 36" in travel direction
    - Exception for balconies
  - Max. landing slope = ¼:12



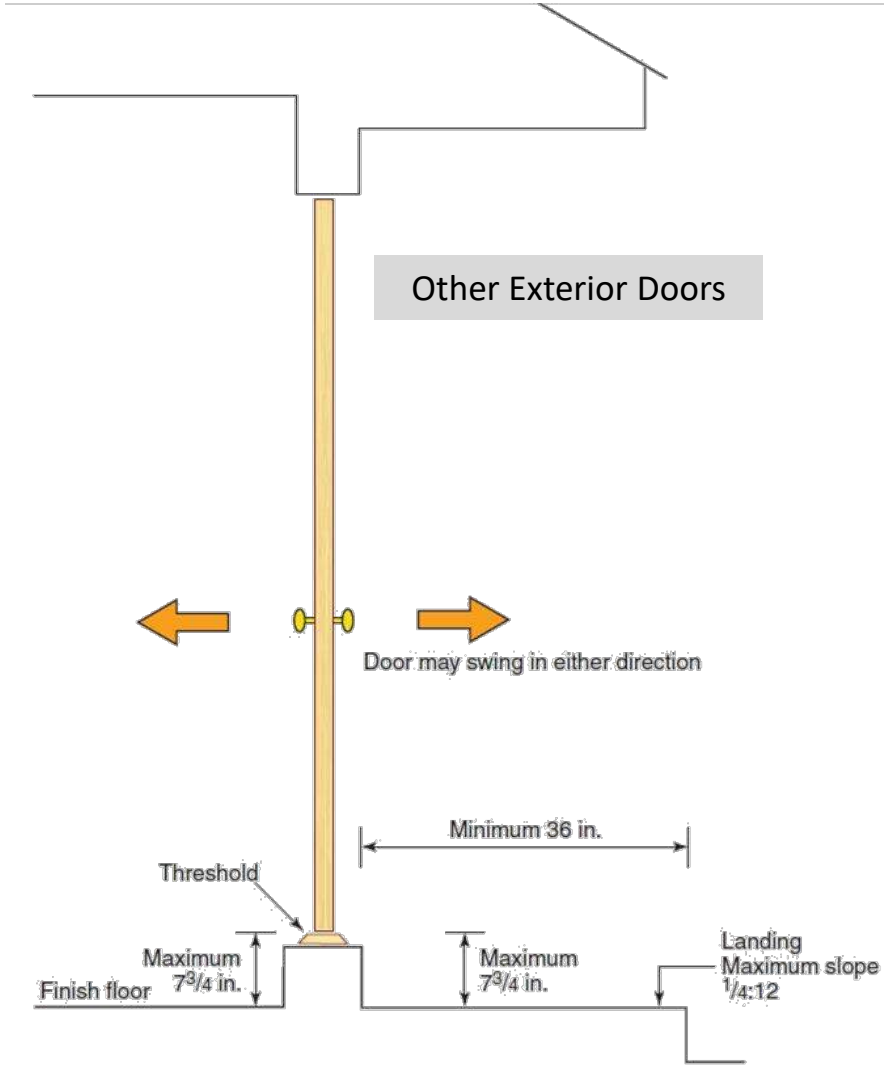
Landings at Exterior Doors

- Landings or finished floors ≤ 1½” below top of threshold
  - Exception
    - Door swings in
    - Exterior landing can be max 7¾” below top of threshold
- Access to grade



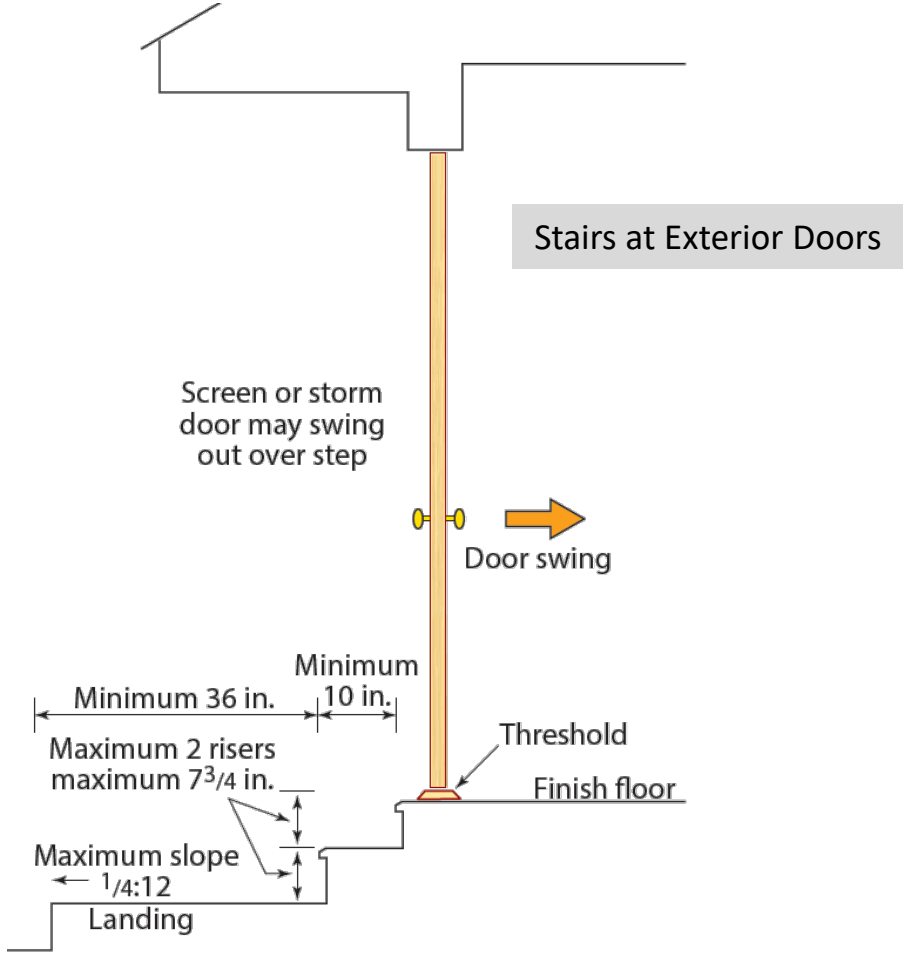
Landings at Exterior Doors

- Other than required egress
- Landing on either side
  - ≤ 7¾” below top of threshold
- Door swings either direction



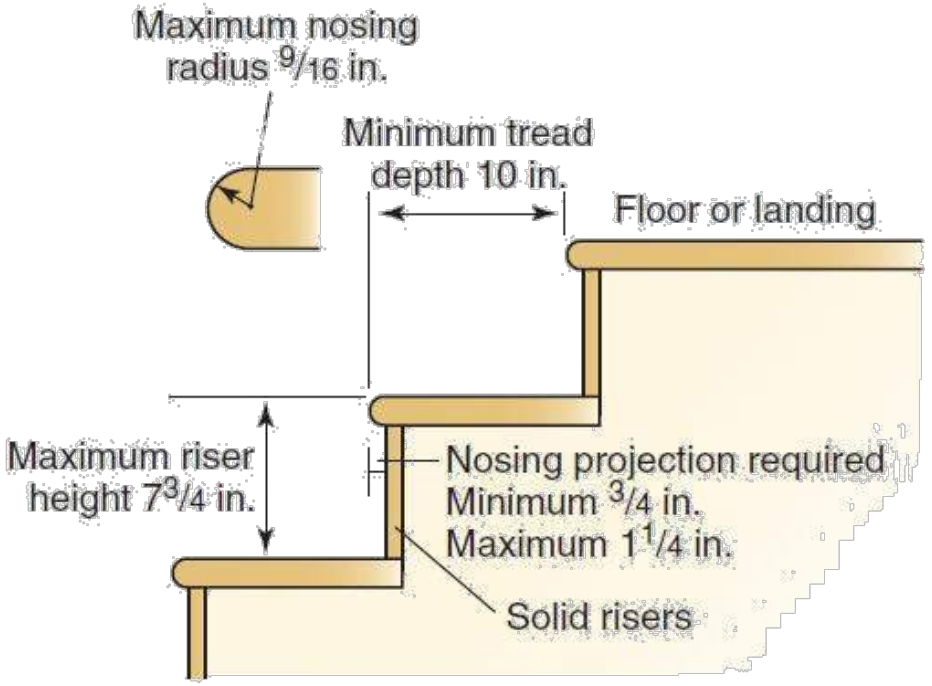
Stairs at Exterior Doors

- Door other than required egress
- Exception
  - Stairs allowed on exterior side
    - Door cannot swing over stairs
    - Stairs can have 2 risers max



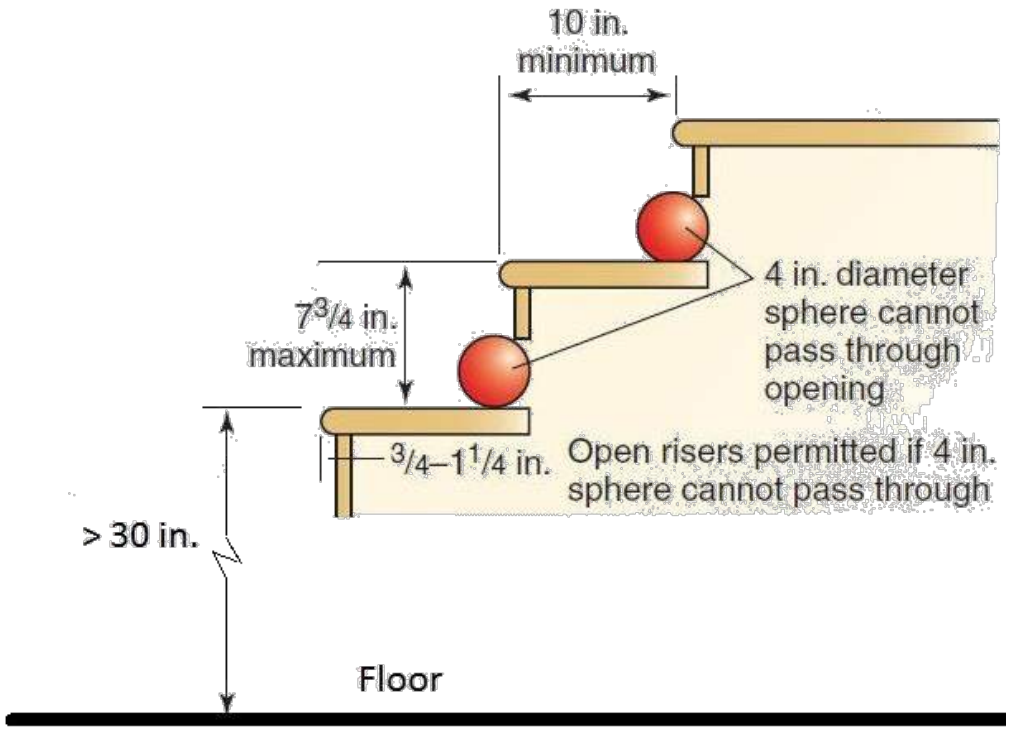
Stair Treads and Risers

- Riser ≤ 7¾”
- Tread ≥ 10”
- Variance ≤ ⅜”
- Nosing projection ¾” - 1¼”



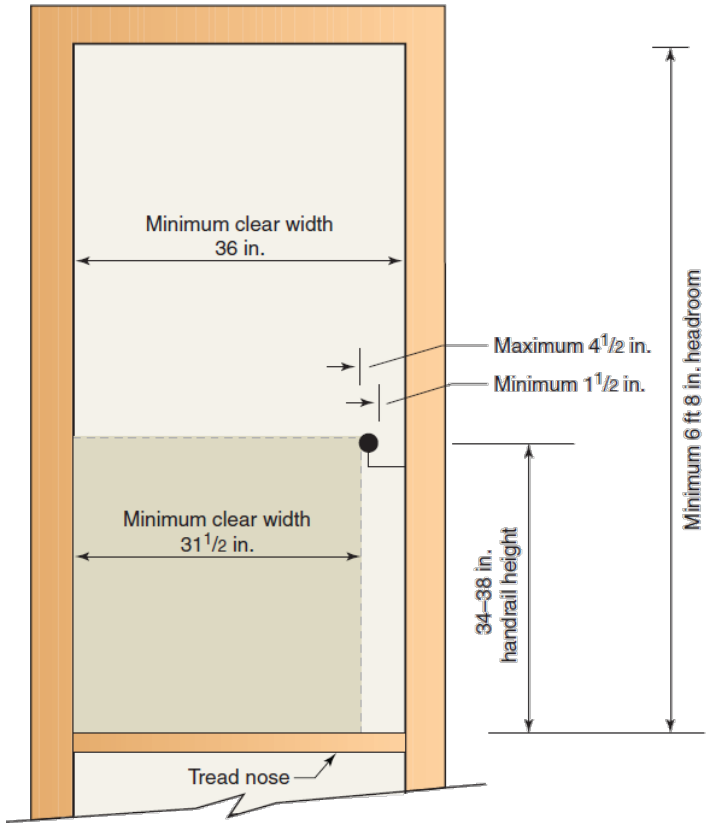
Stair Treads and Risers

- Treads > 30” above floor or grade
  - Solid risers, or
  - 4” diameter sphere limit



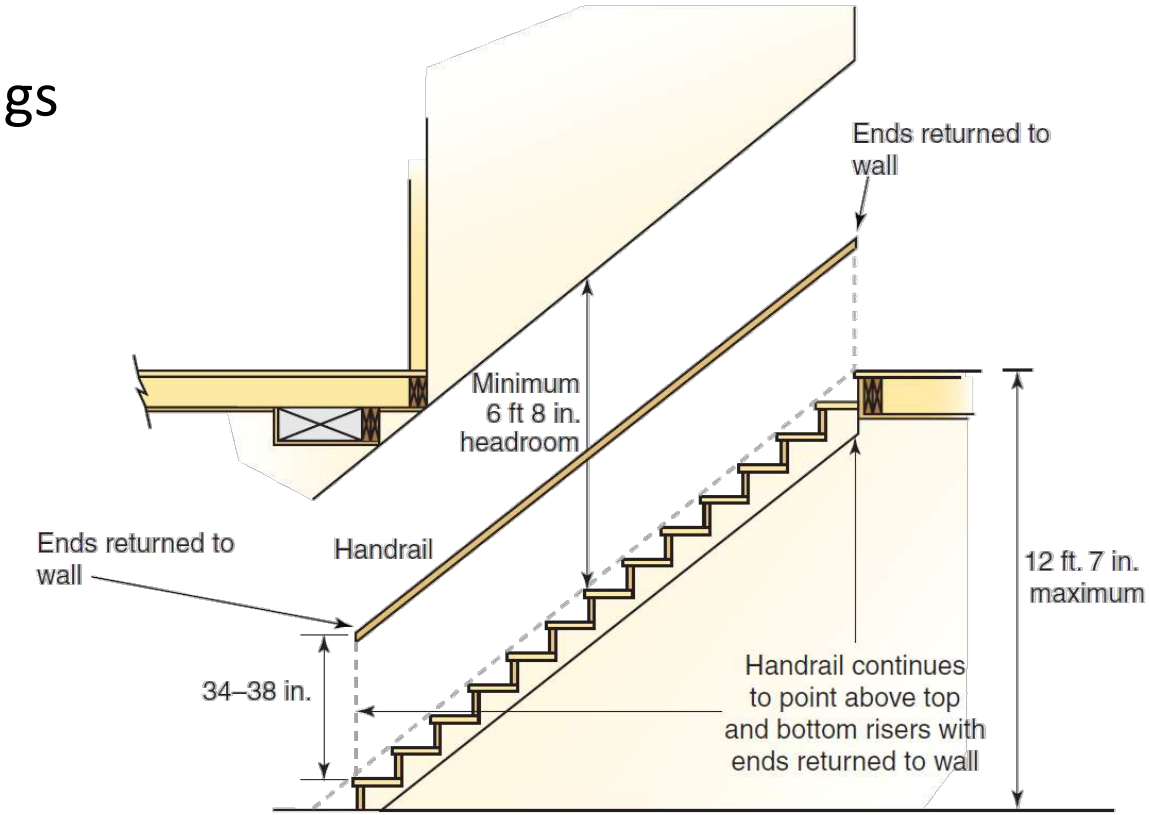
Stairway Width

- 36” min clear width
  - Required above handrail
  - Below required headroom height
  - 4½” max handrail projection either side



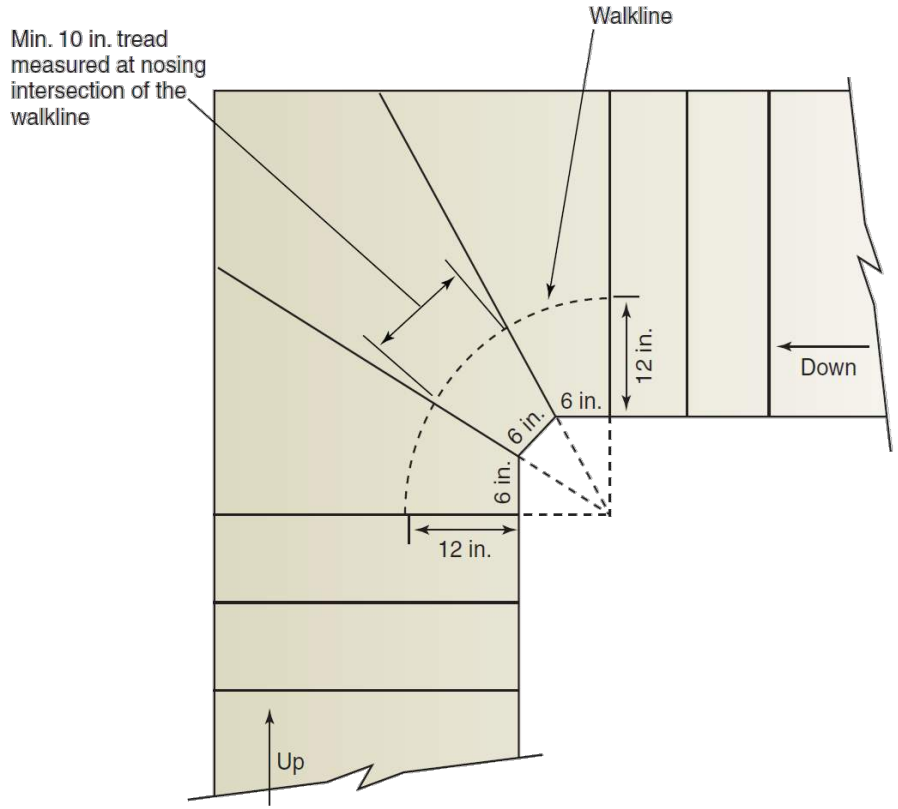
Stairway Headroom

- Minimum headroom
  - 6’-8”
  - Above plane of tread nosings



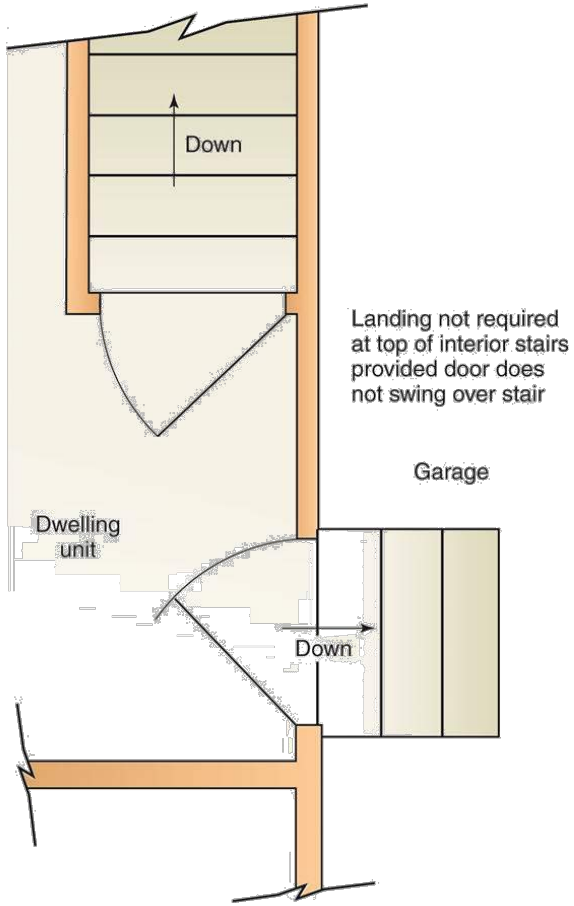
Winder Stairs

- Nonparallel edges
- Tread depth 6” at narrow end
- Tread depth of 10” measured at walk line



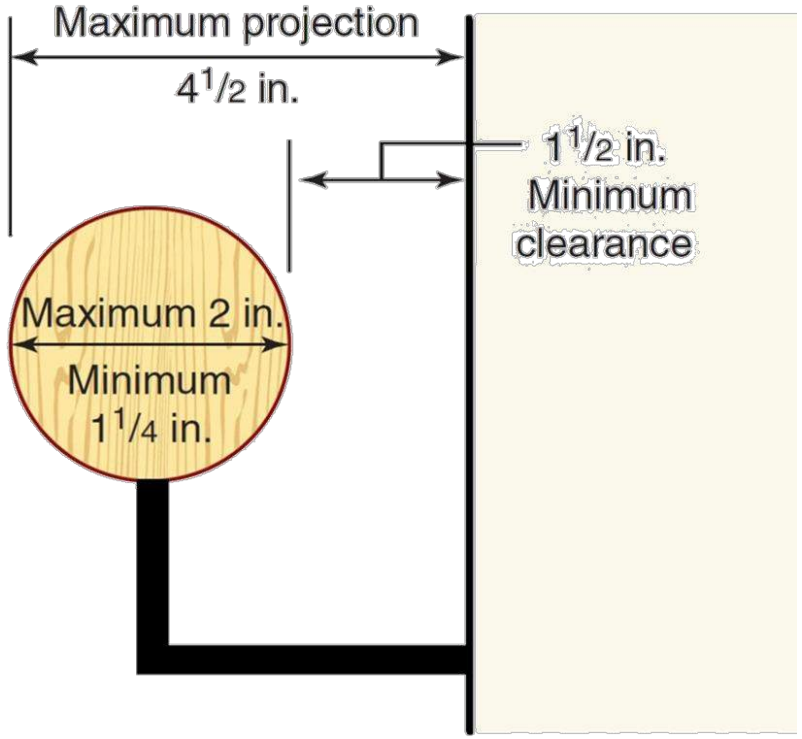
Stair Landings

- Required at top and bottom of stairs
- Width of stairway
- Minimum 36” in travel direction
- Maximum 12’-7” vertically between landings
- Exception at top of interior stairs

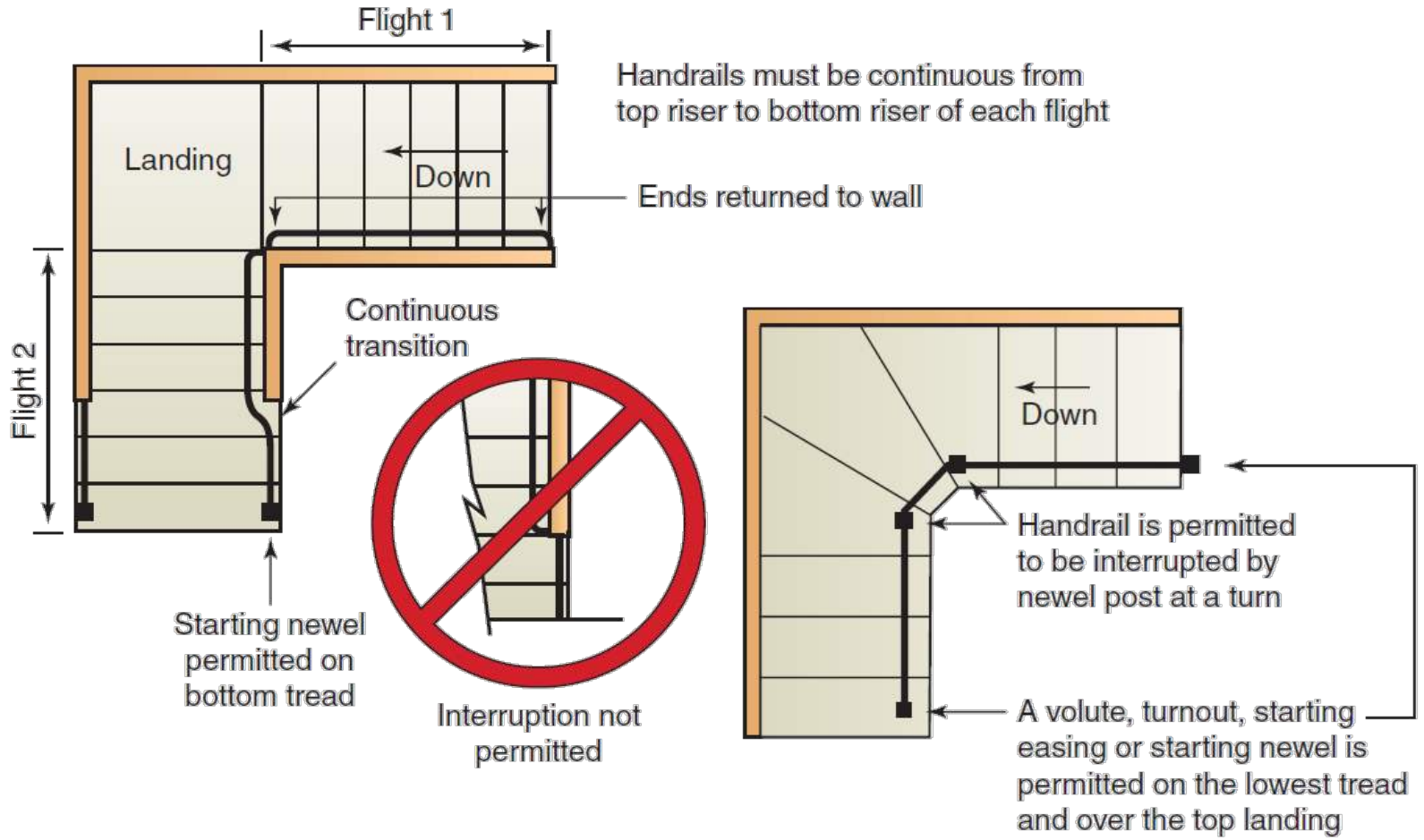


Handrail

- Max 4½” projection from wall
- Min 1 ½” wall clearance
- Graspable shape

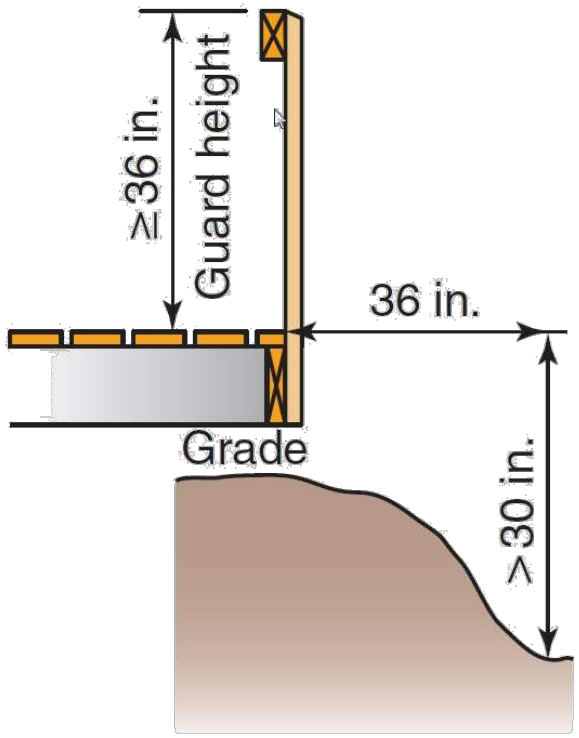


Handrail Continuity



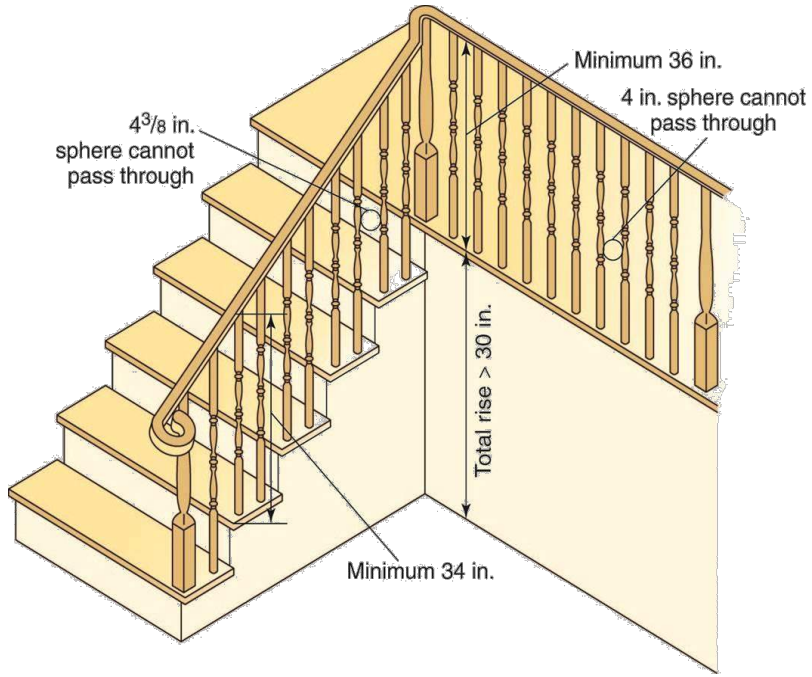
Guards

- Walking surface >30” above any point within 36” horizontally
- Min. guard height 36”
  - 34” at stairs



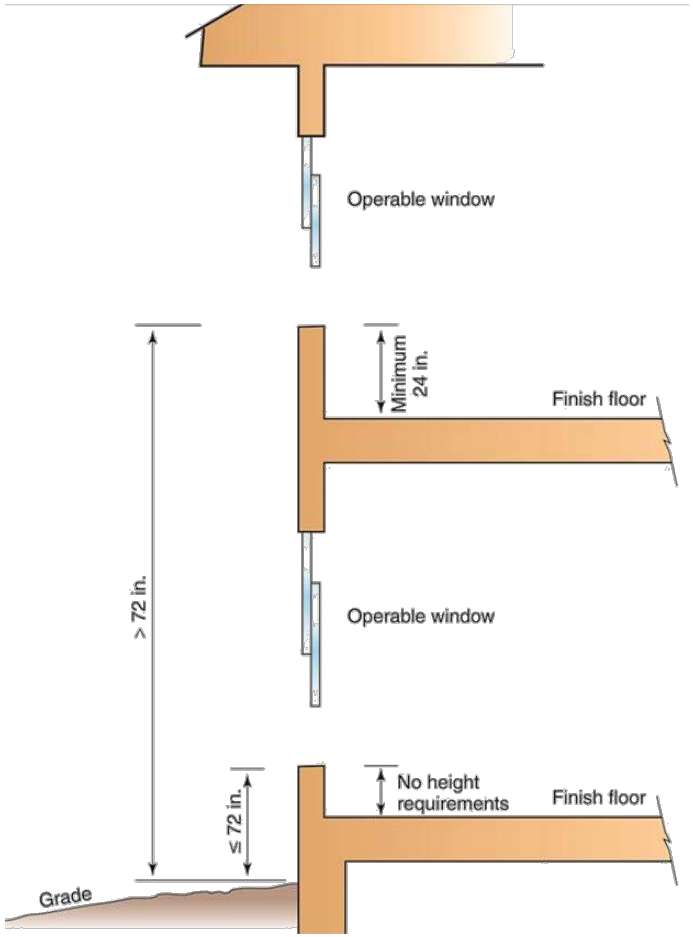
Guards

- Openings <4” sphere
  - <4⅜” along stairs
- Top rail to resist point load of 200 lbs in any direction
- Infill components to resist 50-lb horizontal load applied to an area of 1 ft^2

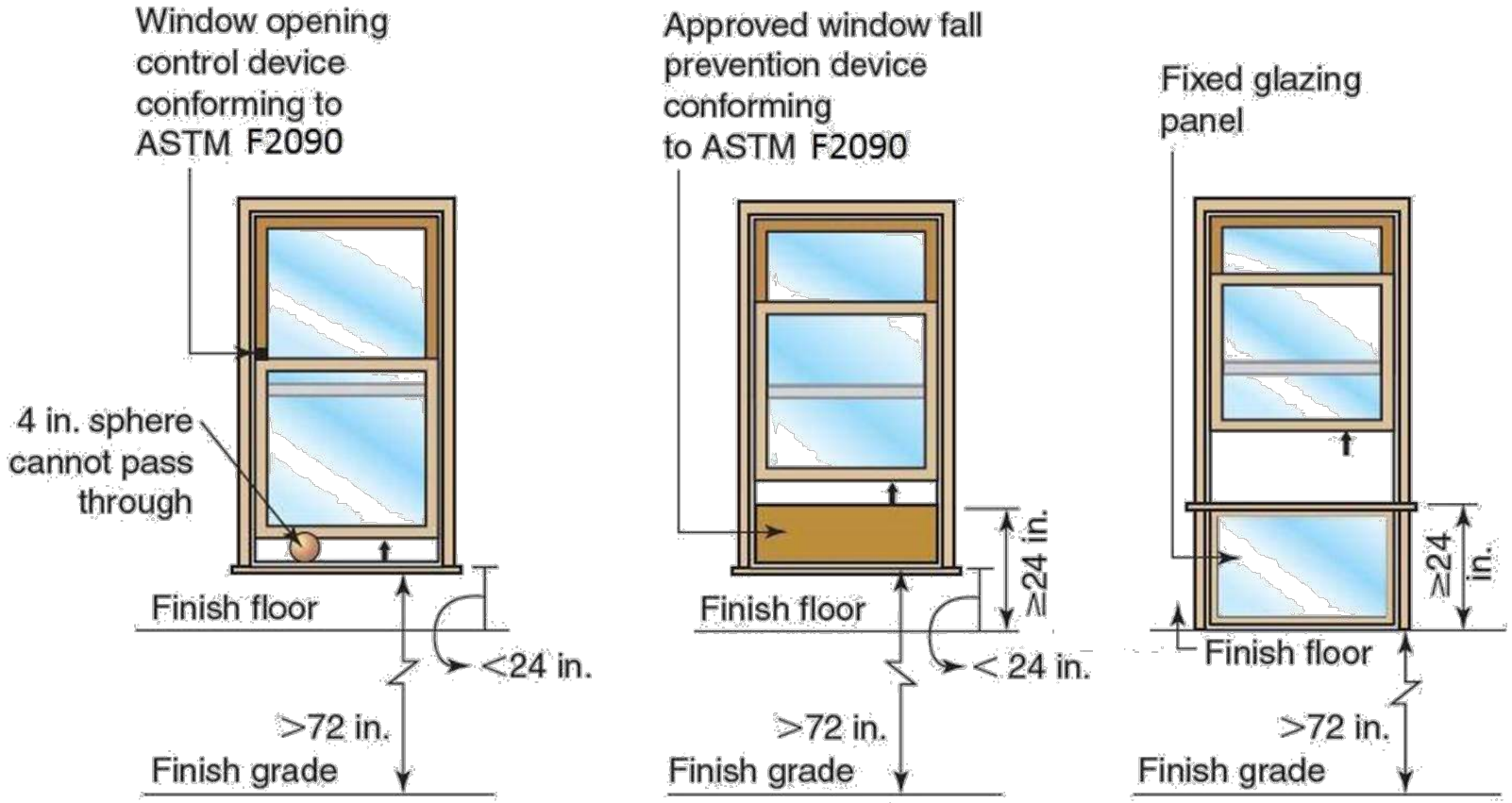


Window-sill Height

- Window openings >72” above grade must have a sill height of >24”

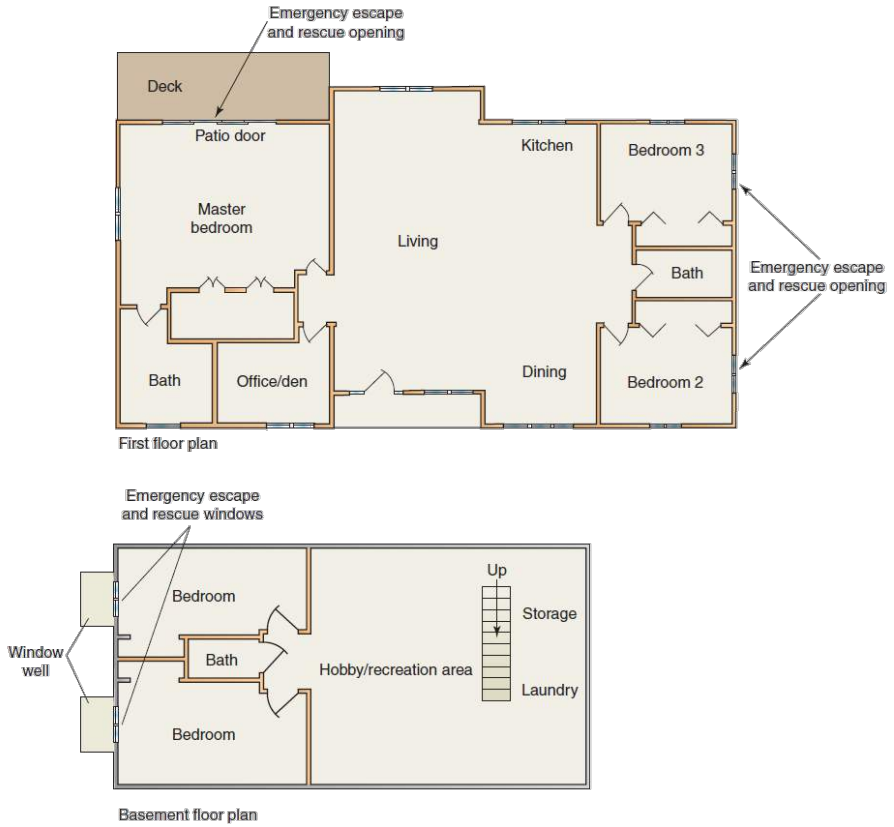


Window-sill Height Alternatives

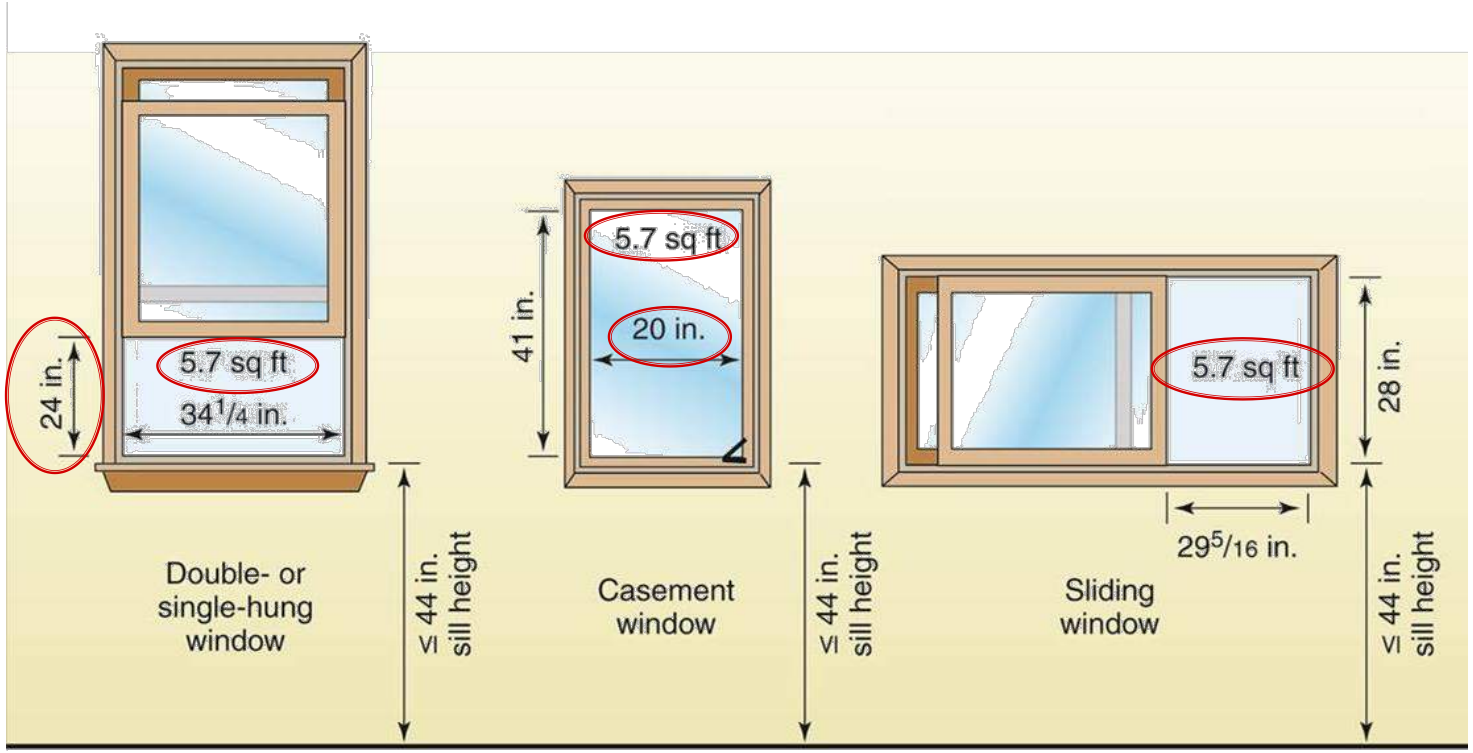


Emergency Escape and Rescue Openings

- Basements
- Habitable attics
- Sleeping rooms
  - Exceptions
    - Storm shelters
    - Basements ≤ 200 ft^2 used only to house mechanical equipment with 2 ways out

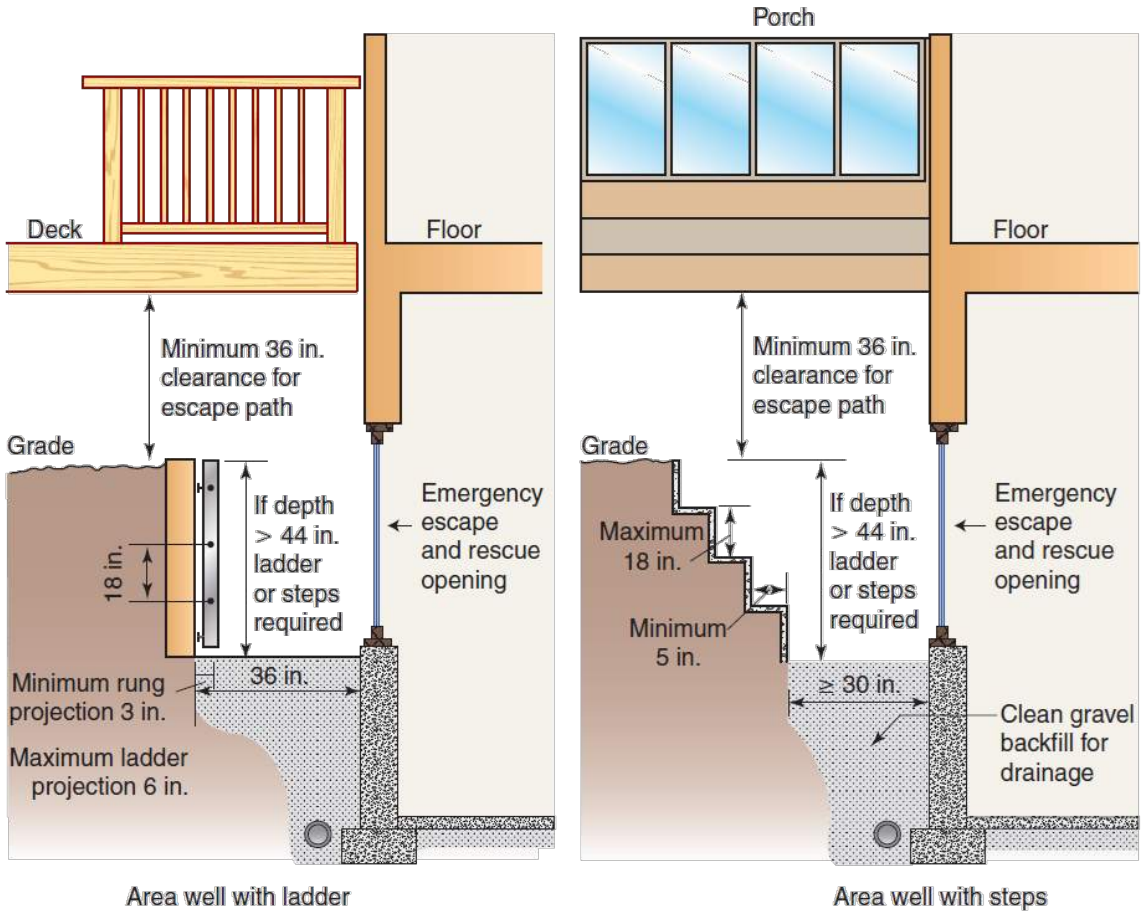


Emergency Escape and Rescue Openings



Minimum area 5.0 ft^2 for grade floor or below grade openings

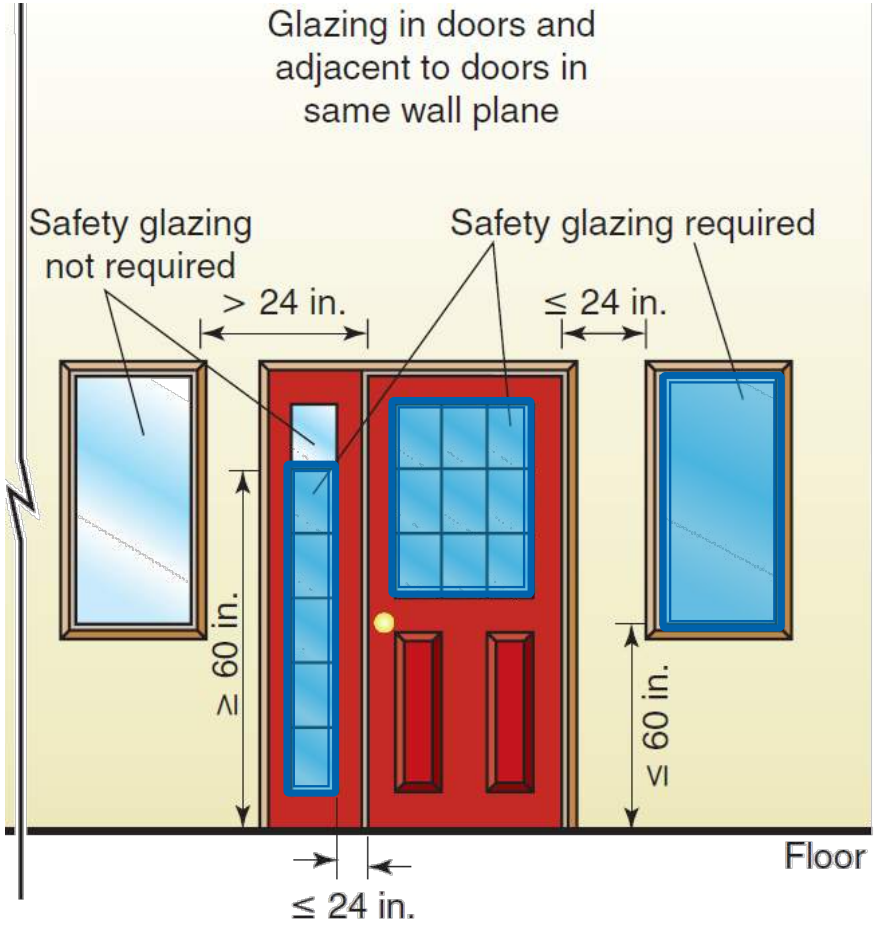
Area Wells

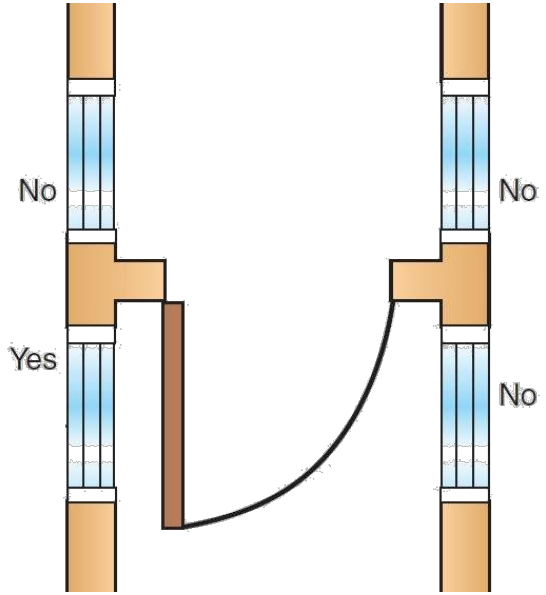


Area well with ladder

Area well with steps

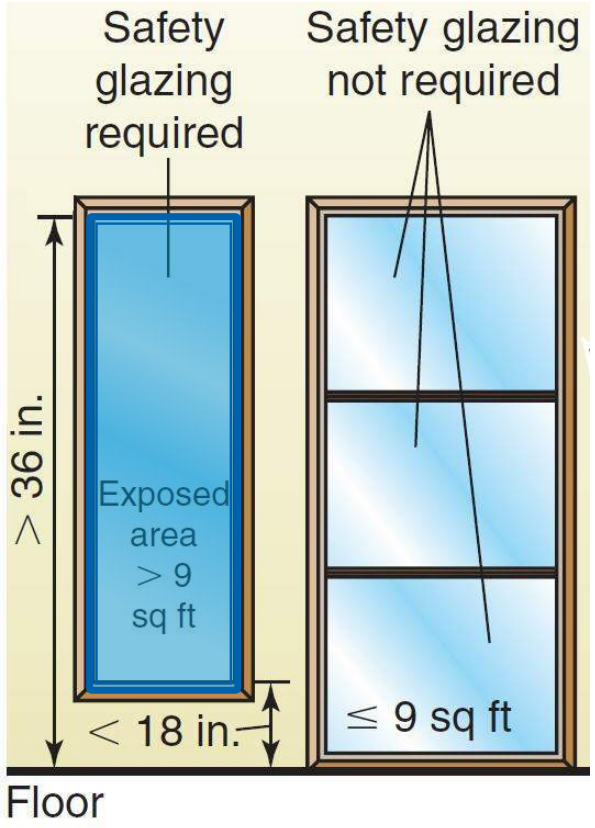
Safety Glazing – Adjacent Doors



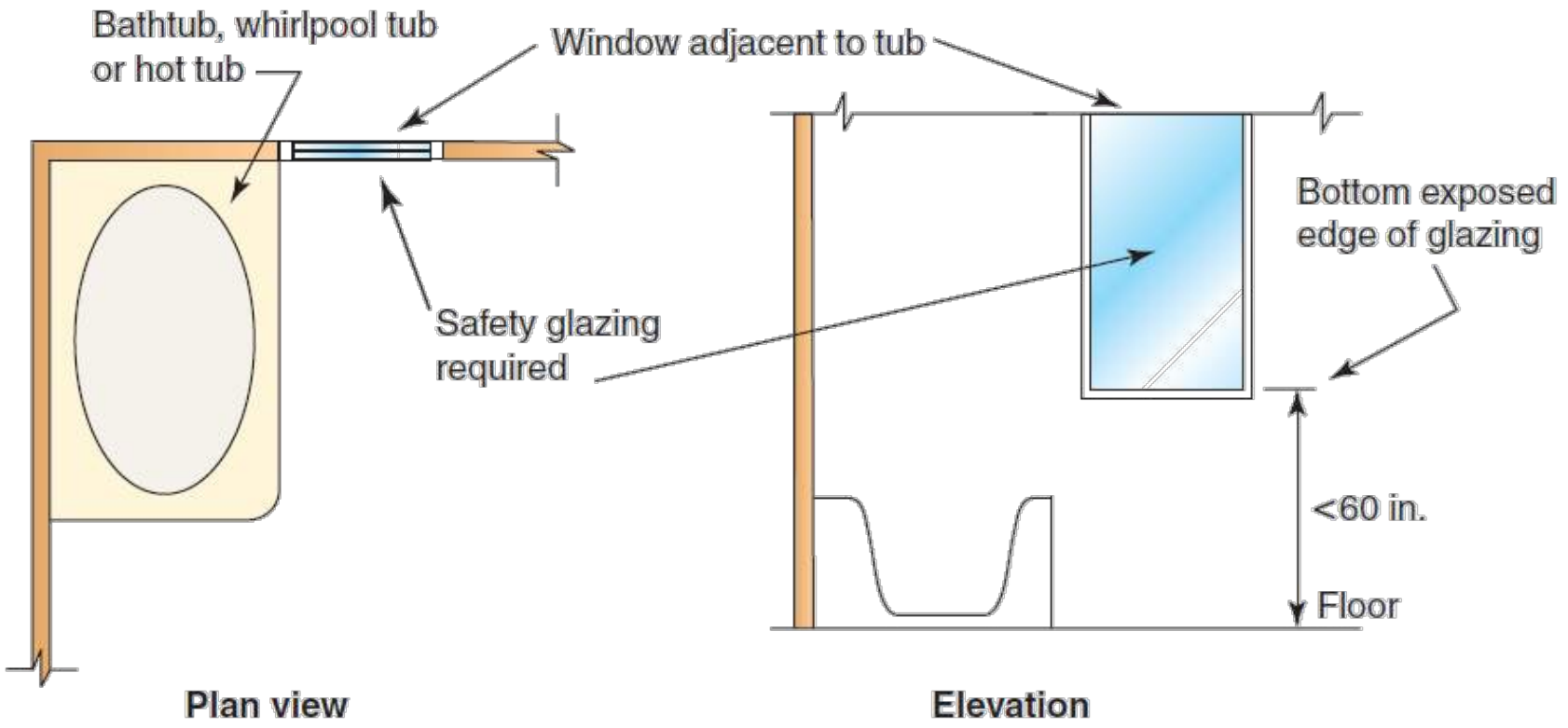


Safety Glazing - Windows

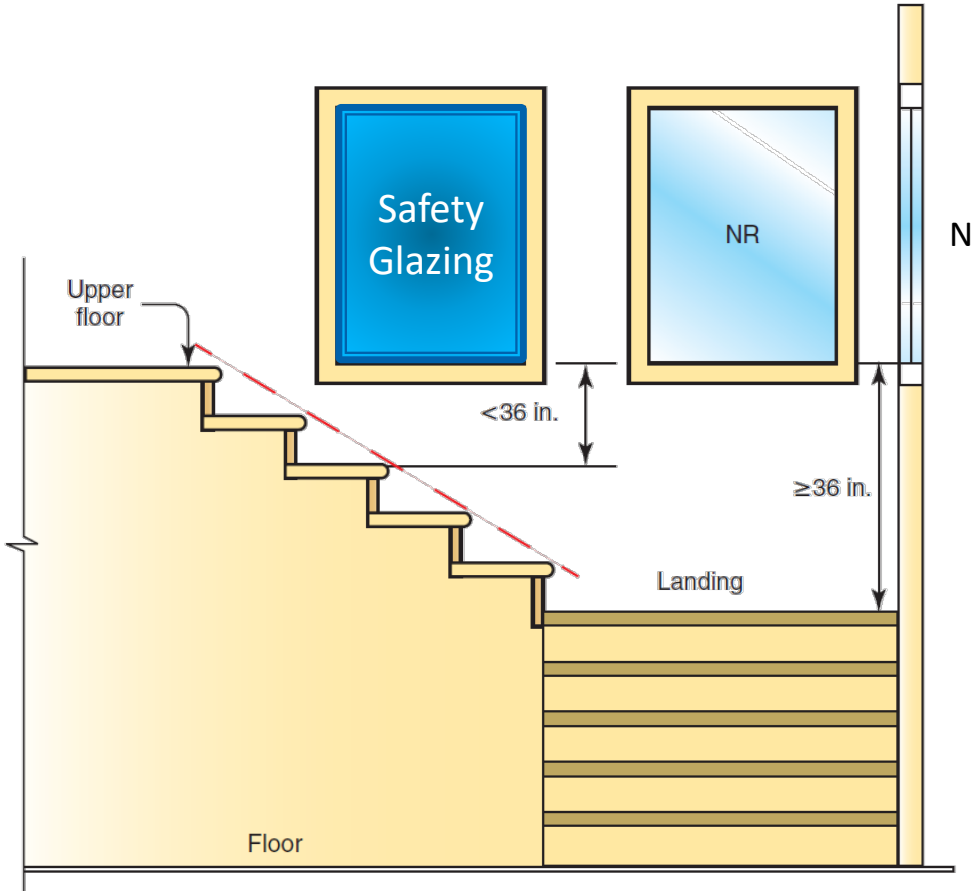
- Exposed area of an individual pane > 9 ft^2
- Bottom edge of glazing < 18” above floor
- Top edge of glazing > 36” above floor
  - Exception
    - Horizontal rail installed 34” to 38” above walking surface



Safety Glazing – Wet Surfaces

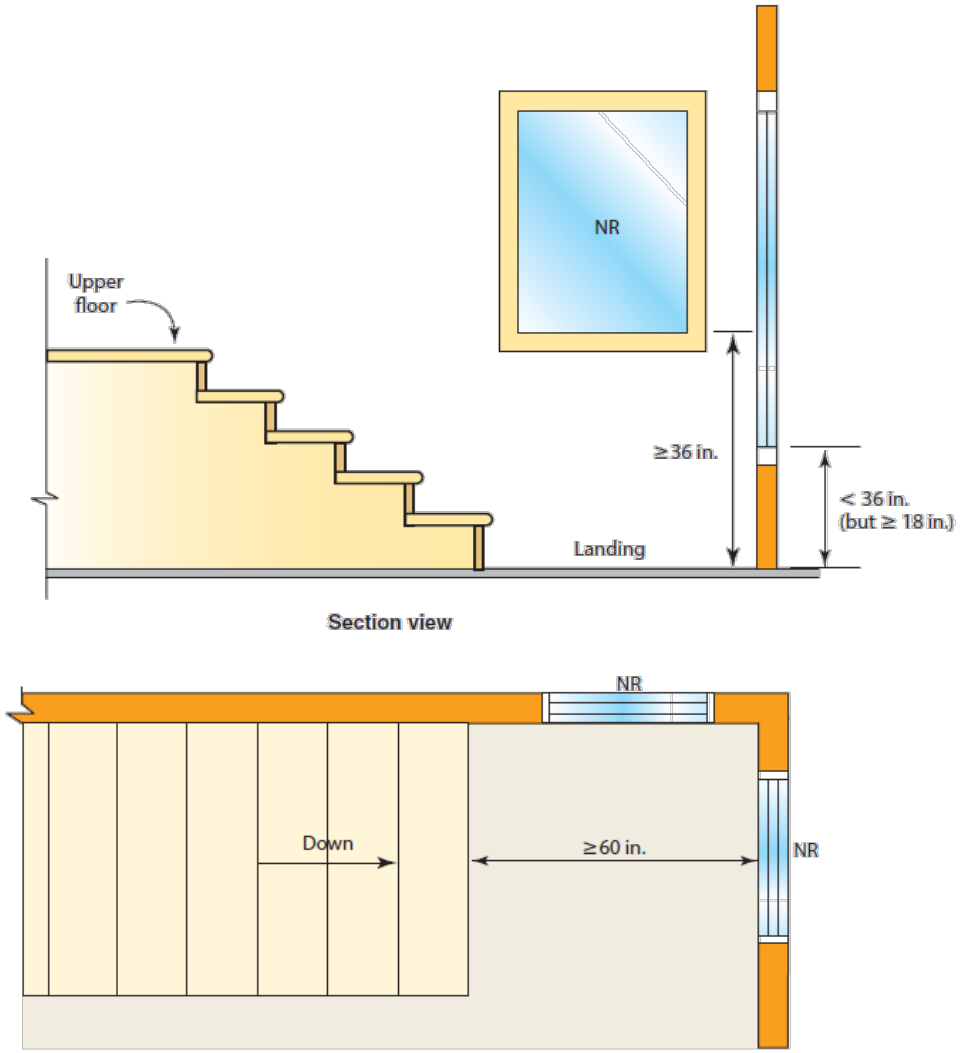


Safety Glazing – Adjacent Stairs

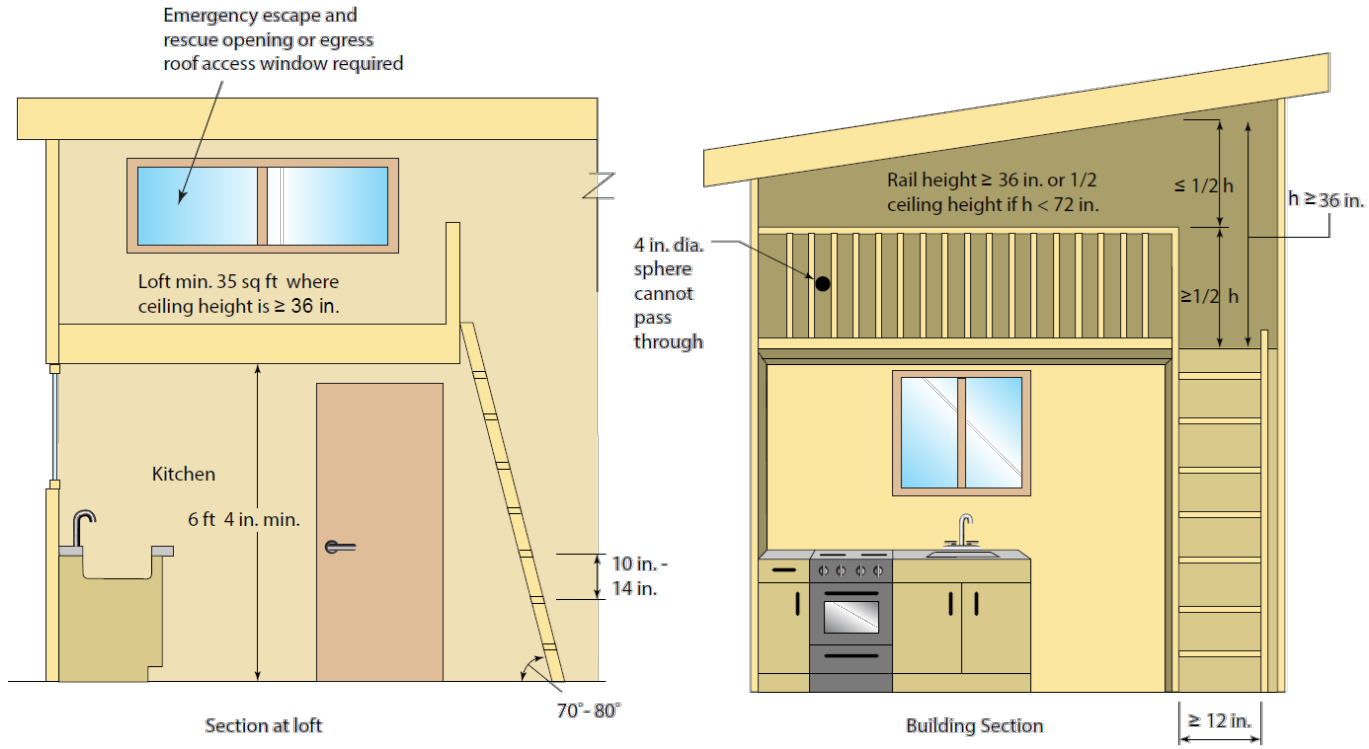


NR - Not required

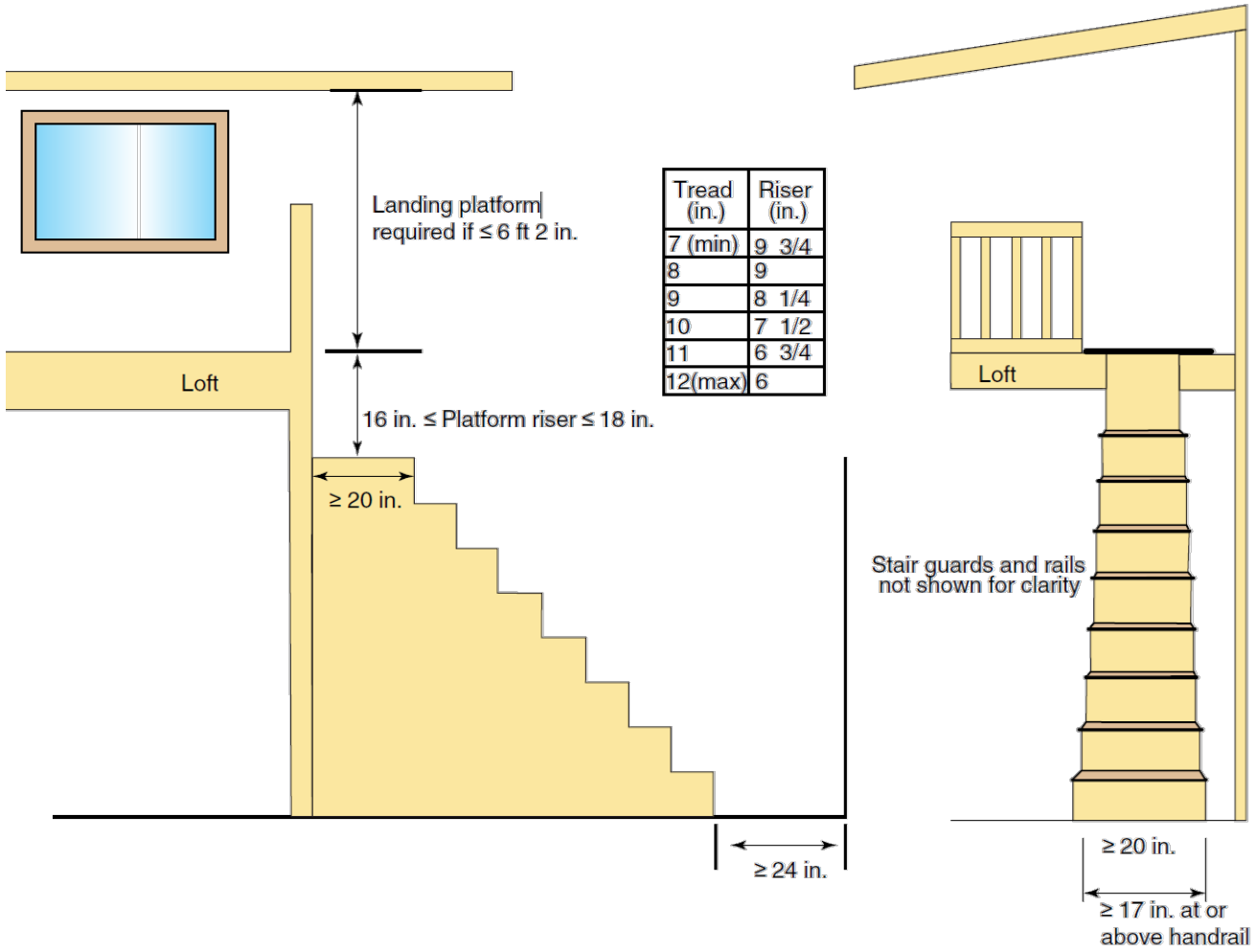
Safety Glazing – Adjacent Landing



Tiny Houses

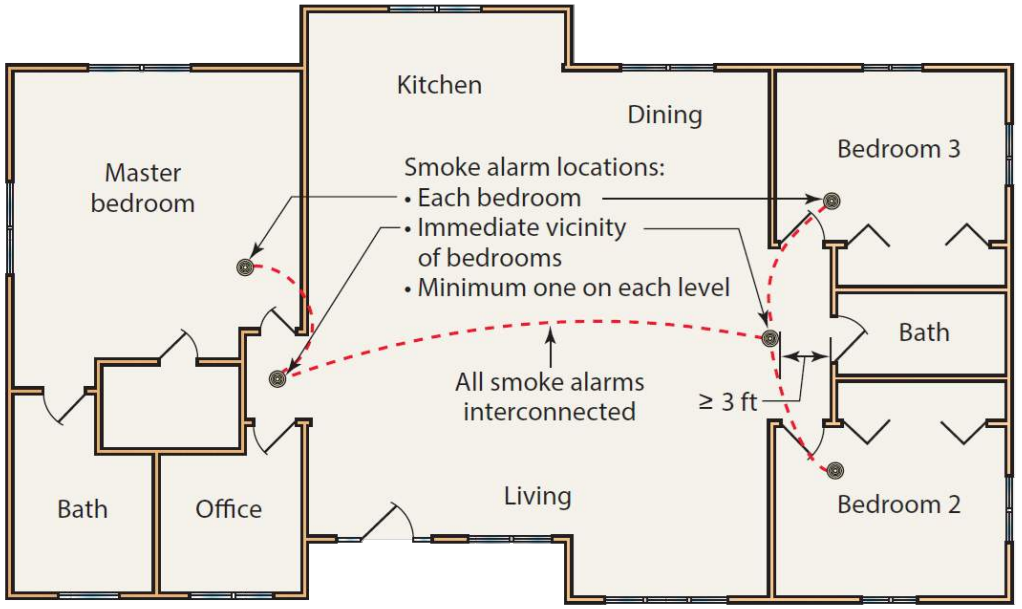


Tiny Houses



Smoke Alarms

- Building wiring system provides primary power
- Battery backup

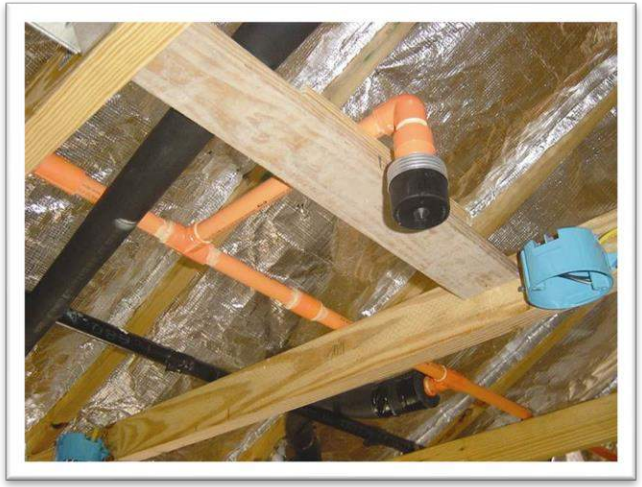


Smoke Alarms – Existing Dwellings

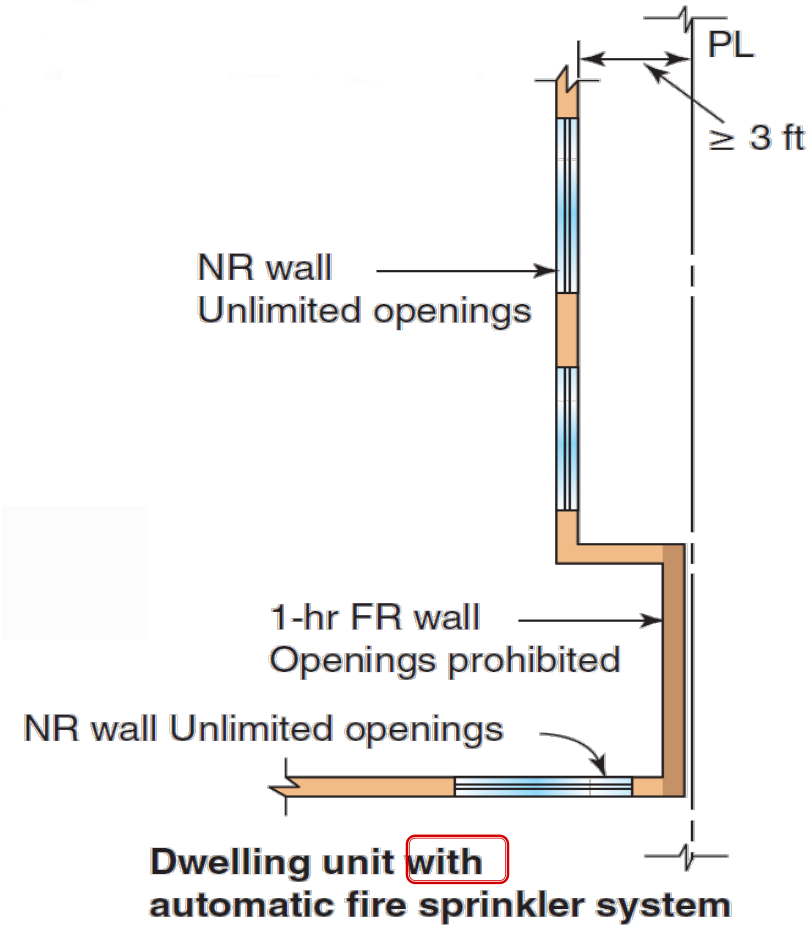
- Retrofit smoke alarms when permit required
  - Interior alterations/repairs and Additions
- Battery-operated smoke alarms
- Interconnection – wireless
- Exceptions
  - Minor work not requiring a permit
  - Exterior work, Addition of a deck or porch
  - Replacing doors or windows

Residential Fire Sprinkler Systems

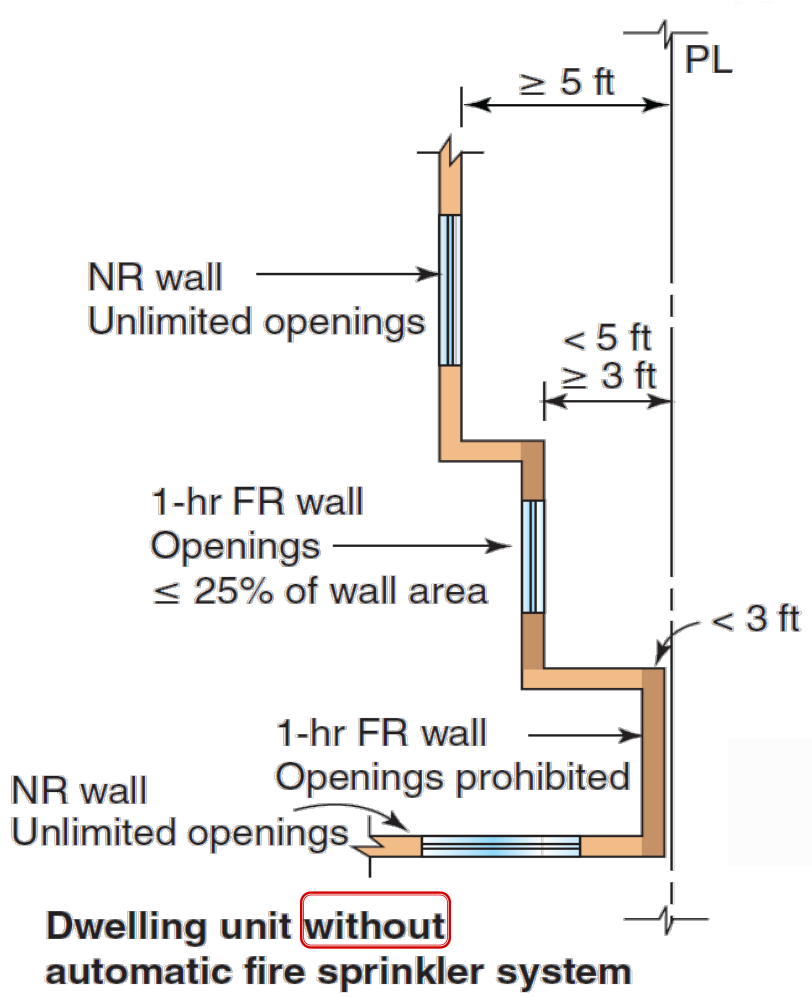
- Required in
  - New dwellings
  - New townhouses
- Design criteria
  - IRC Section P2904
  - NFPA 13D
  - Both designs applicable to 1- and 2-family dwellings



Exterior Walls

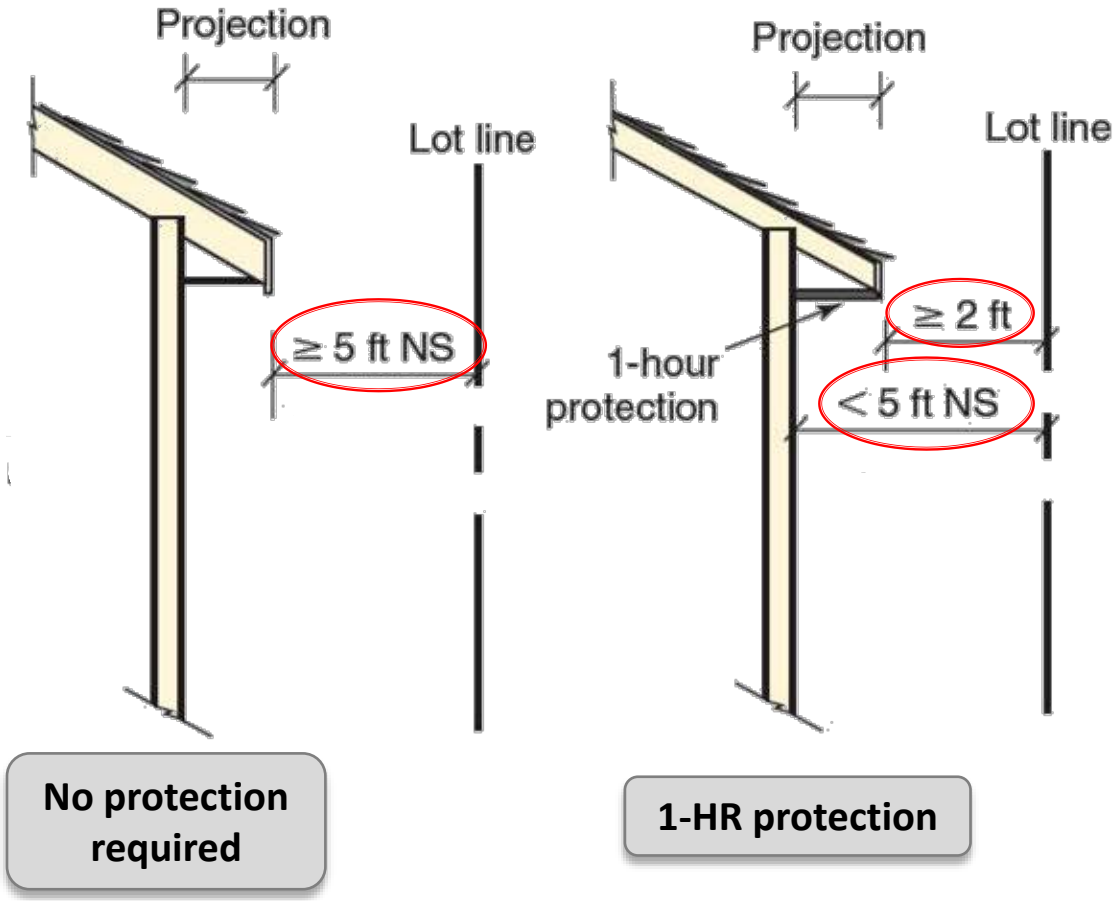


Exterior Walls

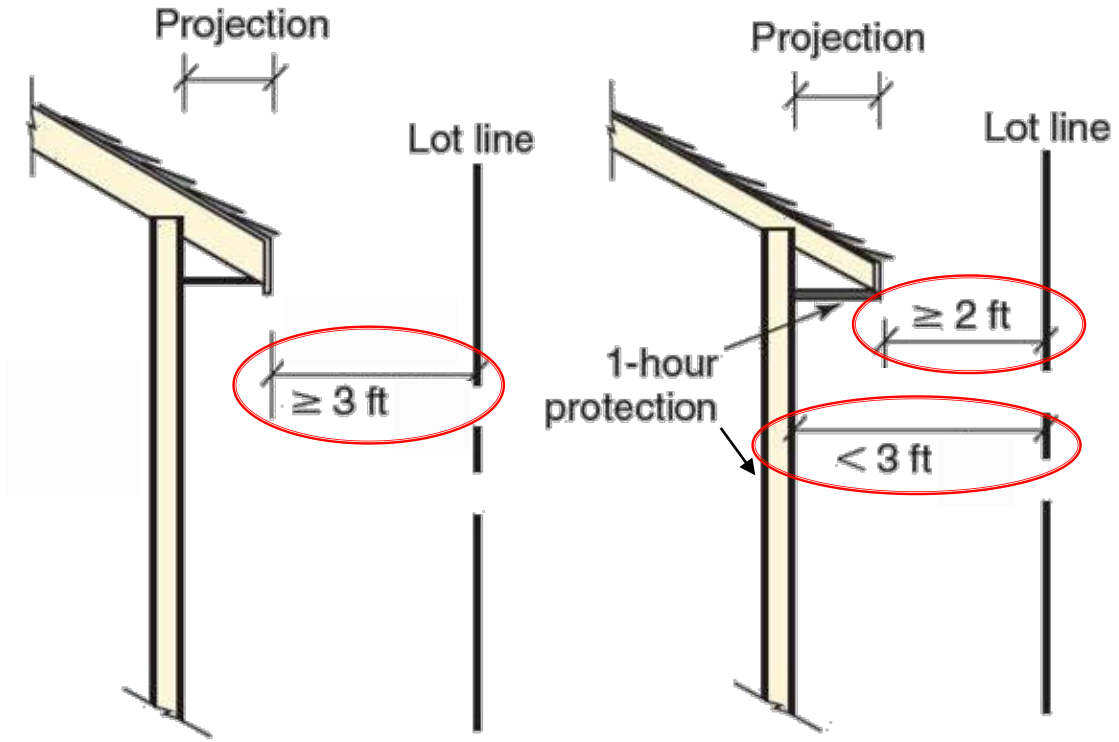


Dwelling unit without automatic fire sprinkler system

Eave Projections – w/o Sprinklers



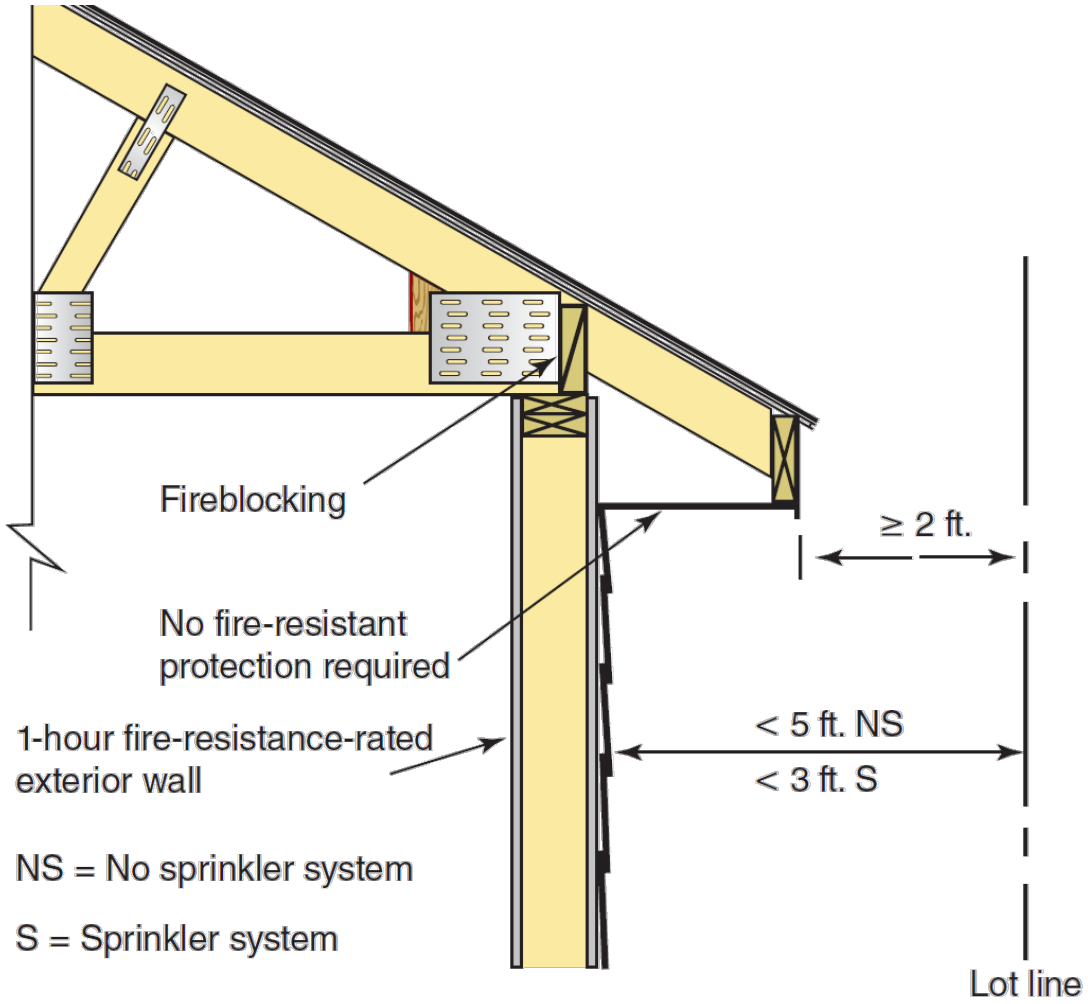
Eave Projections – w/ Sprinklers



No protection required

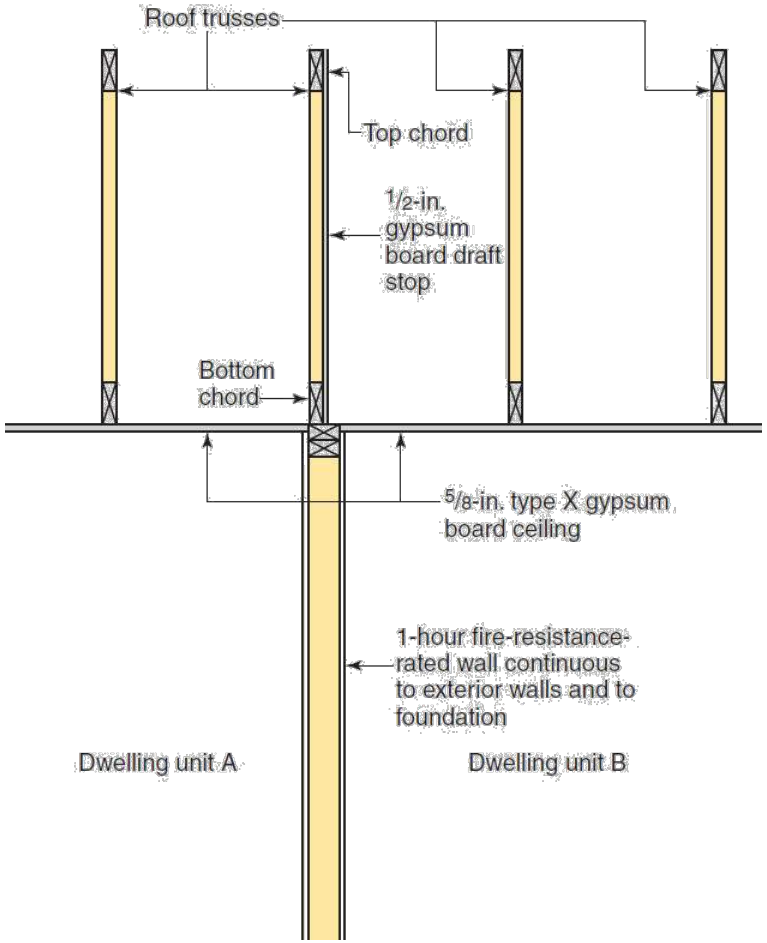
1-HR protection

Eave Projections

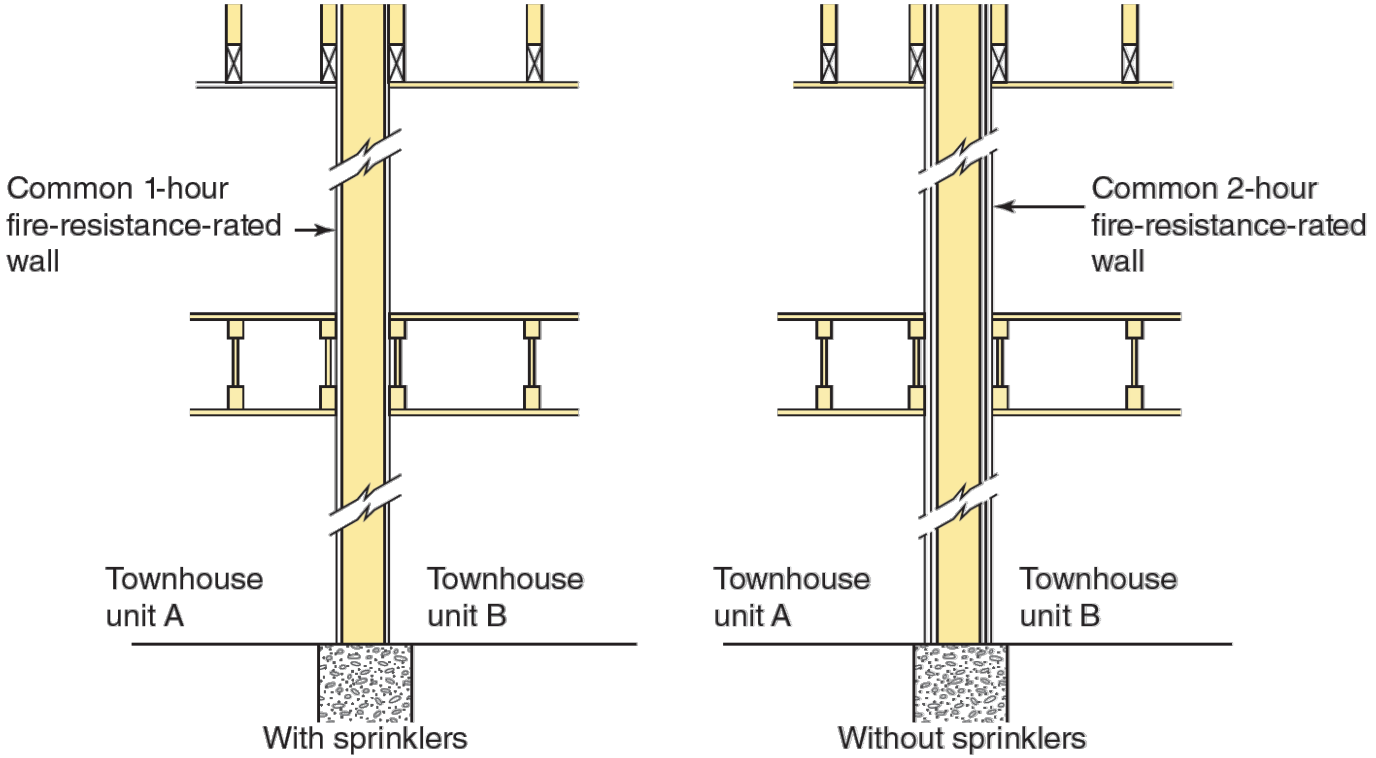


Two-Family Dwelling Separation

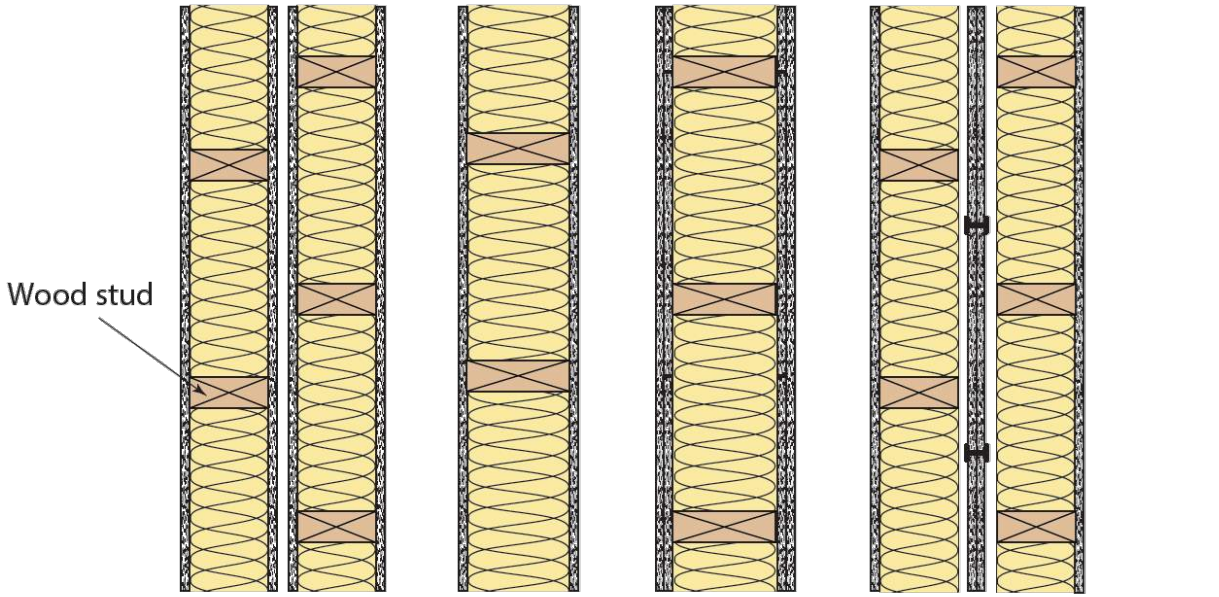
- 1-hour separation
  - Continuous from foundation to roof
- Alternate
  - ⅝” Type X gypsum board ceiling
  - ½” gypsum board on bearing walls
  - Draft stop in attic



Townhouse Separation



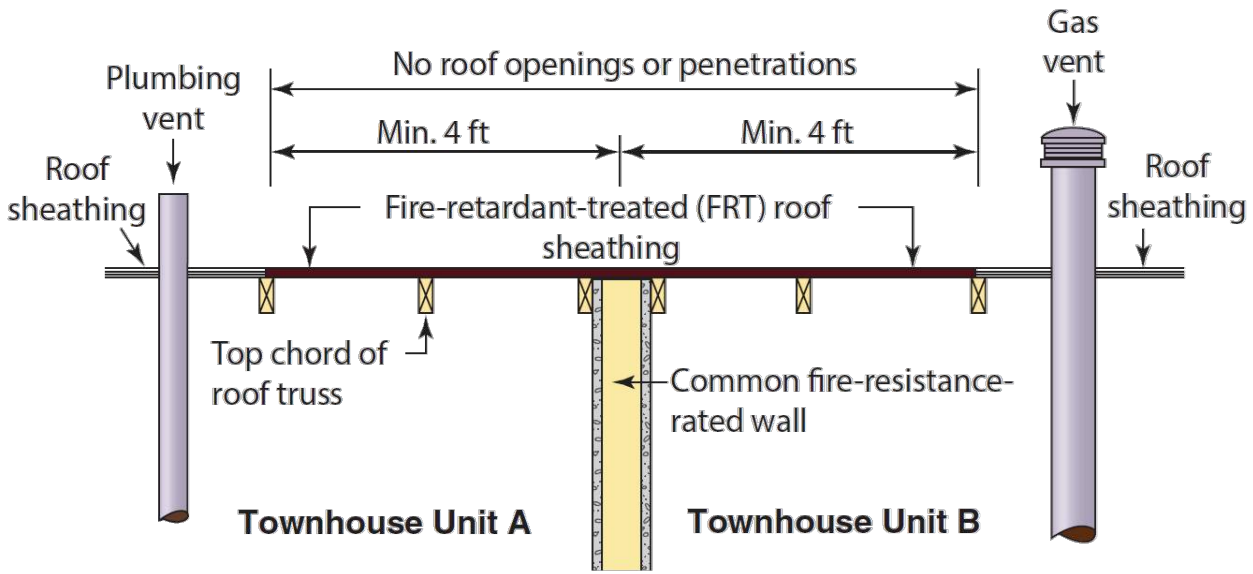
Townhouse Separation



Plan view

Note: Gypsum wallboard and wood stud assemblies must meet all materials, dimensions, spacing, installation and fastening requirements of the specific tested assembly

Parapet Exception

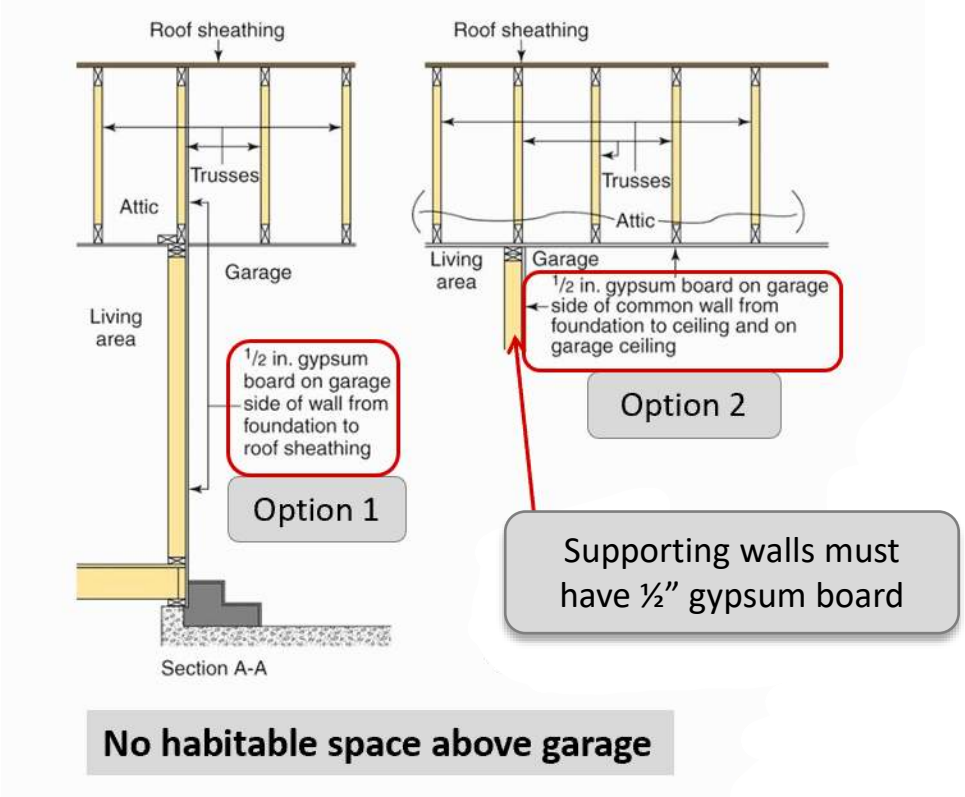


Alternatives to FRT sheathing:

- Non-combustible sheathing
- $^5/_8$-in. Type X gypsum board below sheathing

Dwelling Separation from Garage

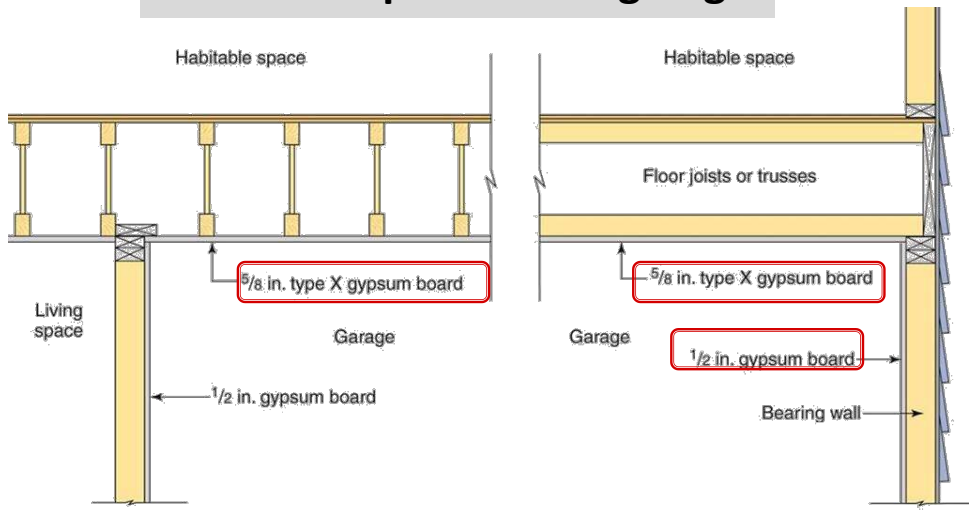
- Not a fire-resistance-rated assembly
- ½” gypsum board on garage side provides limited fire resistance



Dwelling Separation from Garage

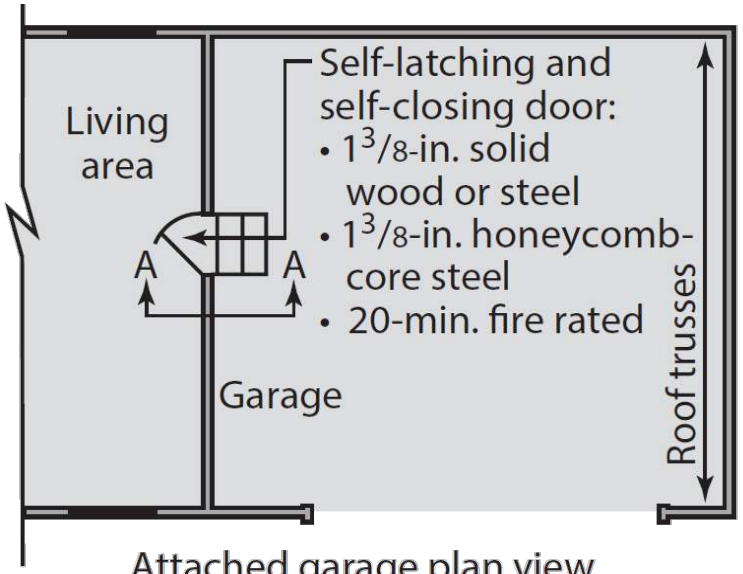
- Not a fire-resistance-rated assembly
- ½” gypsum board on garage side provides limited fire resistance
- ⅝” Type X gypsum board on ceiling when habitable space above

Habitable space above garage



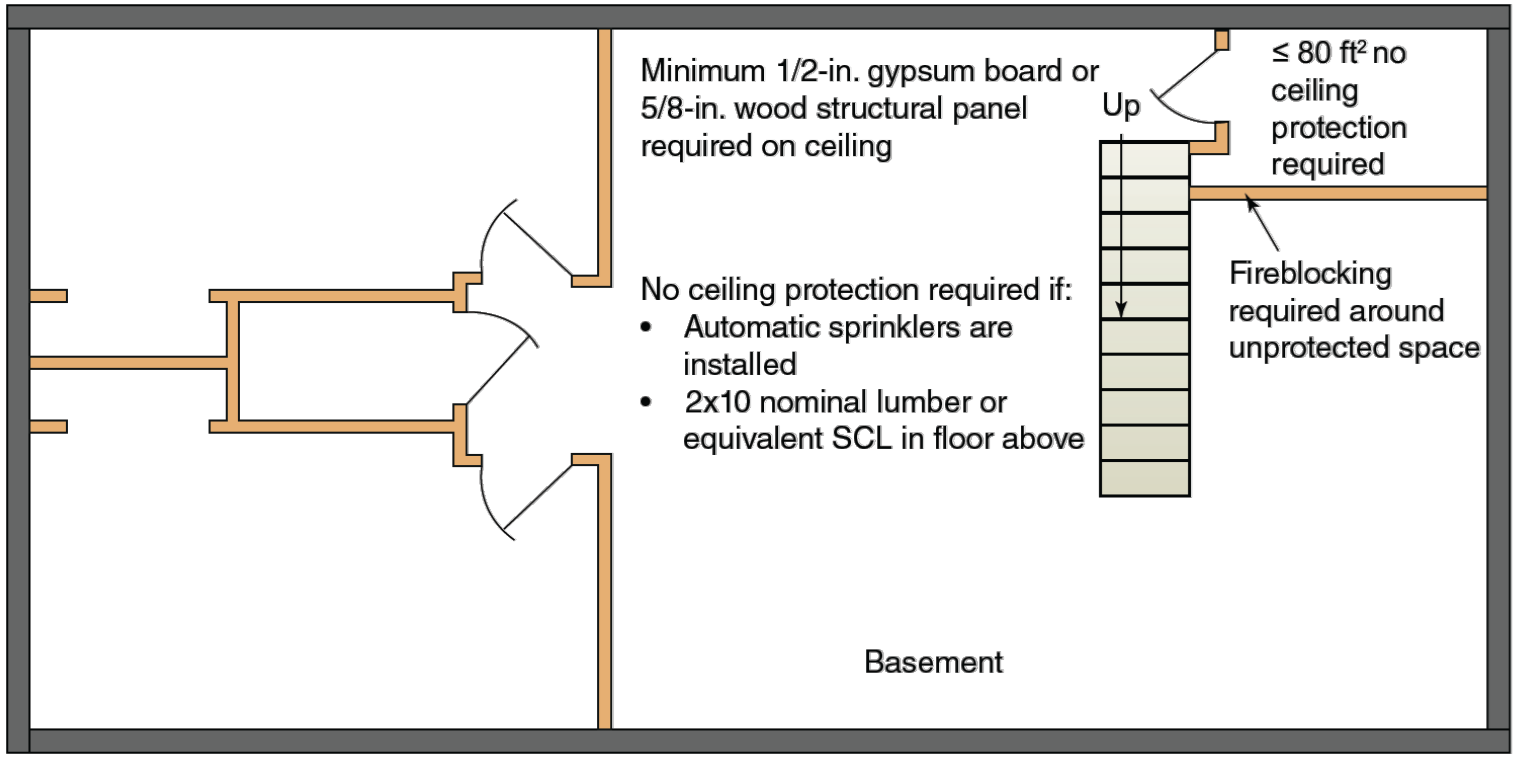
Dwelling Separation from Garage

- Penetrations not rated
- No openings from garage into a sleeping room
- “Automatic closing” permitted in lieu of self- closing



Attached garage plan view

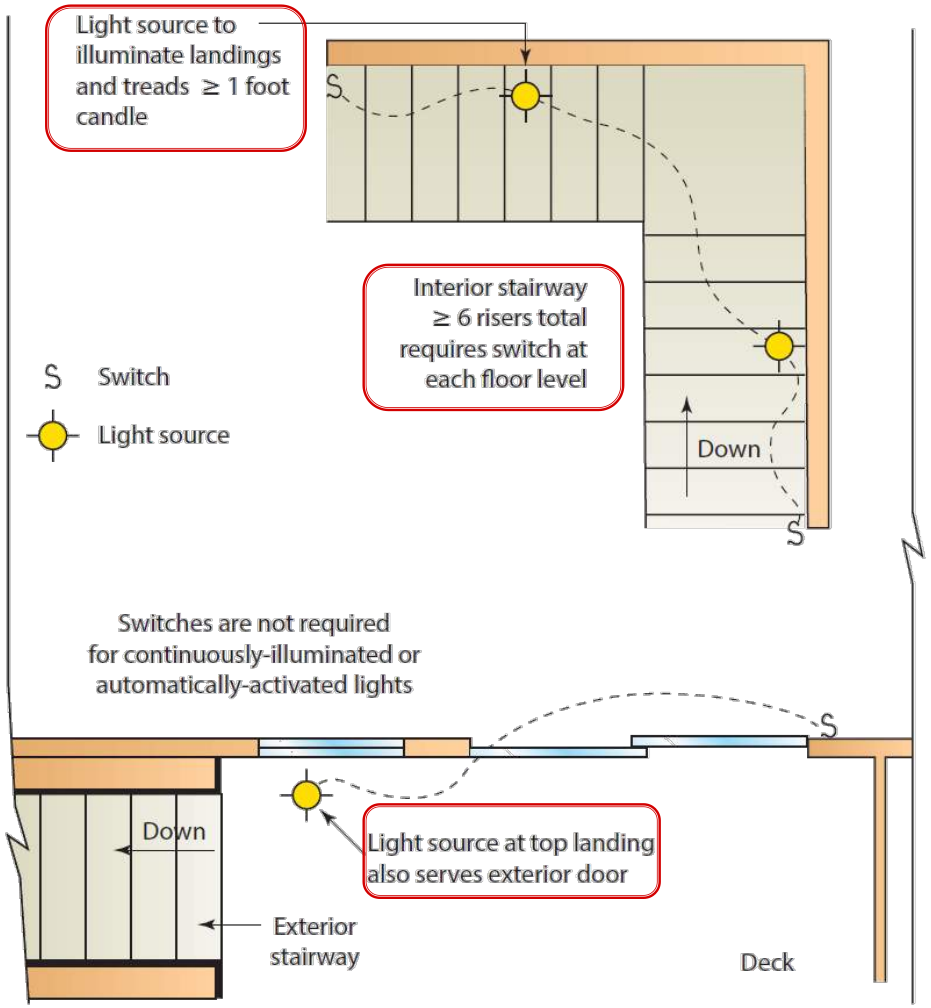
Fire Protection of Floors



Light and Ventilation

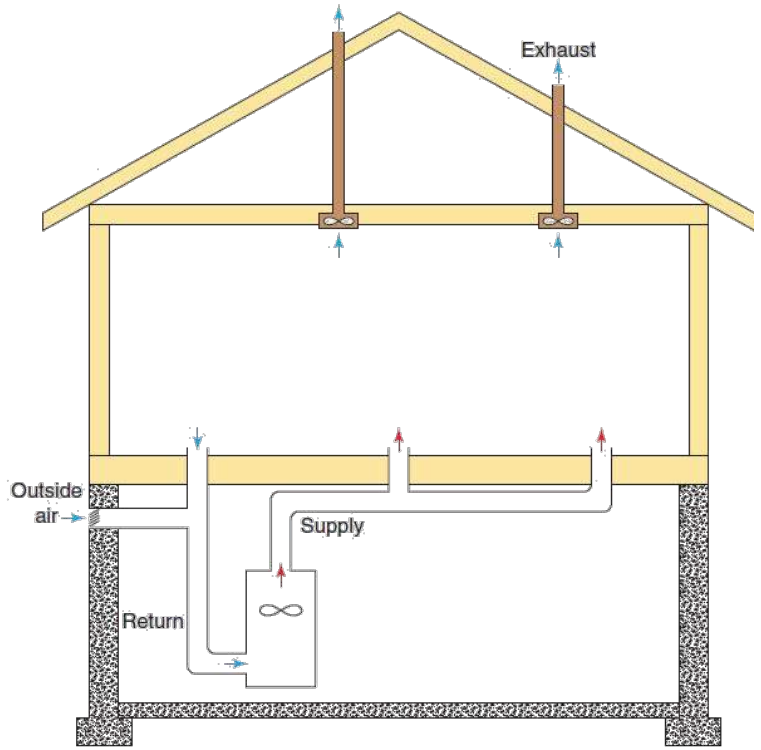
- Habitable rooms
  - Glazing ≥ 8% or lighting ≥ 6 footcandles
  - Openings ≥ 4% or mechanical ventilation
- Bathrooms
  - Glazing ≥ 3 ft^2 or electric lighting
  - Openings ≥ 1.5 ft^2 or mechanical exhaust

Stairway Illumination

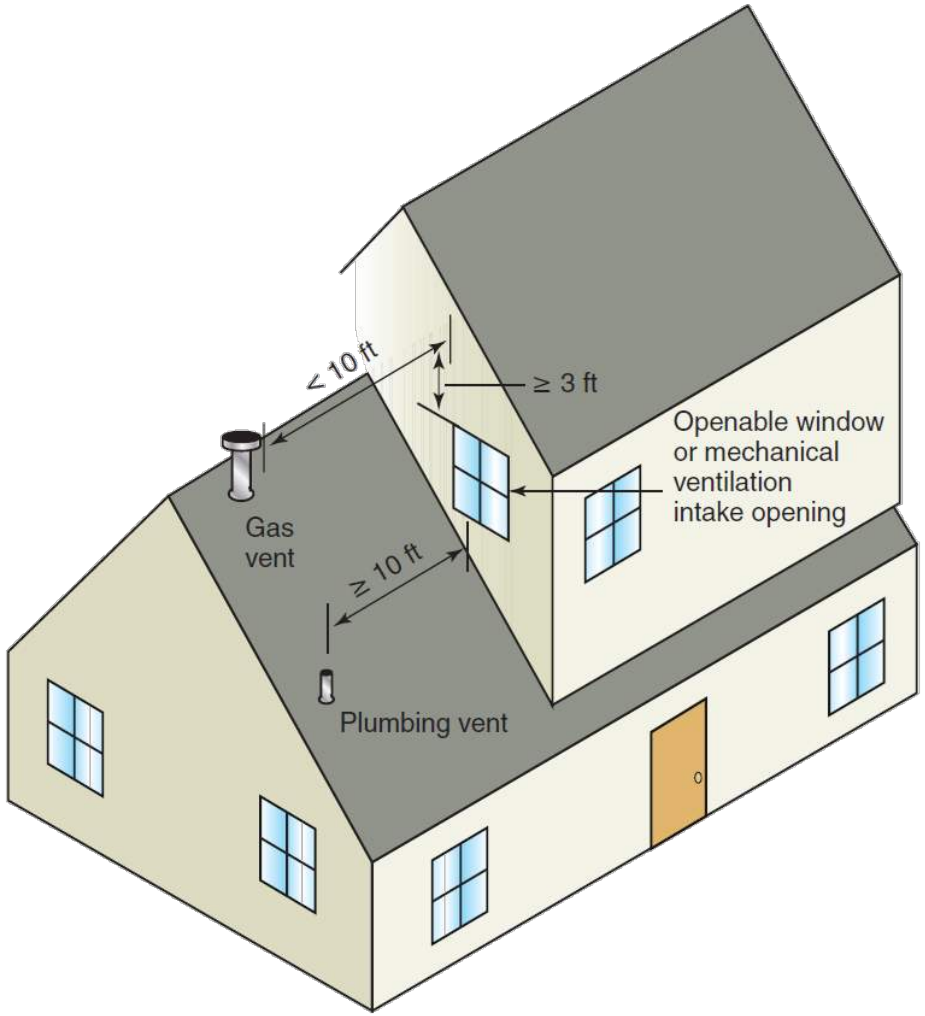


Whole-house Mechanical Ventilation

- Required if
  - Blower door test shows air infiltration rate
    - ≤ 5 ACH or
    - 0.28 cfm/ft^2
- Separate system not required
  - Supply and exhaust fans can achieve ventilation

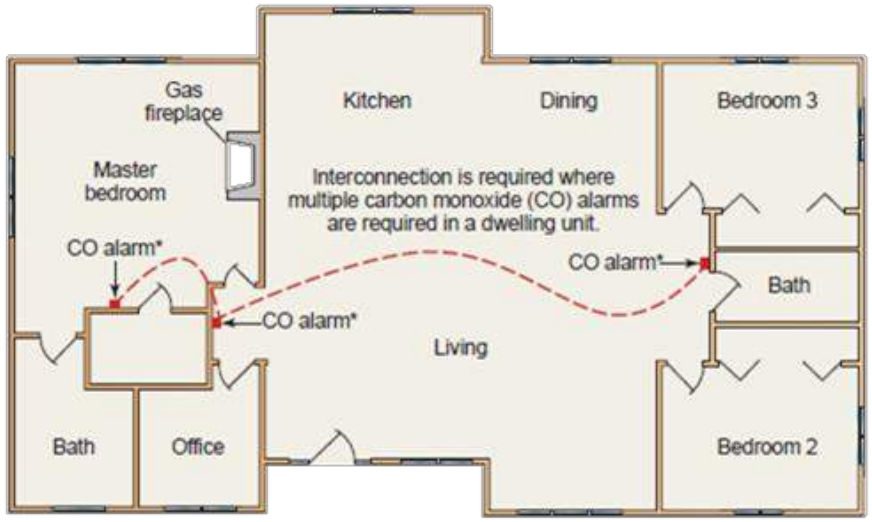


Opening and Intake Locations

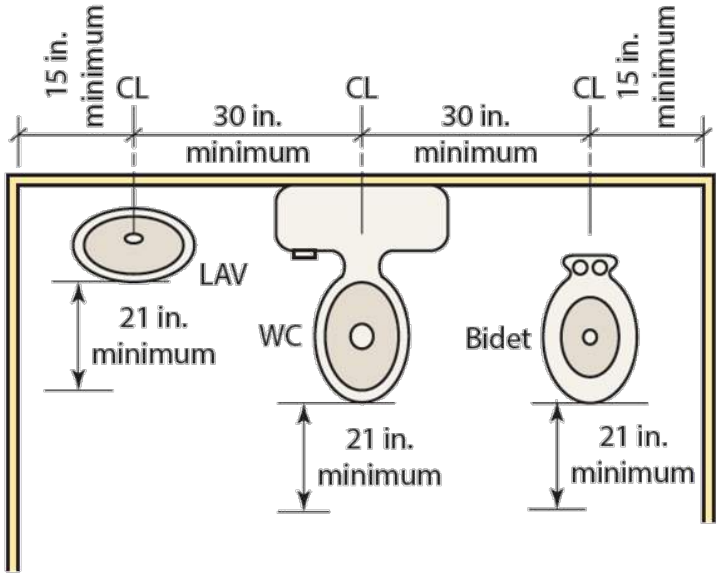


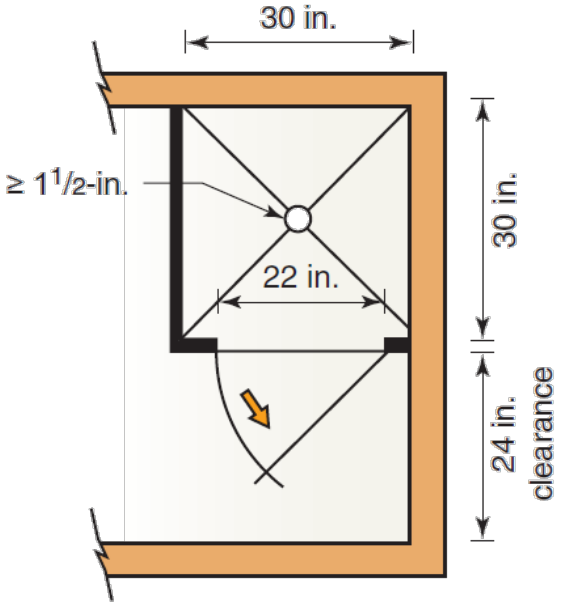
Carbon Monoxide (CO) Alarms

- Required if
  - Fuel-fired appliance or
  - Attached garage communicating with dwelling unit
- Locations
  - Outside of each separate sleeping area adjacent bedrooms
  - Bedrooms with fuel-burning appliance located in or near bedroom
- Power
  - House wiring with battery backup



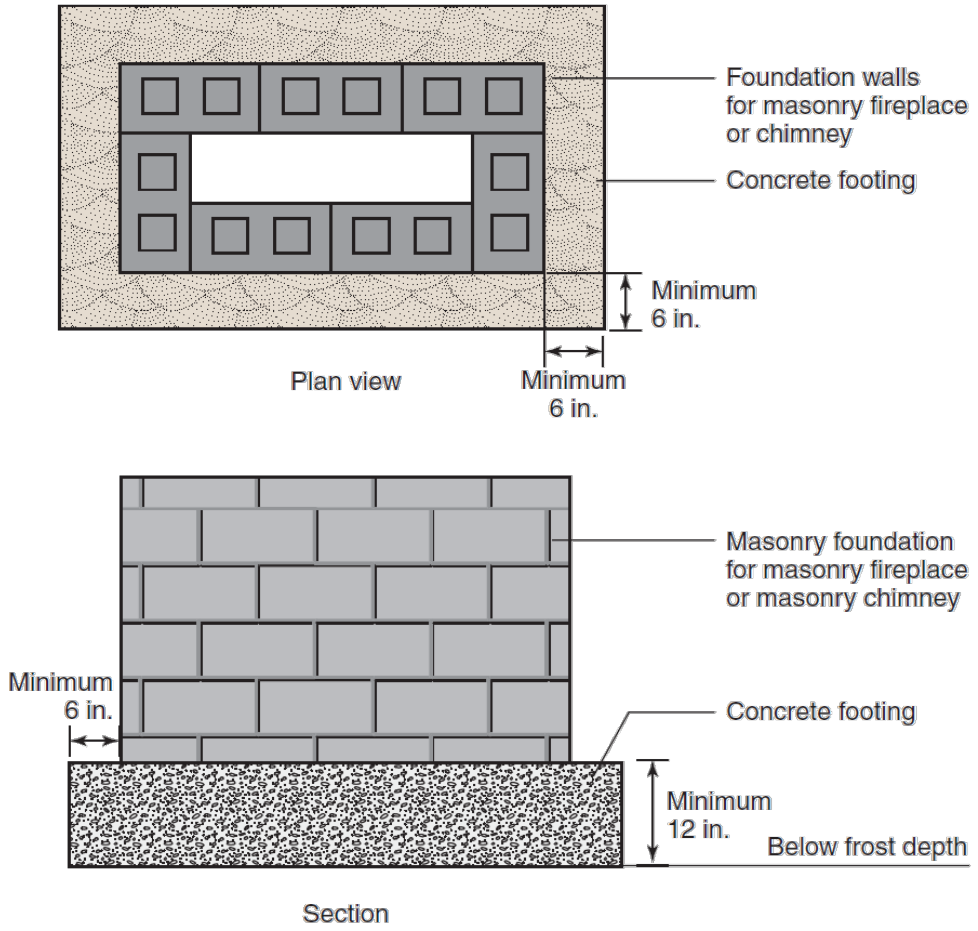
Sanitation





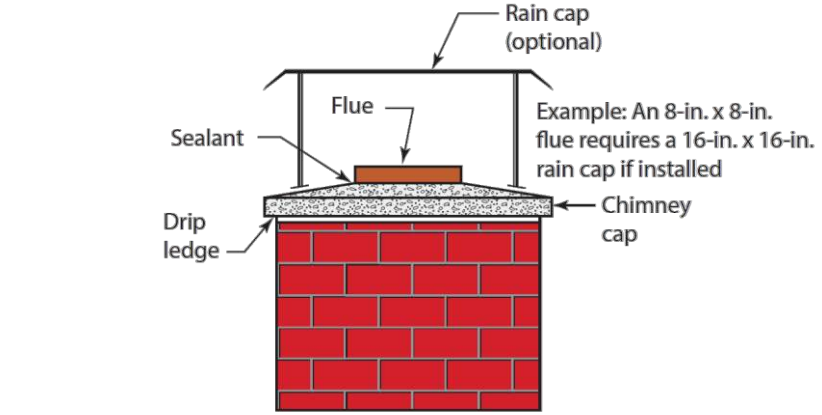
General rule minimum shower dimensions

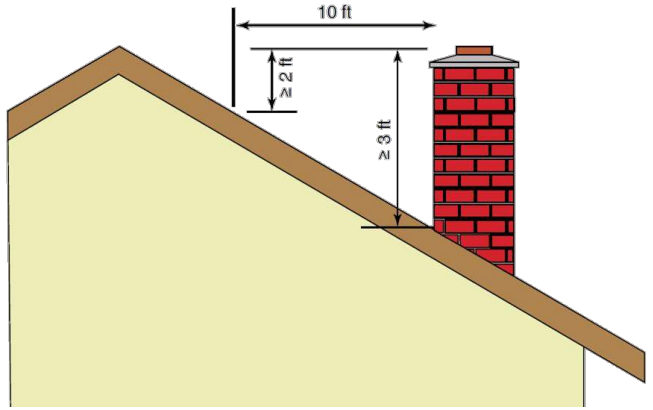
Chimneys and Fireplaces



Masonry Chimney Termination

- Flashing to weatherproof the chimney penetration at the roof
- Crickets required for chimneys ≥30” wide
- Chimney cap required
- Rain cap optional

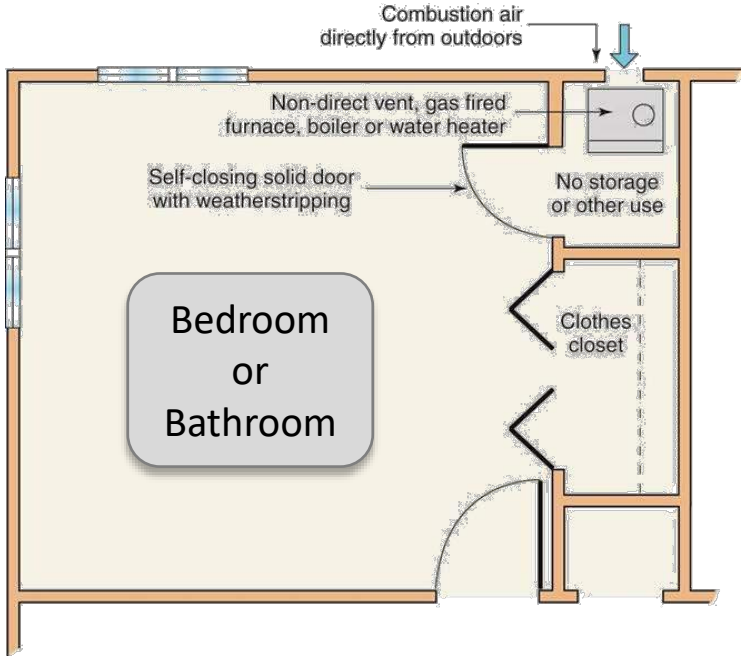




Building Utilities

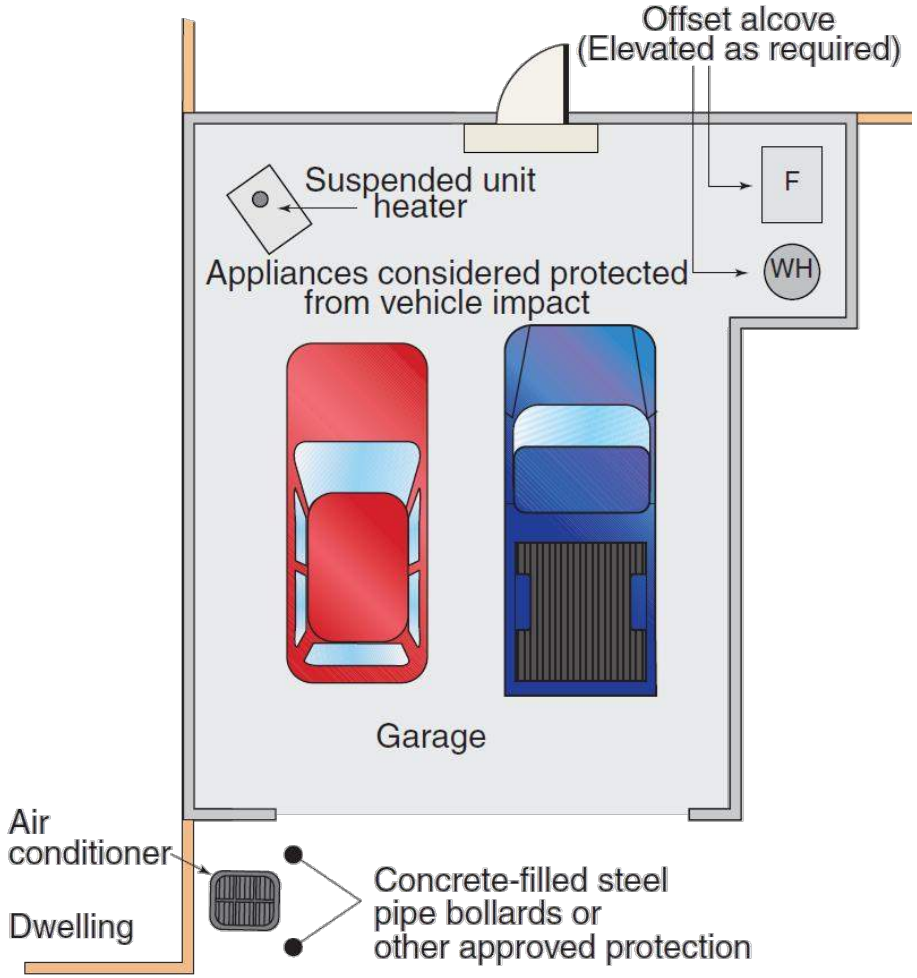
Appliances – Installation and Location

- Gas-fired appliances
- Installation and clearances per appliance listing
- Prohibited locations
  - Sleeping room
  - Bathroom and Toilet rooms
  - Storage closets
  - Space that opens only into such rooms



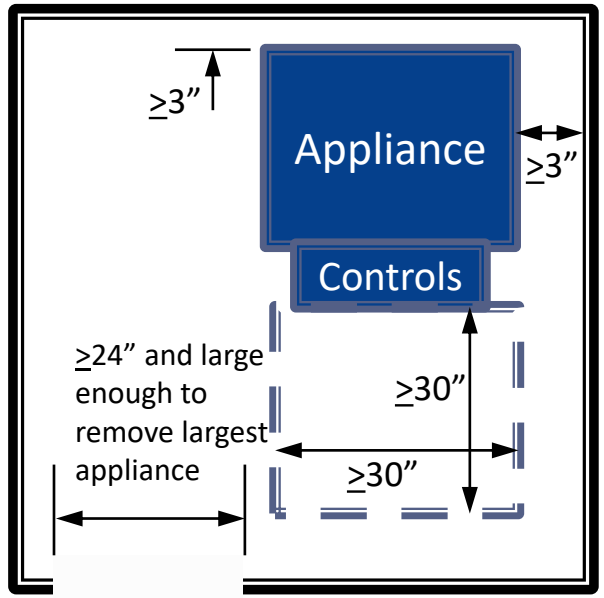
Appliances – Installation and Location

- Private garages
  - Appliances and equipment
  - Ignition source ≥18” above floor
  - Unless appliance listed as flammable-vapor-ignition resistant
  - Protected from vehicle impact

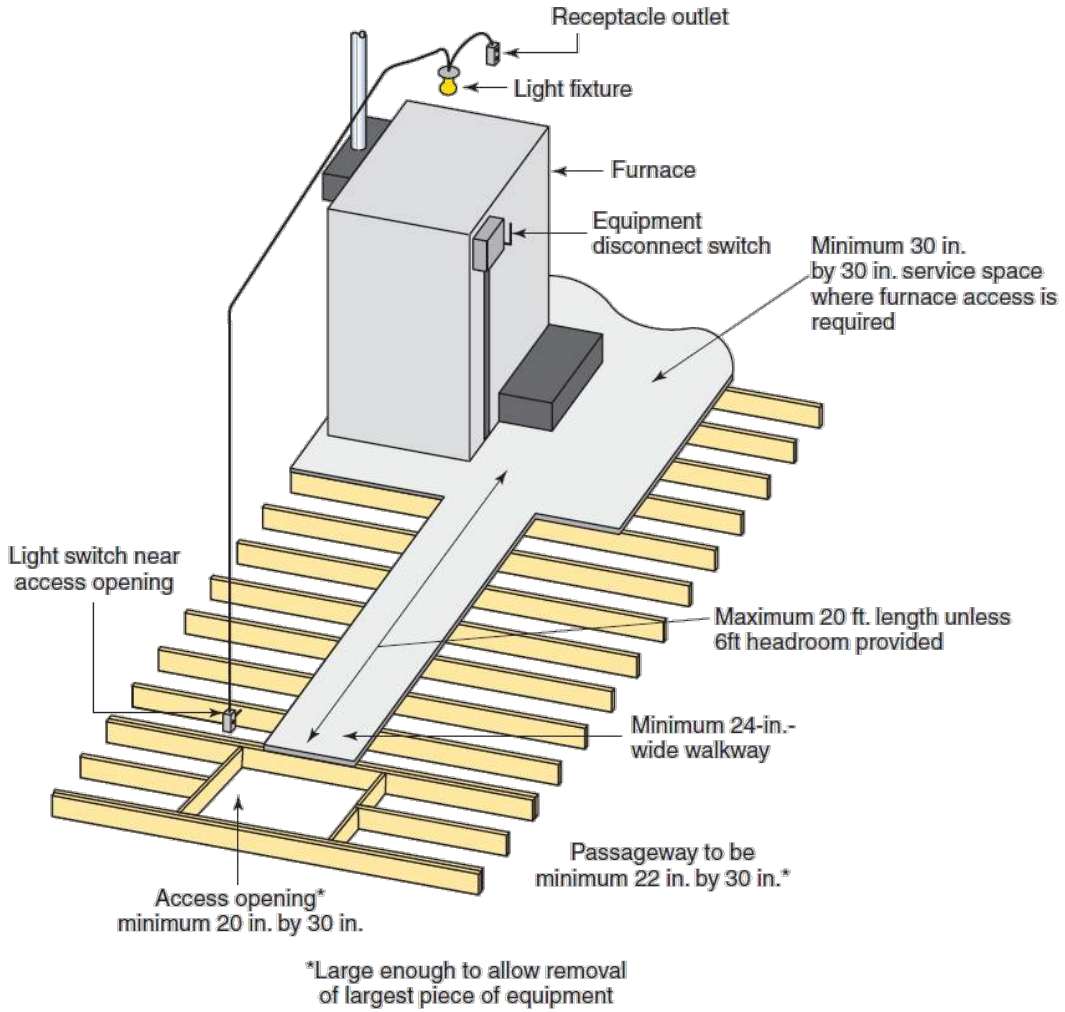


Appliances – Access

- Minimum 30” x 30” working space in front of controls
- Access doors and passageways
  - Minimum 24” wide
  - Large enough to remove largest appliance
- Clearance
  - Furnace compartments >12” wider than appliance
  - Minimum 3” sides & back

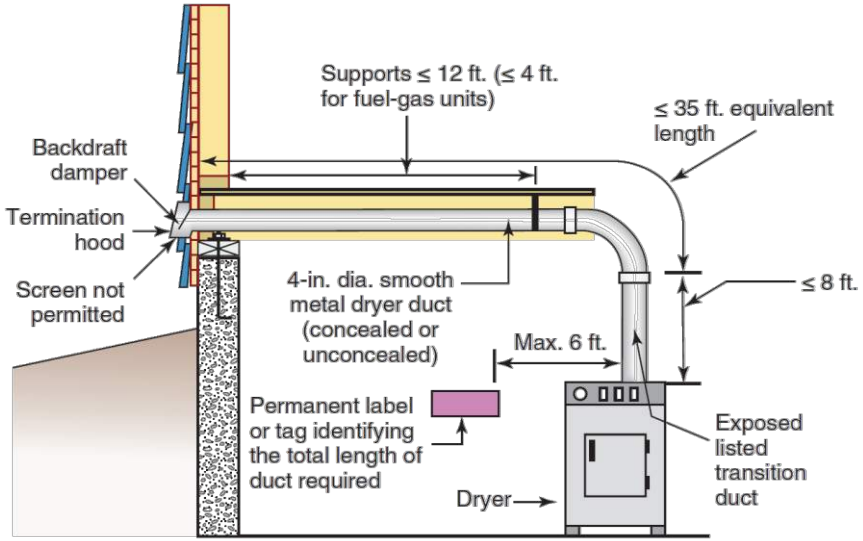


Attic Appliances – Access



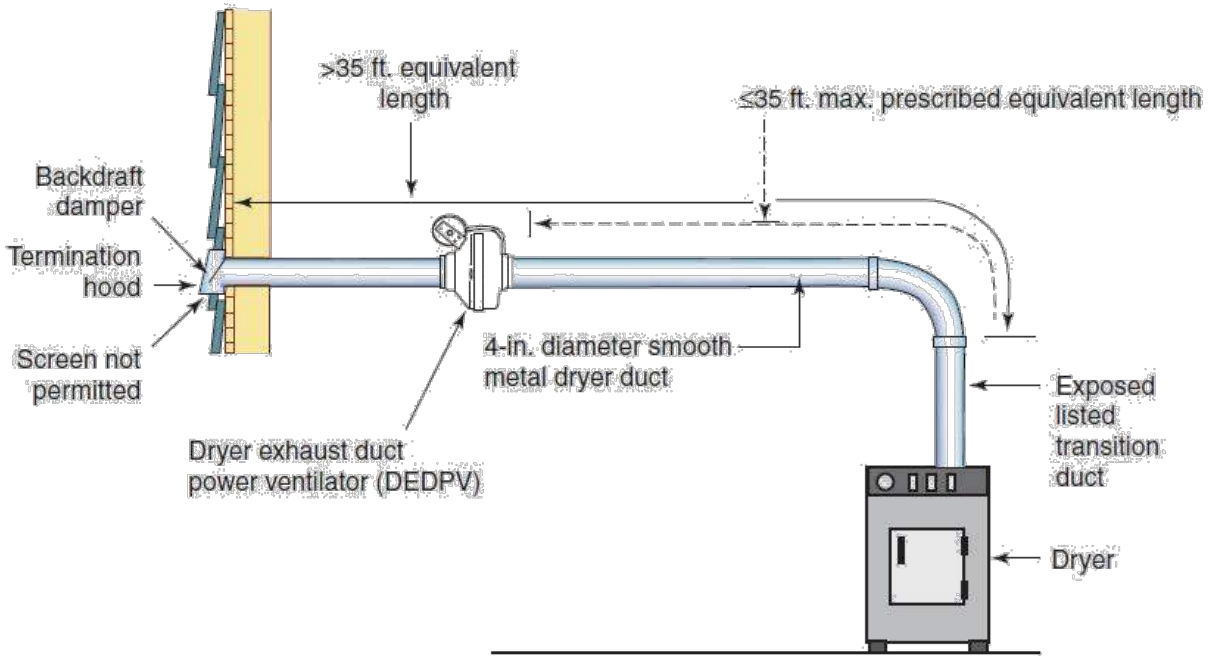
Clothes Dryer Exhaust Systems

- Exhaust Duct Termination
  - Not connected to vent connector, vent or chimney
- Length
  - Deductions for fittings
  - Label when > 35’
  - Per Manufacturer Installation Instructions



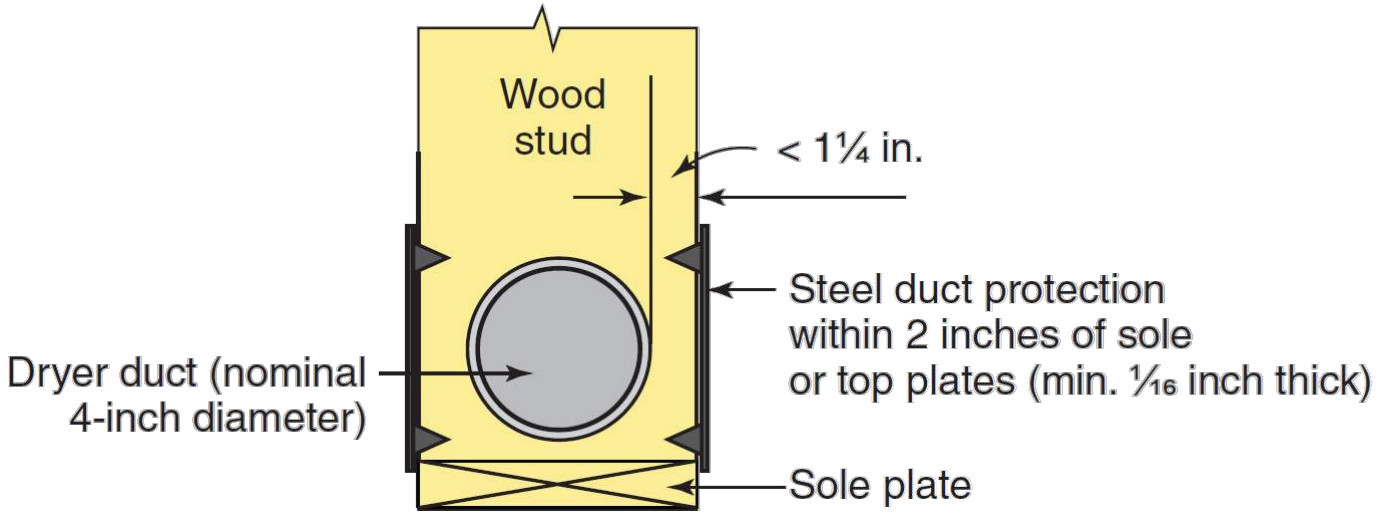
Clothes Dryer Exhaust Systems

- Dryer Exhaust Duct Power Ventilator
  - Per manufacturer



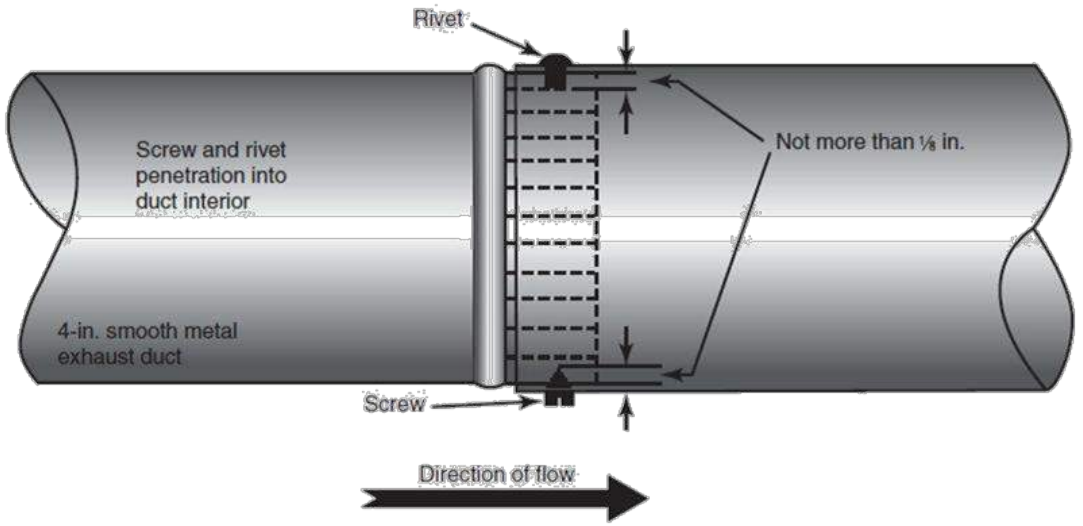
Clothes Dryer Exhaust Systems

- Protection of concealed dryer duct



Dryer Exhaust Duct

- 4” smooth metal duct
  - Min. No. 28 gage
- Insert in direction of flow
- Max. ⅛” screw penetration



Whole-house Mechanical Ventilation System

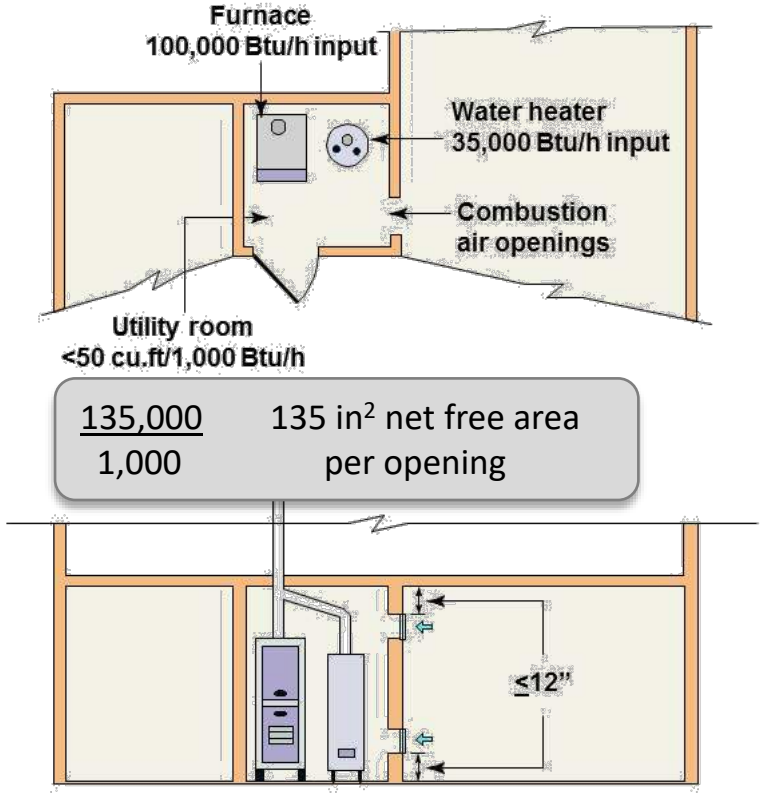
- Prescriptive airflow rate basis
  - Dwelling unit floor area
  - Number of bedrooms
  - Continuous or intermittent
- System design
  - Supply or exhaust fans or both
  - Outdoor air ducts connected to return permitted to supply ventilation

Floor Area	**Bedrooms**	
	2 – 3	4 – 5
	CFM Airflow	
< 1,500	45	60
1,501 – 3,000	60	75
3,001 – 4,500	75	90

APPLICATION

Combustion Air from Inside the Building

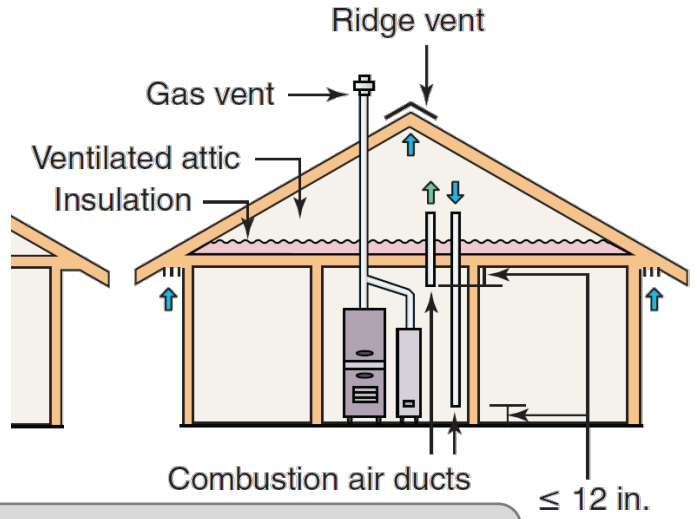
- Combustion air can draw from adjacent rooms if
  - Volume of adjacent space is >50 ft^3 per 1,000 Btu/h
  - At least 2 openings
  - Free area of openings per
    - Btu/h input rating of all appliances
    - 1 in^2 per 1,000 Btu/h



APPLICATION

Combustion Air from Two Outdoor Openings

- Direct openings
- Vertical ducts
  - Free area ≥1 in^2 per 4,000 Btu/h of total input rating
- Horizontal ducts
  - Free area ≥1 in^2 per 2,000 Btu/h of total input rating



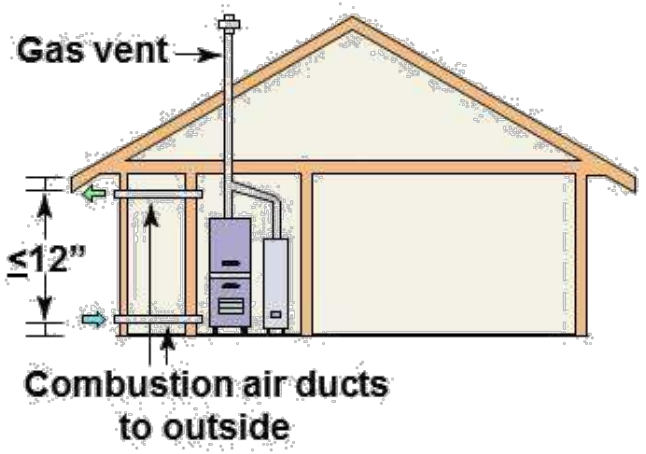
$\frac{135{,}000}{4{,}000}$ = 33.75 in^2 net free area per opening

APPLICATION

Combustion Air from Two Outdoor Openings

- Direct openings
- Vertical ducts
  - Free area ≥1 in^2 per 4,000 Btu/h of total input rating
- Horizontal ducts
  - Free area ≥1 in^2 per 2,000 Btu/h of total input rating

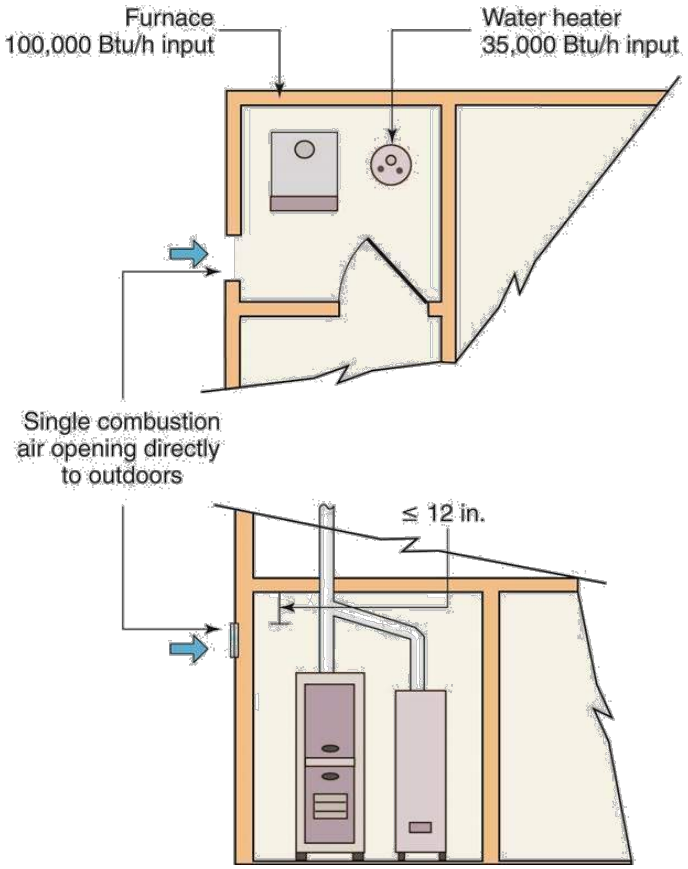
$$\frac{135{,}000}{2{,}000} = 67.5\ in^2 \text{ net free area per opening}$$



APPLICATION

Combustion Air from Single Outdoor Opening

- Free area of opening
  ≥1 in^2 per 3,000 Btu/h
- Free area ≥ sum of all vent connectors areas in the space
- Minimum clearances required around appliances



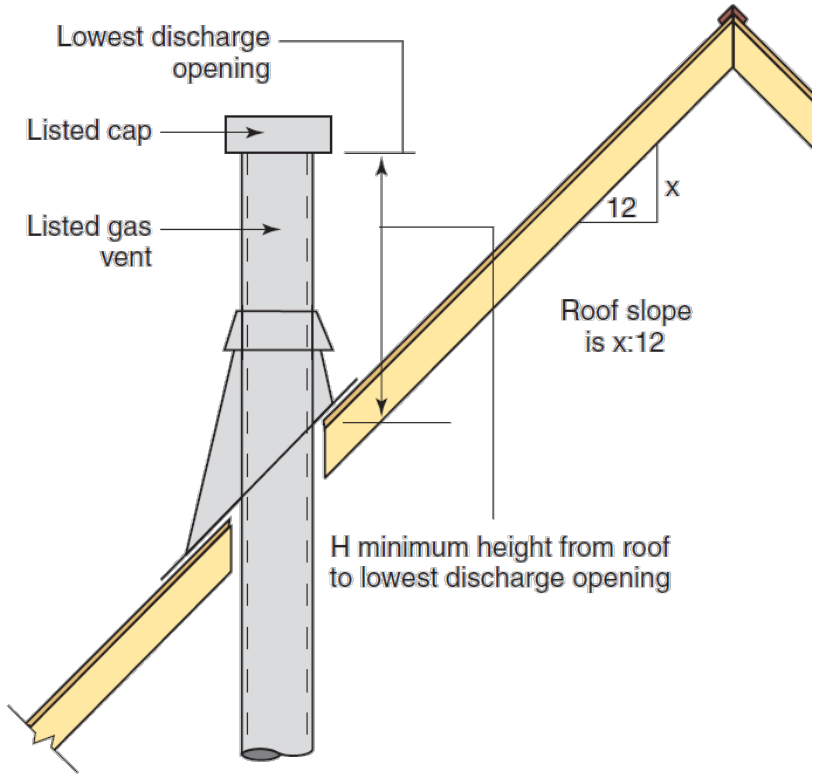
$\frac{135,000}{3,000}$ = 45 in^2 net free area per opening

7” diameter = 38.5 in^2
4” diameter = 12.5 in^2
Combined = 51.0 in^2

Larger of the two = 51 in^2

Gas Vent Roof Termination

- Termination height for gas vents with cross section ≤12” and ≥8’ from a vertical wall based on roof slope

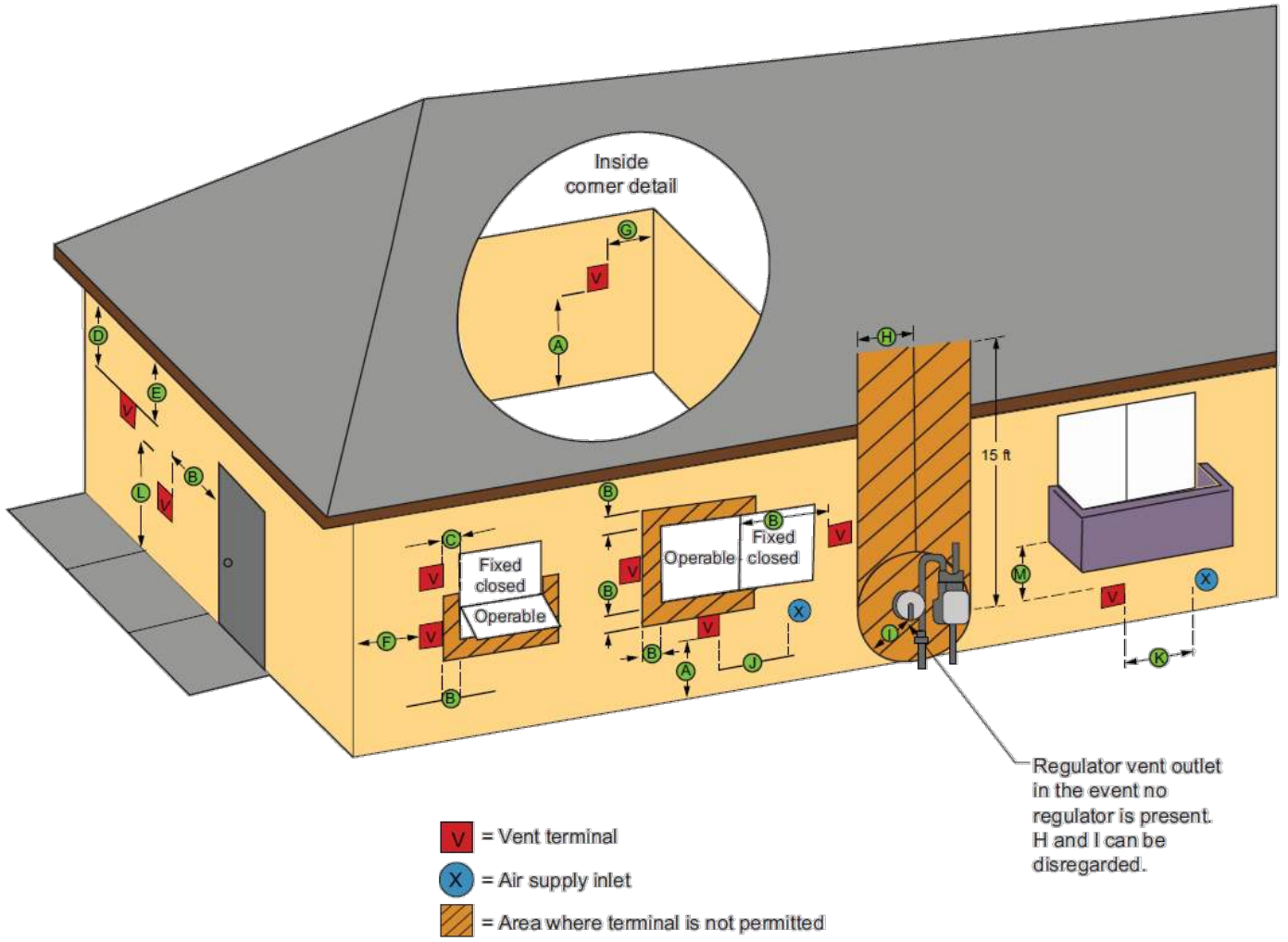


Gas Vent Roof Termination

- Termination height for gas vents with cross section ≤12” and ≥8’ from a vertical wall based on roof slope

ROOF SLOPE	MINIMUM HEIGHT (ft) FROM ROOF TO LOWEST DISCHARGE OPENING
Flat to 6:12	1.0
Over 6:12 to 7:12	1.25
Over 7:12 to 8:12	1.5
Over 8:12 to 9:12	2.0
Over 9:12 to 10:12	2.5
Over 10:12 to 11:12	3.25
Over 11:12 to 12:12	4.0
Over 12:12 to 14:12	5.0
Over 14:12 to 16:12	6.0
Over 16:12 to 18:12	7.0
Over 18:12 to 20:12	7.5
Over 20:12 to 21:12	8.0
[Ref. Figure G2427.6.4]	

Direct-vent Appliance Vent Termination

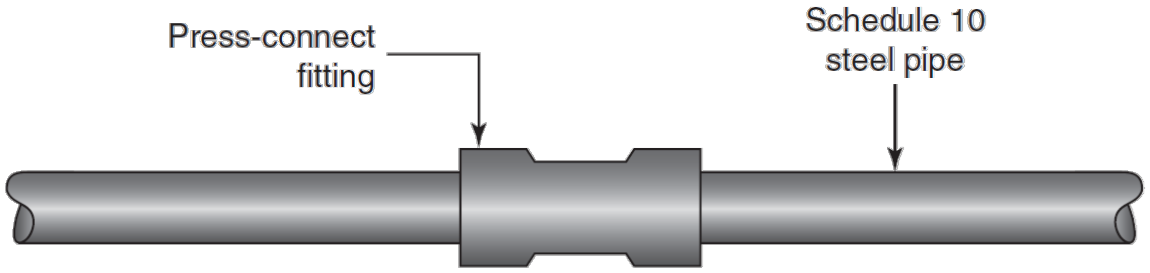


Direct-vent Appliance Vent Termination

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCE FOR DIRECT-VENT TERMINALS	
A	Clearance above finished grade level, veranda, porch, deck or balcony	12 inches	
B	Clearance to window or door that is openable	**Appliance Btu/ Hr Rating**	**Minimum Clearance to Terminal**
		≤ 10,000	6 inches
		≤ 50,000	9 inches
		≤ 150,000	12 inches
		> 150,000	Use manufacturer's instructions and at least nondirect vent clearances

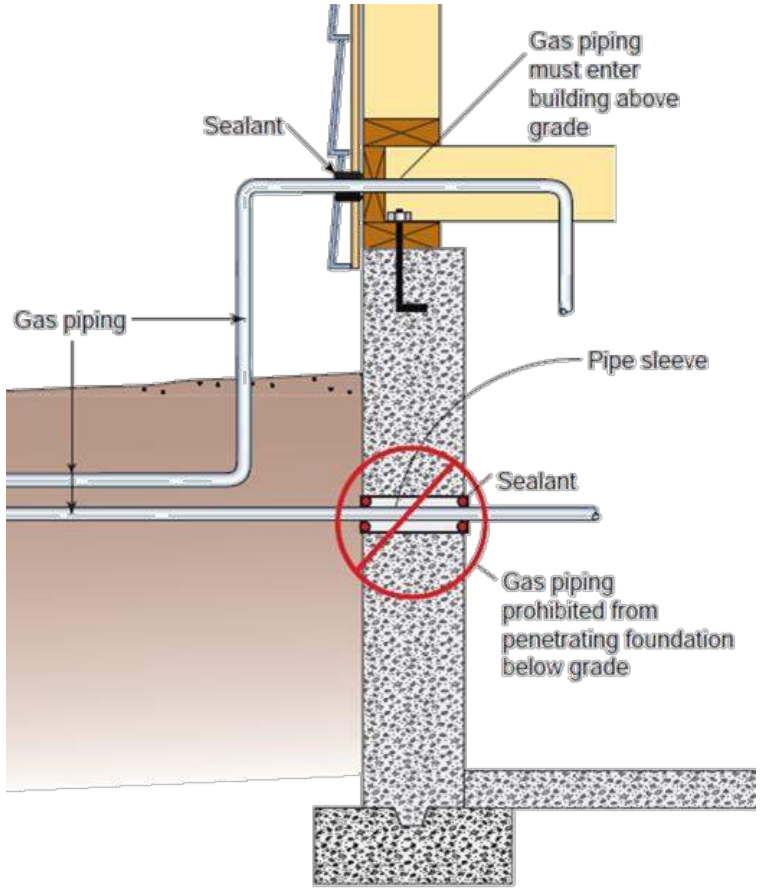
Gas Pipe Materials

- Steel, stainless steel and wrought-iron
  - Minimum Schedule 10
- Approved seamless metallic tubing
  - Gas not corrosive to pipe material
- Corrugated stainless steel tubing (CSST)
- Exterior underground locations only
  - Approved plastic pipe, tubing and fittings



Prohibited Locations for Gas Piping

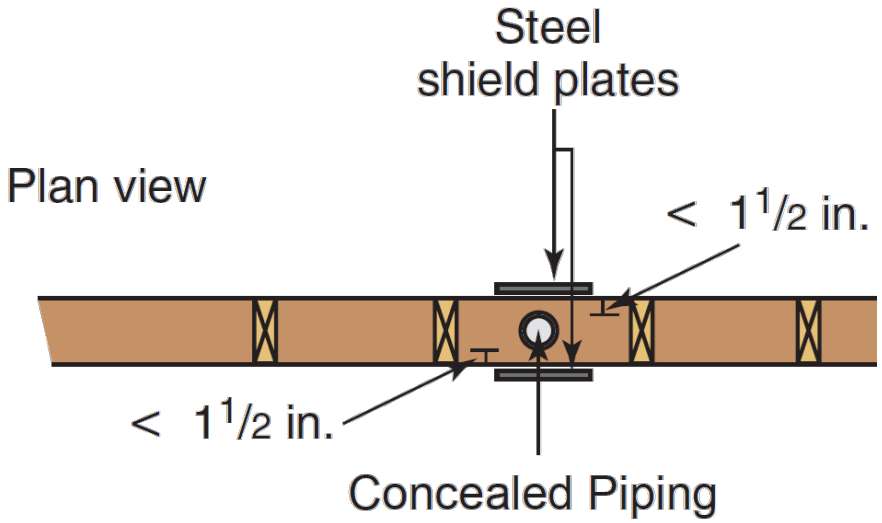
- Piping cannot be installed
  - Within
    - Air ducts
    - Clothes chutes
    - Chimneys
    - Gas vents
  - Through any other townhouse unit
  - Entering a building below grade



Gas Piping Protection

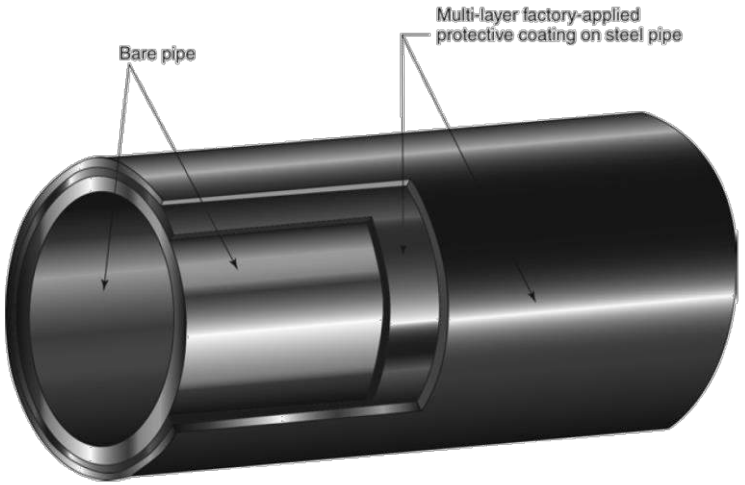
- Concealed piping installed through holes or notches in studs, joists, rafters must be
  - >1½" from nearest edge of member or
  - Protected by No. 16 Gage nail shield plates

- CSST protection per manufacturer's instructions



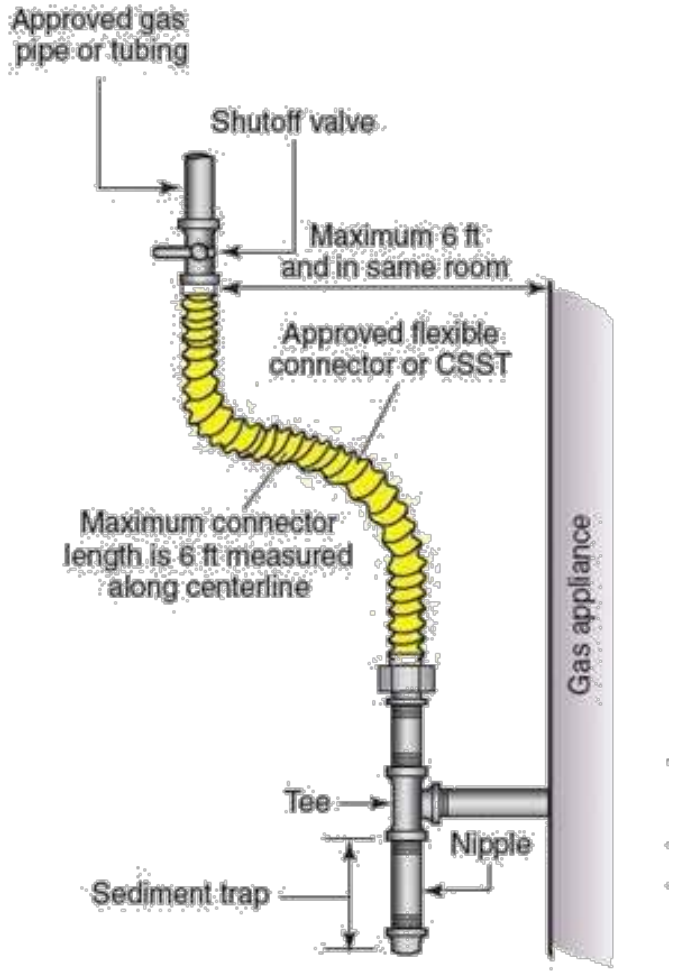
Other Gas Piping Installation Requirements

- Above-ground outdoors
  - ≥ 3½” above ground and roof surfaces
  - Protection from corrosion for ferrous metal
    - Painting and Galvanizing
- Underground
  - Steel pipe wrapped with approved material for protection
  - Galvanizing not approved corrosion protection
  - Buried ≥ 12” deep



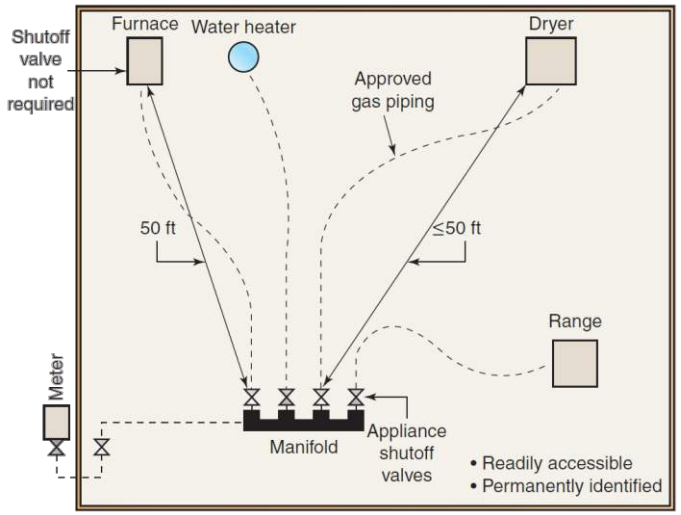
Gas Appliance Connections

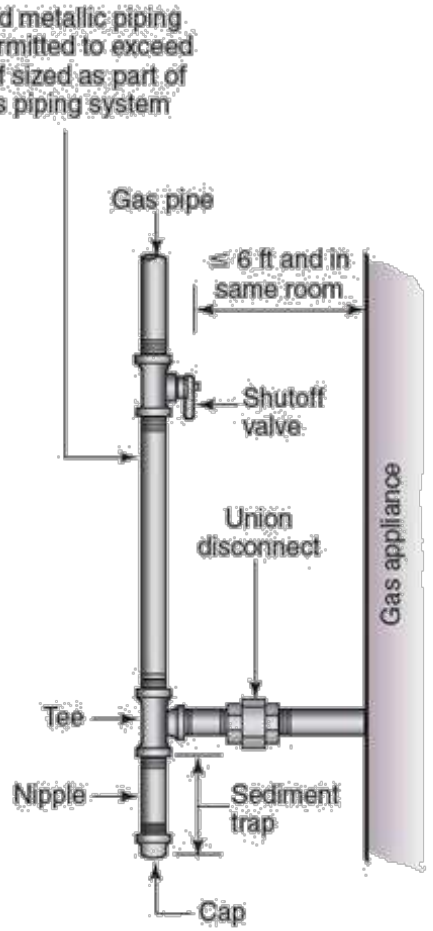
- Materials
  - Rigid metallic piping
  - CSST
  - Listed and labeled
    - Appliance connectors
    - Quick-disconnects
- Installation
  - Can pass through appliance housing
  - Cannot pass through walls, floors, partitions, ceilings



Gas Appliance Connections

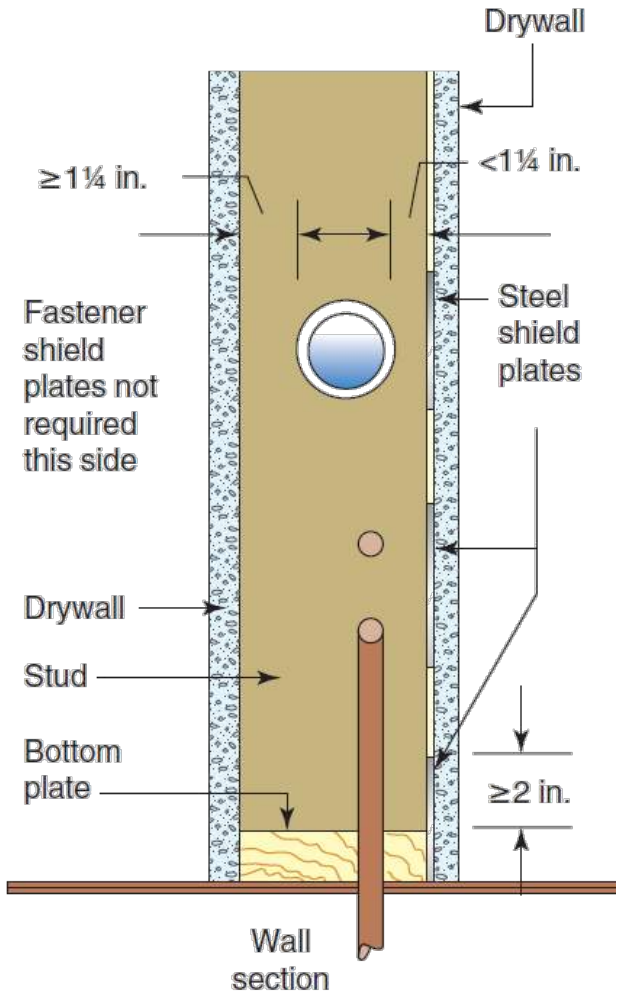
- Shut-off valve
  - ≤6’ or
  - <50’ when connected to manifold





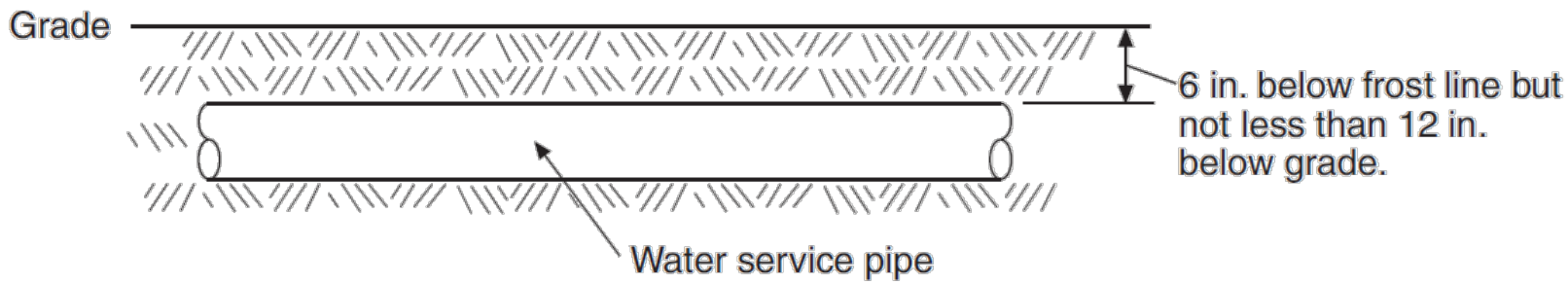
Plumbing Piping Protection

- Concealed piping installed through studs, joists or rafters
- If < 1¼" from edge
  - 16-gage steel shield plates
    - Extends ≥ 2" above bottom plates and below top plates
- Exception for cast iron and galvanized steel pipe



Protection from Freezing

- Underground water service pipe
  - Buried ≥12” deep
  - Buried ≥ 6” below frost line
- Building sewer pipe
  - Depth determined by Jurisdiction
  - Stipulated in adopting ordinance



Plumbing Piping Support

- Support
  - Maintains alignment and slope
  - Prevents sagging
  - Allows for expansion and contraction
- Underground
  - Continuous support
  - Suitable bedding materials
  - Not supported on rocks or blocks
  - Backfill free of debris, rocks, concrete, and frozen material
  - Protection of footings

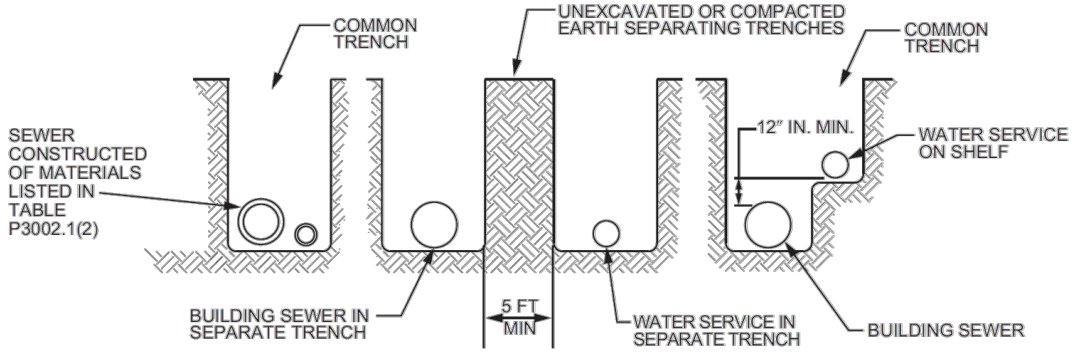
Aboveground Piping Support

- Mid-story guide required for vertical plastic piping ≤2” diameter

PIPING MATERIAL	MAX. HORIZONTAL SPACING (ft)	MAX. VERTICAL SPACING (ft)
ABS	4	10
Cast-iron, < 10 ft lengths	5	15
Cast-iron, 10 ft lengths	10	15
Copper or copper alloy , ≥ $1^1/_2$ in. dia.	10	10
PEX, ≤ 1 in. dia.	2.67	10
PVC	4	10

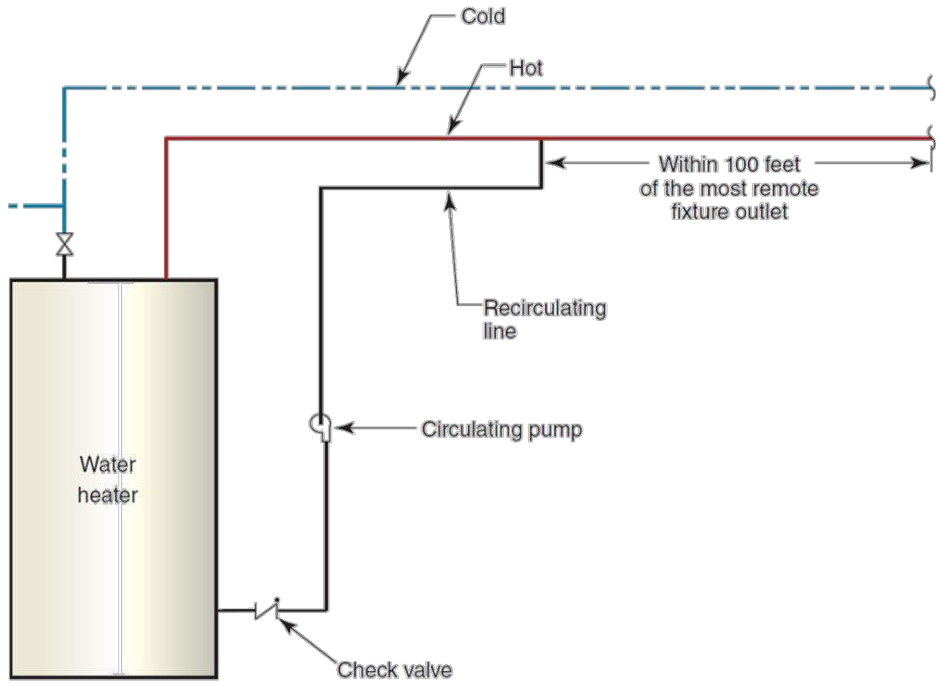
Water Service

- Sewer pipe listed for underground use
  - Water service pipe permitted in same trench with building sewer (e.g. cast-iron or schedule 40 PVC DWV)
- Sewer pipe not approved for underground use
  - Water service must be separated from sewer pipe
    - ≥ 5’ of horizontal separation, or
    - Installed on a ledge ≥ 12” inches above and to one side of highest point of building sewer



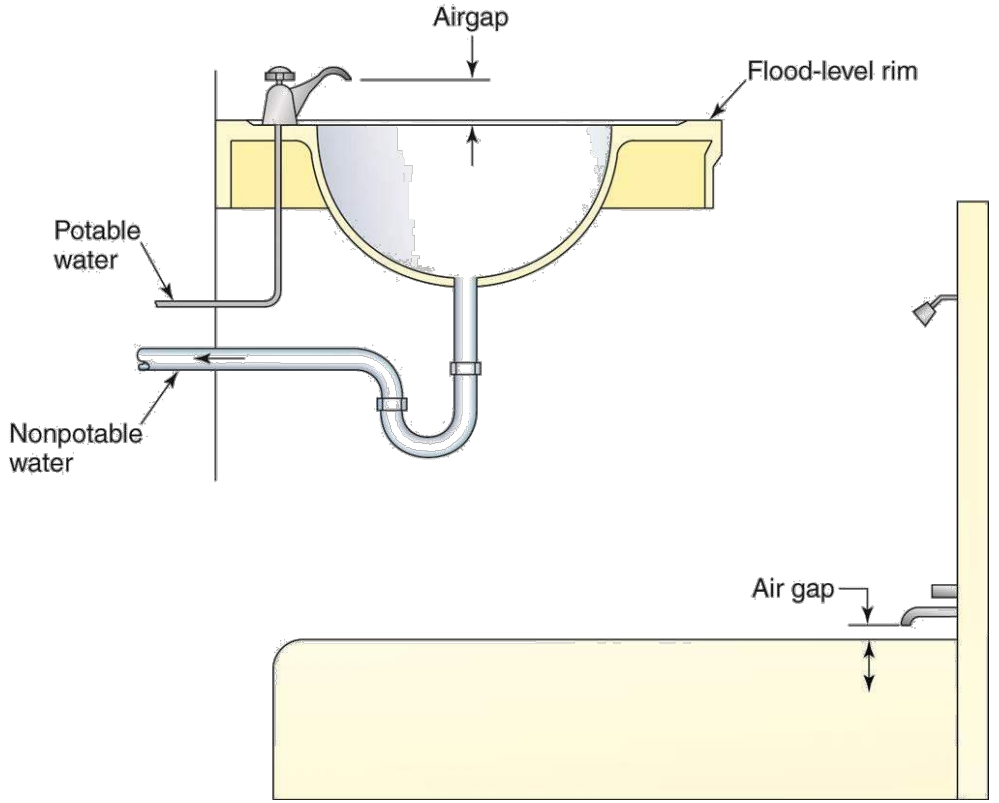
Water Supply System Design Criteria

- Water service at building entrance
  - Max 80 psi, Min ¾” pipe
- Distribution system pipe size based on
  - Fixture unit values, Developed length of piping, and Water pressure
- Fixture flow rates & consumption limited to conserve water
- Shut-off valve
  - At each fixture other than showers and tubs



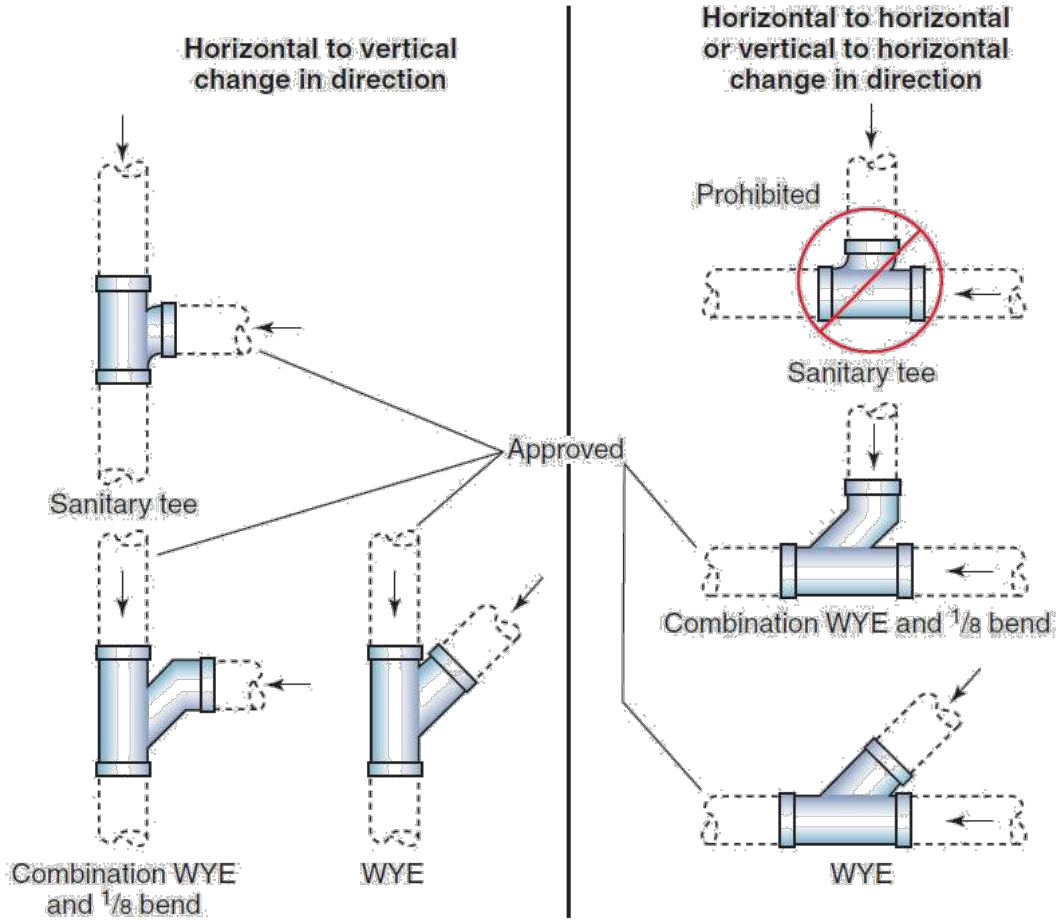
Water Supply Protection

- Backflow prevention devices suitable for application
  - Hose connections
  - Boilers
  - Heat exchangers
  - Lawn irrigation systems
- Air gap required at
  - Sinks
  - Lavatories
  - Bathtubs



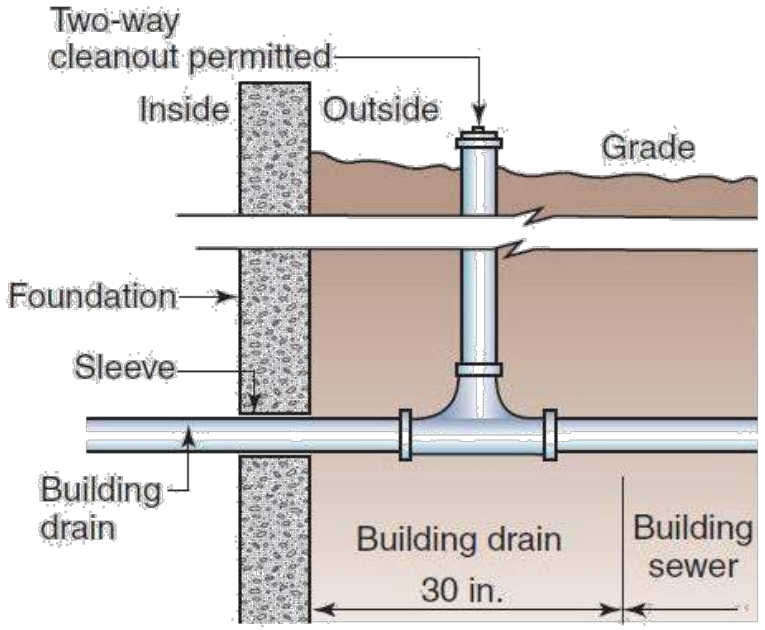
Sanitary Drainage

- Approved fittings for change in direction



Cleanouts

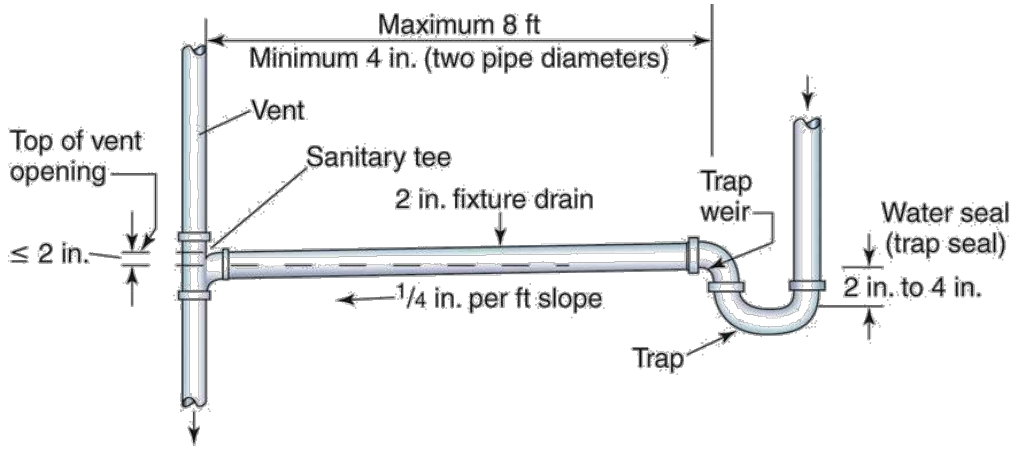
- Cleanouts required:
  - Where horizontal drain lines change direction >45°
  - Within 10’ of building drain / sewer connection
- Where more than one change of direction occurs
  - Only one cleanout is required in each 40’
- Readily removable fixture may serve as cleanout
  - Water closet or Sink fixture trap



Cleanout required near building drain/sewer connection

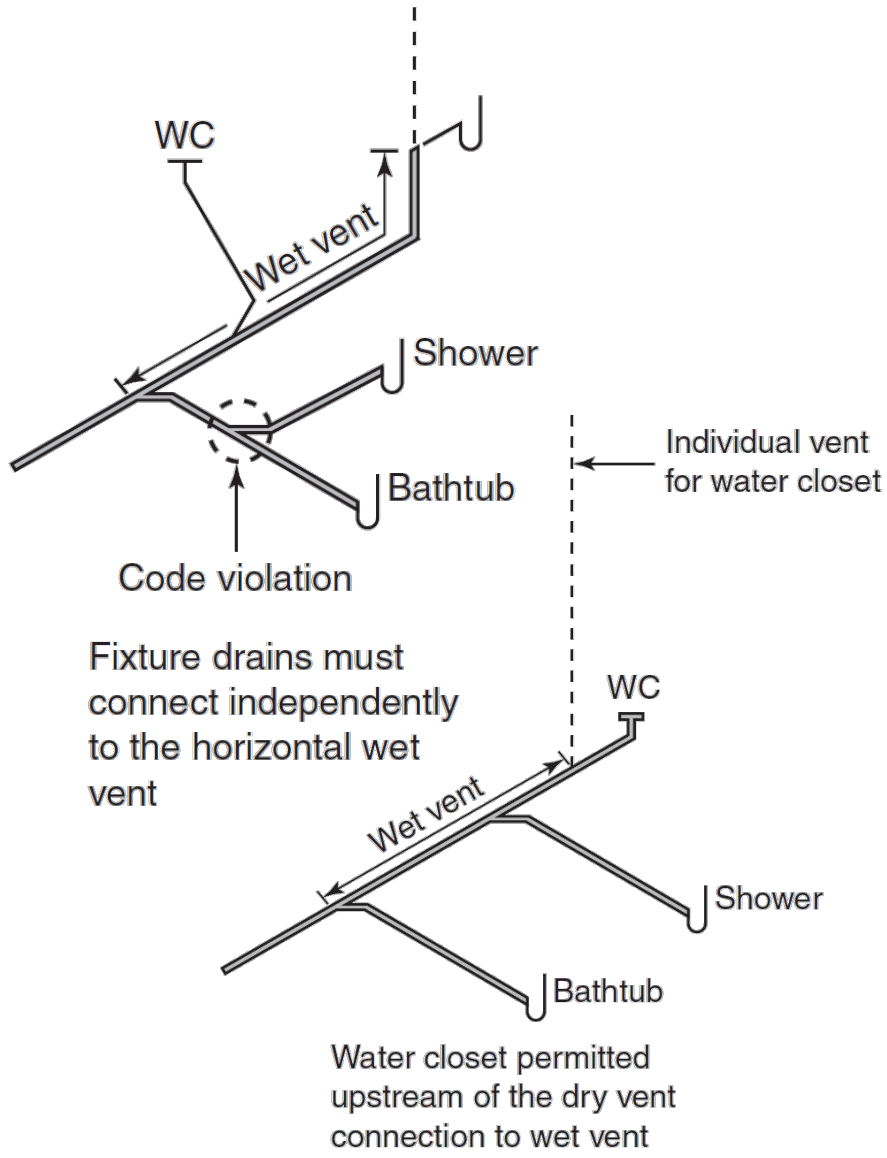
Fixture Vents

- Distance from trap to vent limited
  - Self-siphoning fixtures such as water closets not limited
- Vent connection not permitted below trap weir



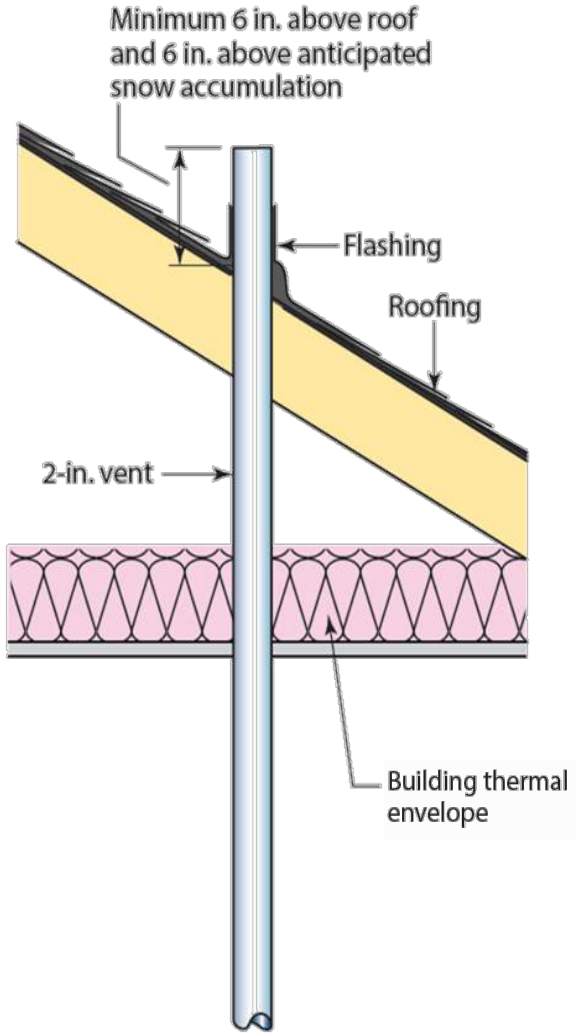
Wet Venting

- Permitted for 1 or 2 bathroom groups on same level
- Vent piping diameter
  - At least ½ of required diameter of drain served
  - >1¼”
  - Vents >40’ increase one pipe size



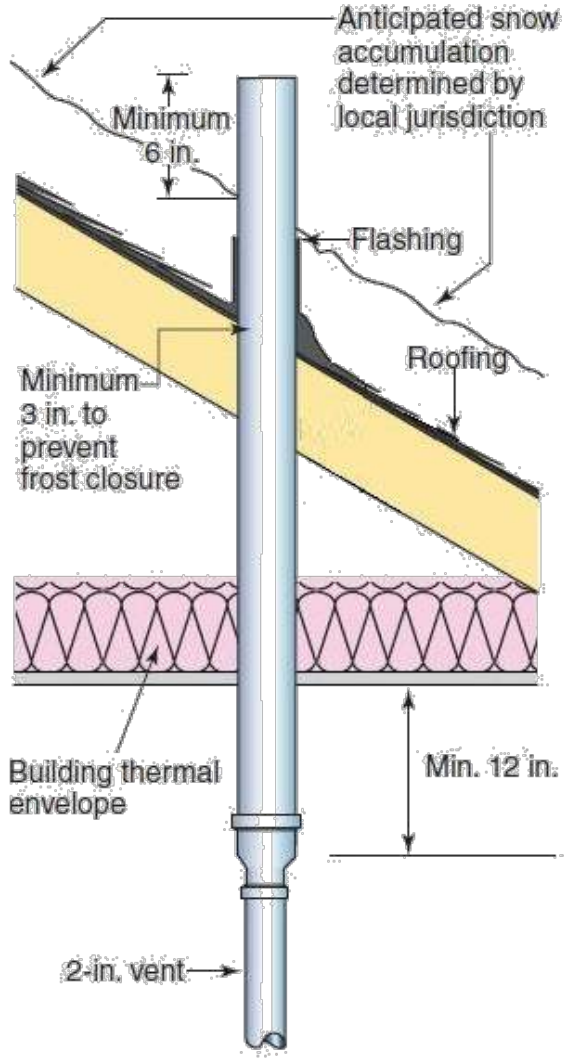
Vent Termination

- Warmer climates
  - 97.5% outside design temperature > 0°F



Vent Termination

- Frost closure
  - 97.5% outside design temperature ≤ 0°F
  - Increase to 3” at point ≥ 12” inside building envelope



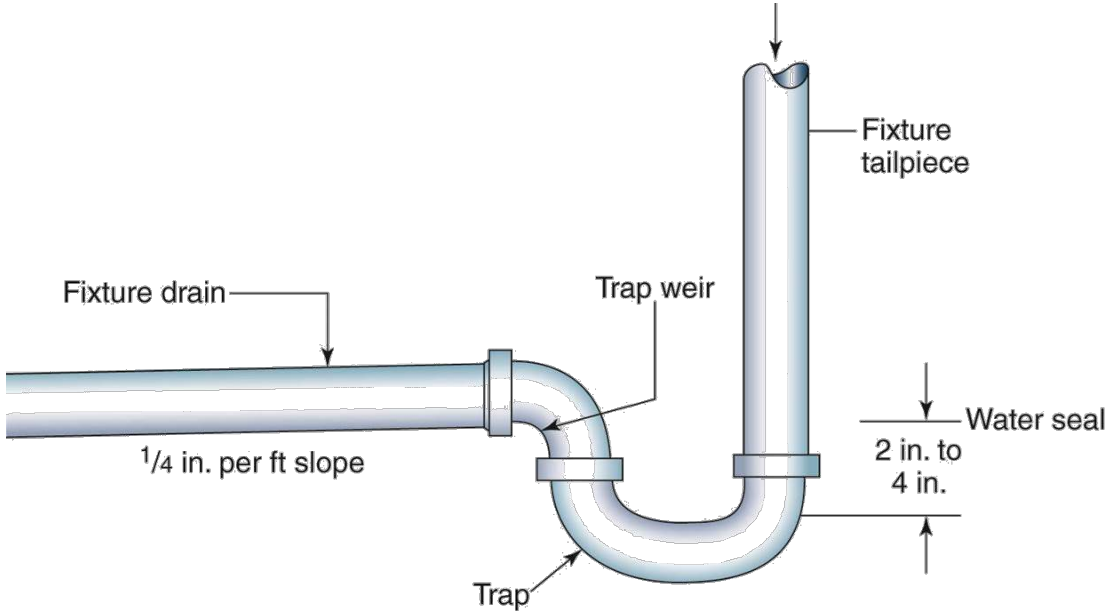
Protection Against Scalding

- Required temperature control devices

FIXTURE	MAX. TEMPERATURE	APPROVED DEVICE	STANDARD
Shower or tub-shower combination	120°F	Balanced-pressure valve or Thermostatic valve or Combination balanced-pressure/ thermostatic valve	ASSE 1016/ASME A112.1016/CSA B125.16
Bathtub or whirlpool bathtub	120°F	Water-temperature-limiting device	ASSE 1070/ASME A112.1070/CSA B125.70
Bidet	110°F		

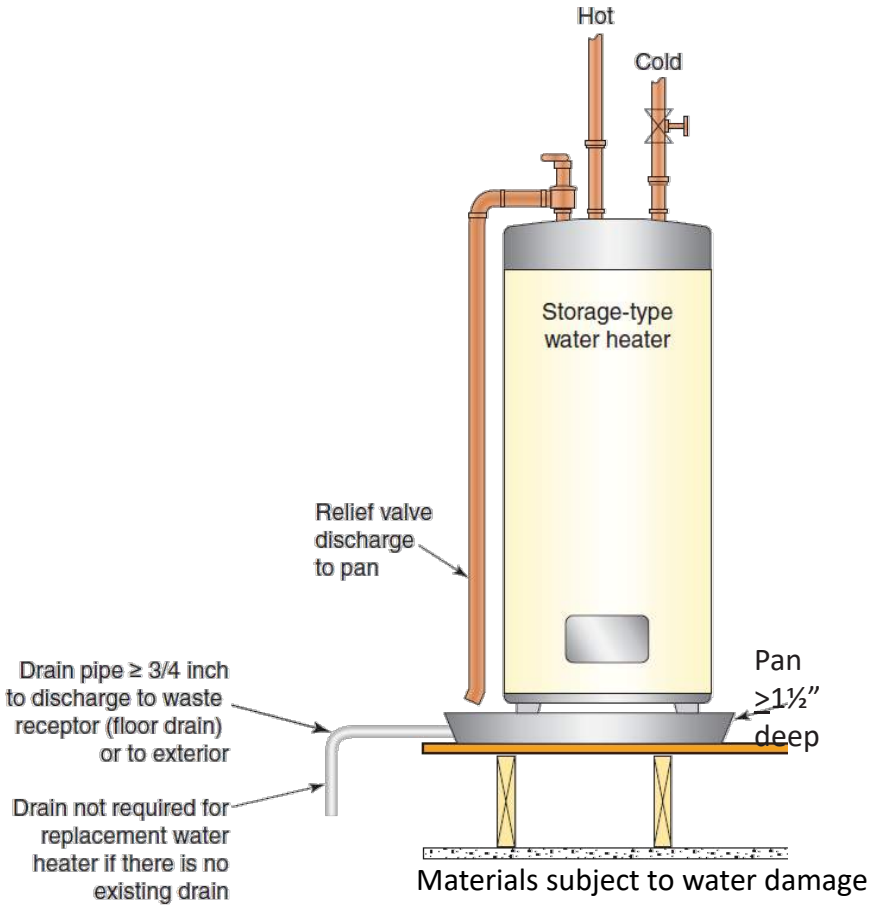
Fixture Traps

- Traps provide water seal to prevent sewer gases from entering the building
- Floor drains require trap-primer or deep-seal design to prevent loss of water seal by evaporation



Water Heaters

- Temperature & pressure relief valve
- Ignition sources elevated
  - ≥18” above garage floor
- Anchorage to walls
  - SDCs D_0, D_1, and D_2
  - Townhouses in SDC C

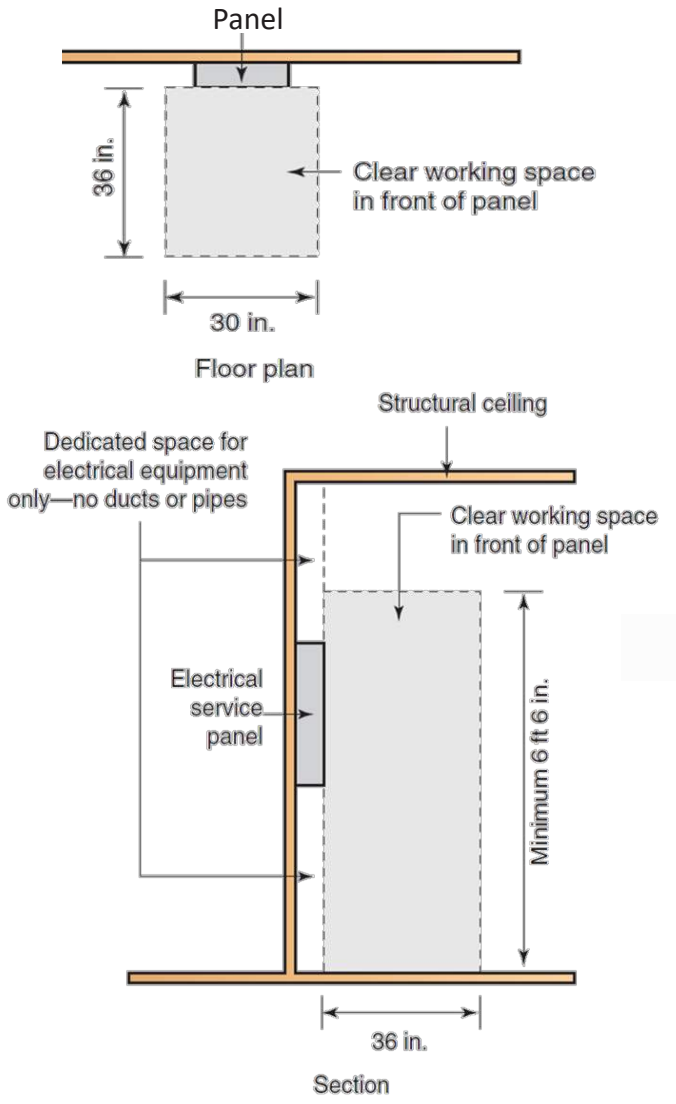


Electrical Services

- Service distributes electricity to premises system
- Only one service permitted for 1- and 2-family dwellings
- IRC covers
  - 120/240-volt
  - Single-phase systems
  - <400 amperes
- Main service disconnect

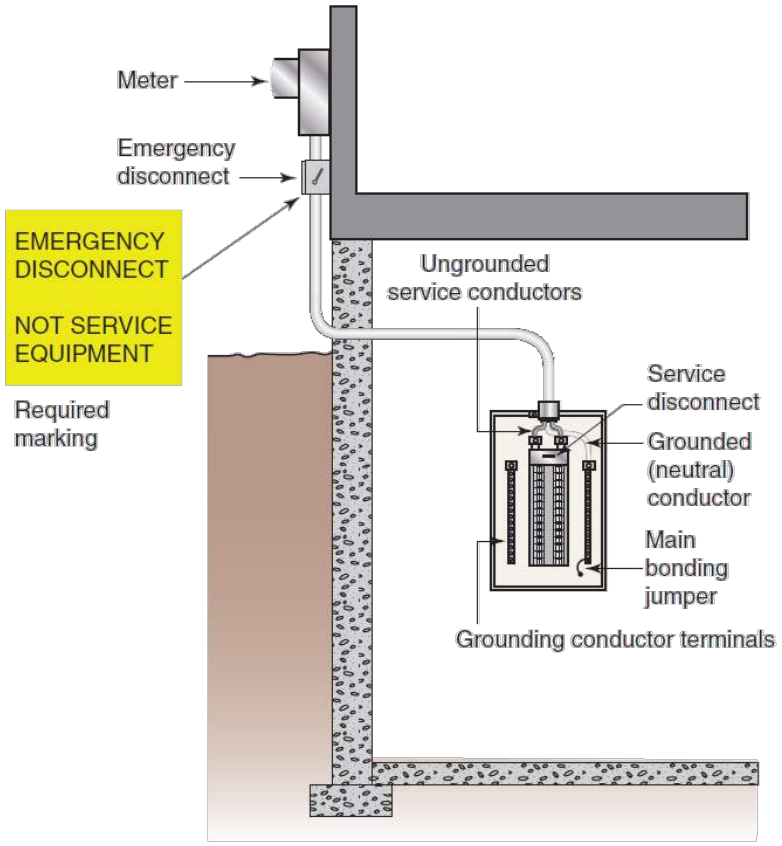
Equipment Location

- Readily accessible service disconnect
- Light source nearby
- Not in clothes closets or bathrooms
  - Electrical panels
  - Service disconnects
  - Circuit breakers



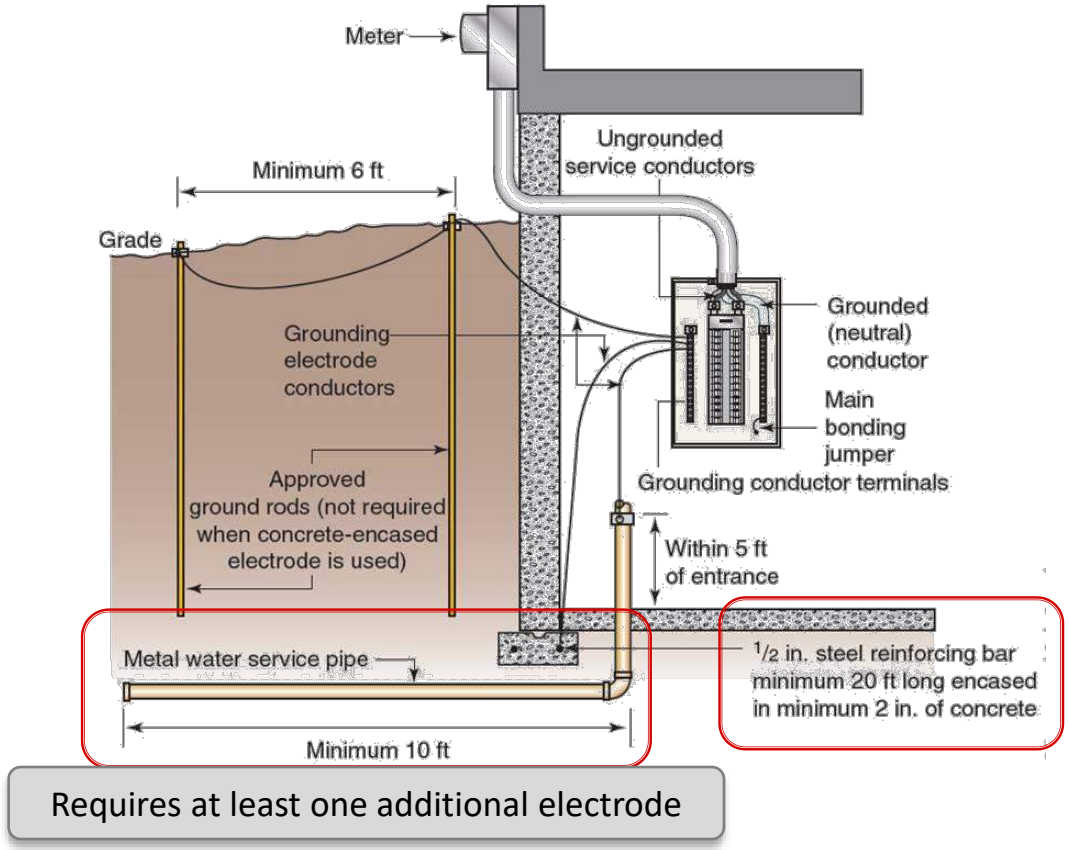
Electrical Service Size & Rating

- Service rating
  - Minimum 100 amp for single-family dwellings
  - Minimum 60 amp for other installations
- Ampacity of ungrounded service conductors and disconnect ≥ load served



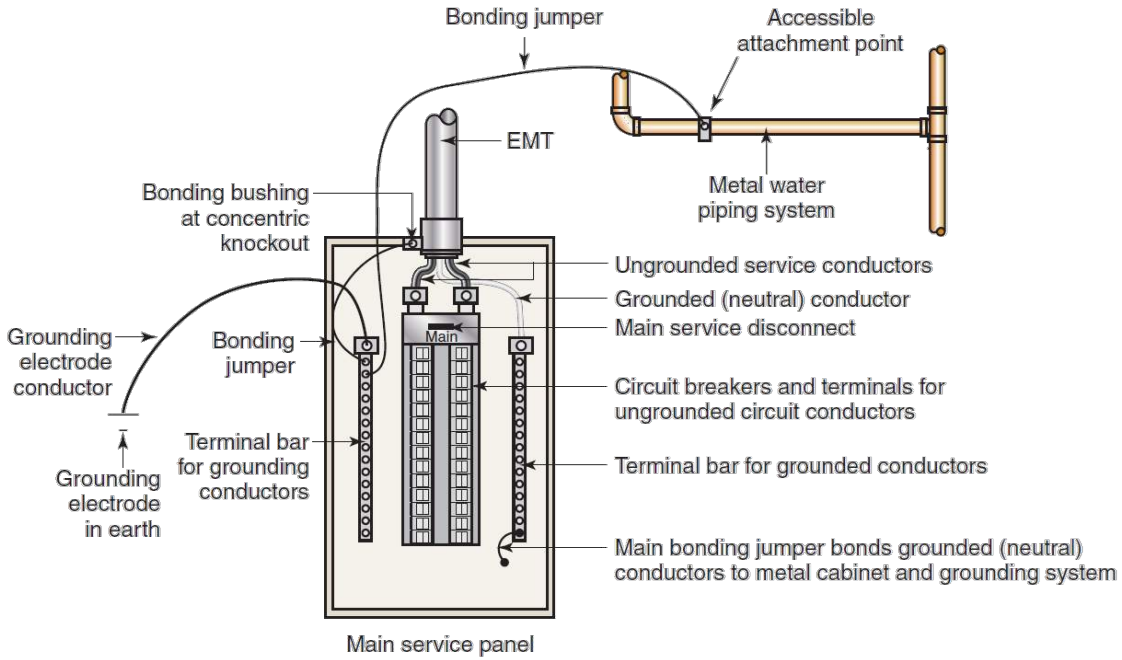
Grounding Electrode System

- Grounding options
  - Underground metal water pipe
  - Concrete-encased reinforcing bar (Ufer ground)
  - Approved ground rods



Bonding

- Connection of grounding system to grounded (neutral) conductors occurs at main service disconnect



Conductor Sizing

- Ampacity tables for all wire sizes based on material and insulation type
- Variables when sizing wires > 30-amp circuits
  - Temperature rating of
    - Conductor insulation
    - Terminal
  - Derating for bundled conductors

Conductors	Circuit Rating		
	15 amp	20 amp	30 amp
Min. size (AWG) circuit conductors (copper)	14	12	10
Overcurrent-protection device: max. amp rating	15	20	30
Duplex or multiple outlet receptacle rating (amps)	15 max.	15 or 20	30
Single receptacle outlet minimum rating (amps)	15	20	30
Max. load (amps)	15	20	30

Overcurrent Protection Required

- Circuit breaker or fuse required to protect all ungrounded branch circuit and feeder conductors

COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM	
SIZE (AWG)	MAX. OVERCURRENT PROTECTION DEVICE RATING (amps)	SIZE (AWG)	MAX. OVERCURRENT PROTECTION DEVICE RATING (amps)
14	15	12	15
12	20	10	25
10	30	8	30

[Ref. Table E3705.5.3]

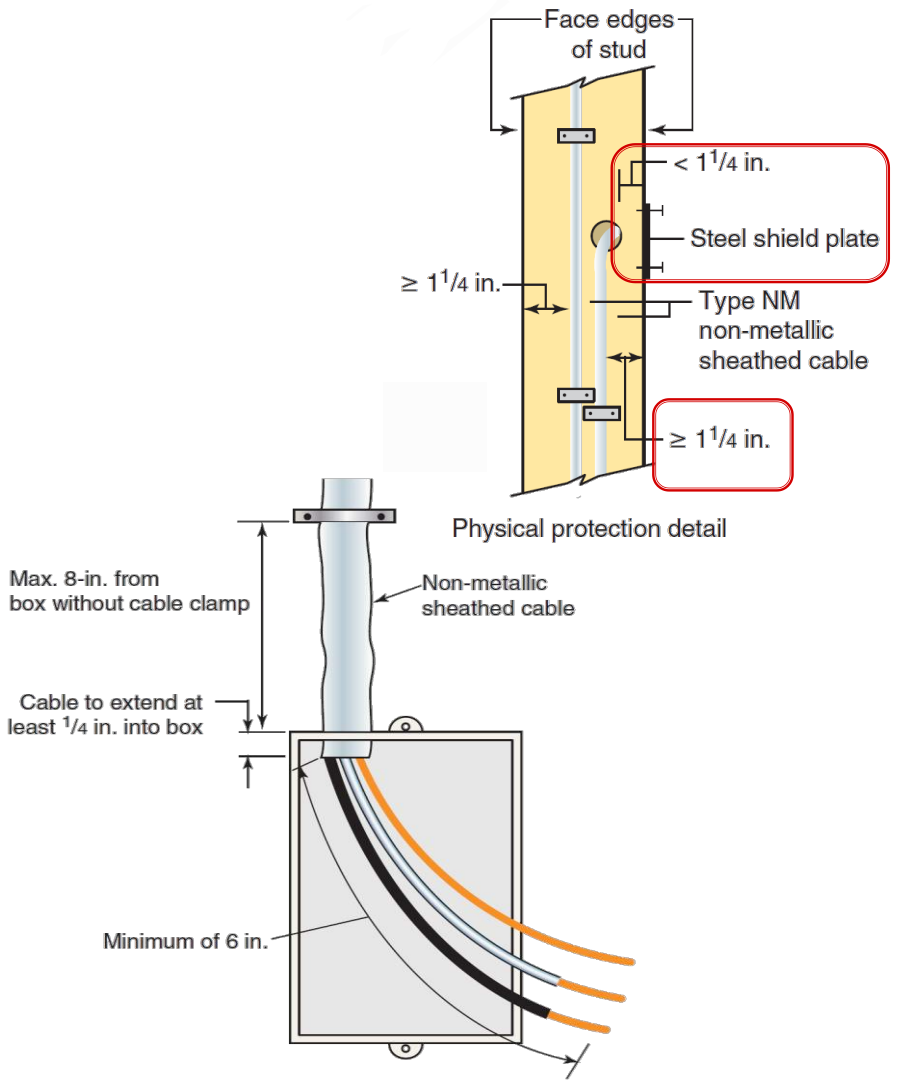
Overcurrent Protection Required

Overcurrent device locations

- Where branch circuit conductors receive their supply
- At service panel (typically)
- Where readily accessible
- Where not subject to damage
- Not in clothes closets or bathrooms
- Not located above a step

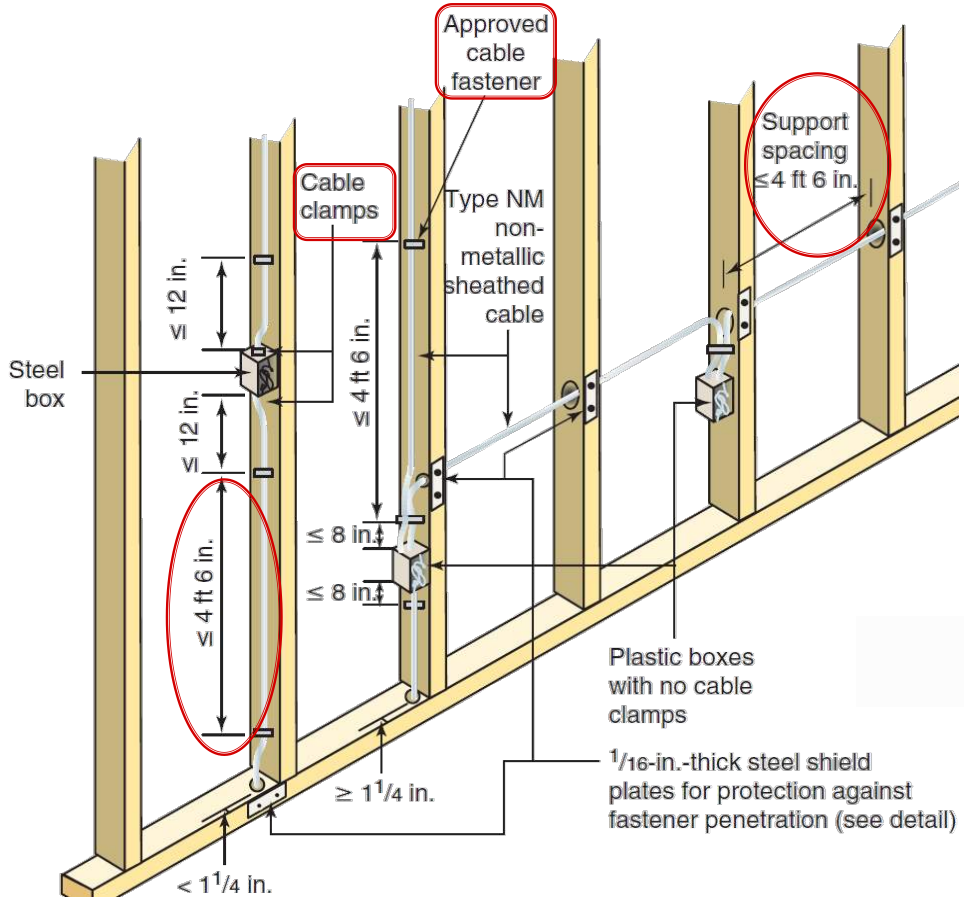
Wiring Methods

- Cable and conductors must be approved for location
- Typically, above-ground wiring is Type NM non-metallic cable
- Protection from physical damage

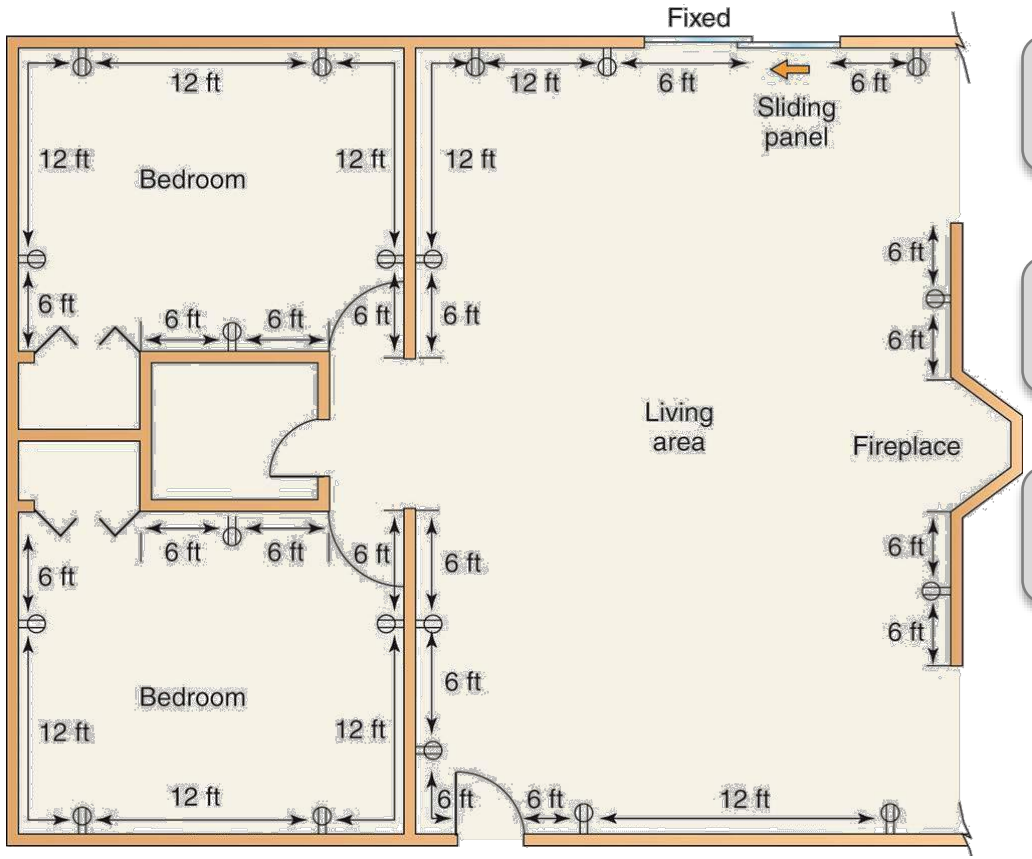


Wiring Methods

- Protection from physical damage
- Fasteners
  - Approved
  - Spacing
- Cable support



Receptacle Locations – Habitable Rooms

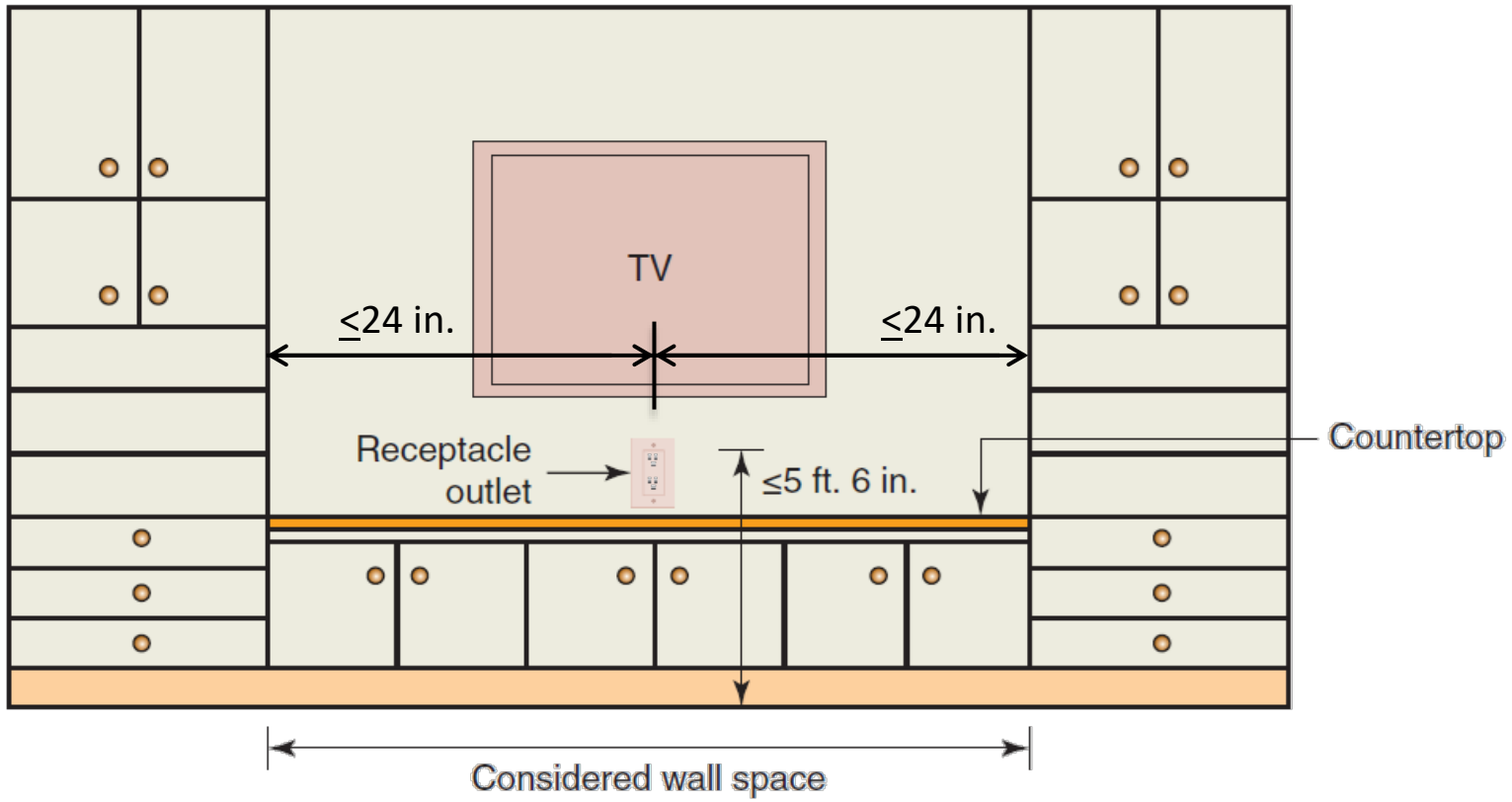


An outlet within 6’ measured along wall

Wall spaces <2’ wide are not included

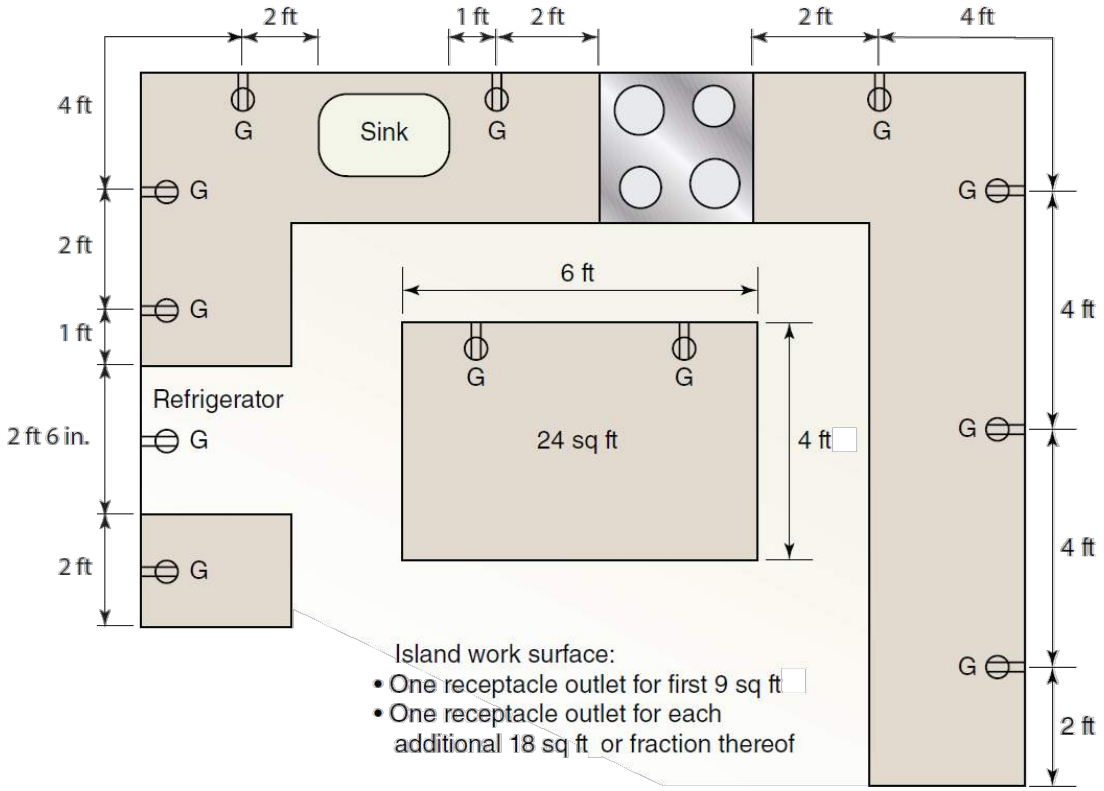
Walls are measured around corners

Receptacle Locations – Habitable Rooms



Elevation—Family room

Receptacle Locations – Kitchens



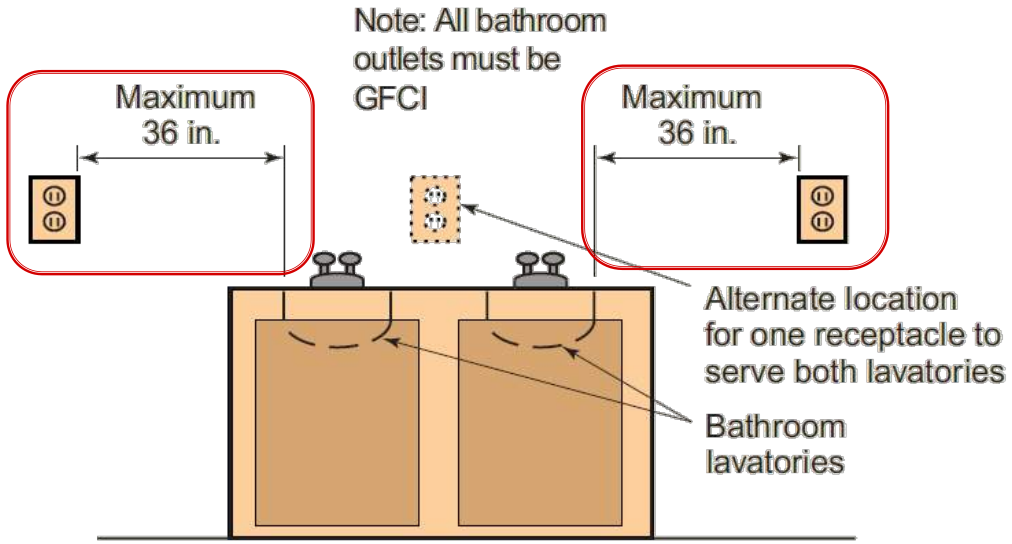
An outlet within 24” measured along wall

Counters ≥12” wide need an outlet

Outlet not required behind range or sink

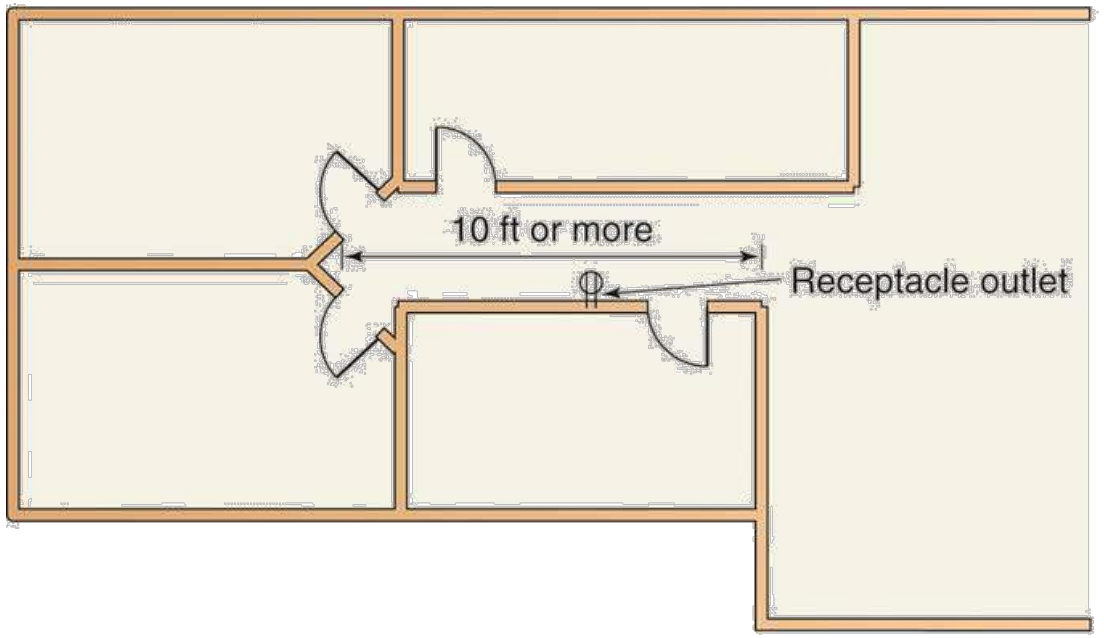
Outlets shall have GFCI protection

Receptacle Locations – Bathrooms



- At least one outlet in each bathroom
- Outlet ≤36” of each lavatory
- Outlets shall have GFCI protection

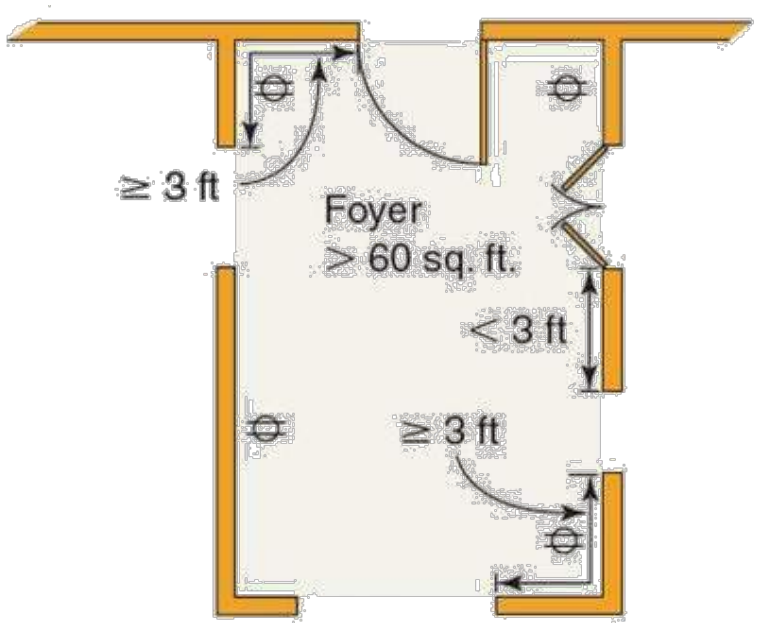
Receptacle Locations – Hallways



1 outlet required when hallway length ≥10’

Length measured along hallway centerline

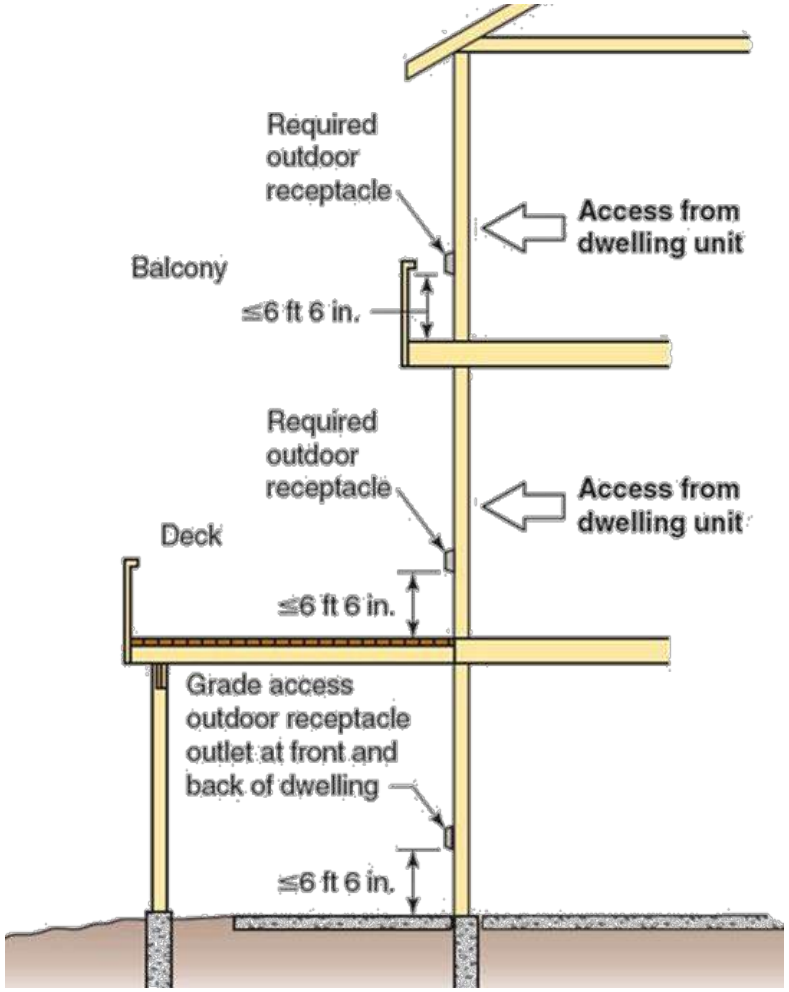
Receptacle Locations – Foyers



Foyers >60 ft^2 require an outlet on each wall ≥3’ wide

Measured between
- Doorways
- Floor-to-ceiling windows
- Similar openings

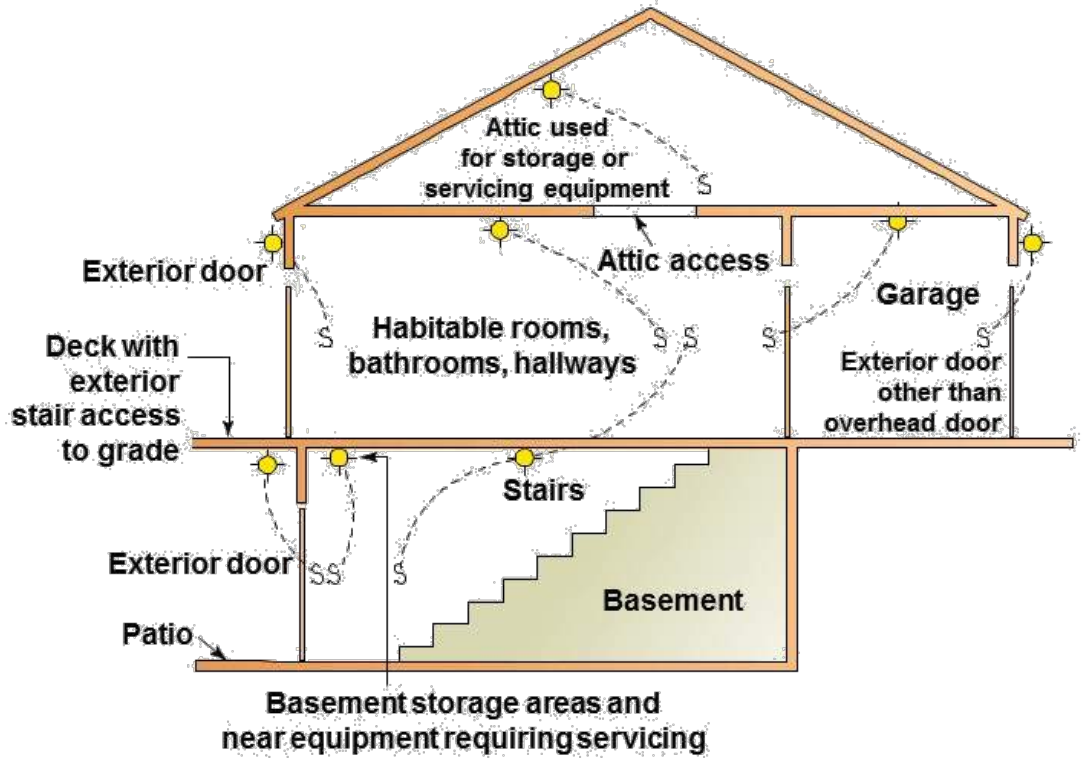
Receptacle Locations – Outdoors



- 1 outlet in front and 1 outlet in back of dwelling
- 1 outlet for accessible balconies, decks, and porches
- Located ≤6’6” above grade
- Outlets shall have GFCI protection

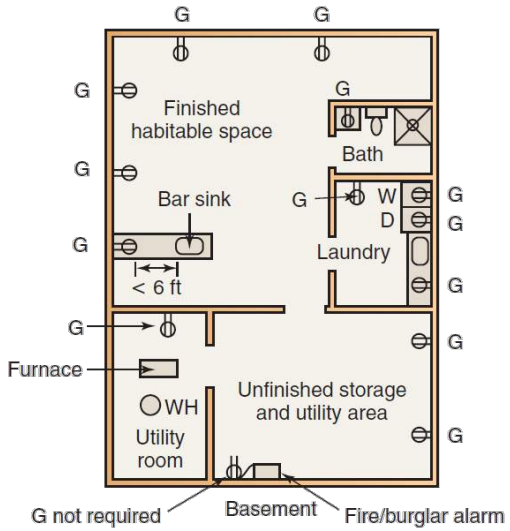
Lighting Outlets

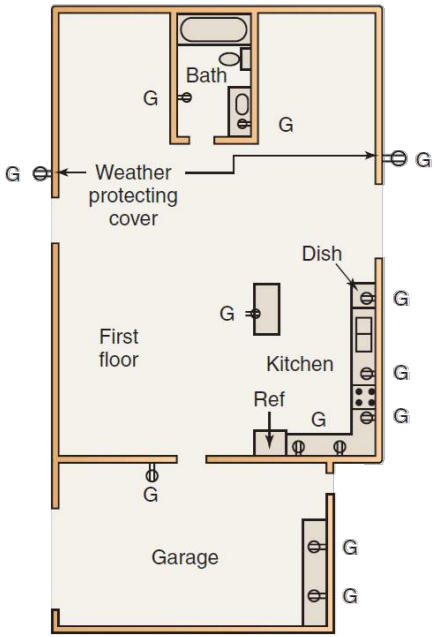
- Wall switch–controlled lighting outlet
  - Habitable rooms
  - Bathrooms
  - Hallways and Stairways
  - Storage areas and Garages
  - Outside exterior doors



Ground-Fault Circuit Interrupter

- GFCI protection required in bathrooms, laundry rooms and similar potentially damp locations like basements and garages





Arc-Fault Circuit Interrupter

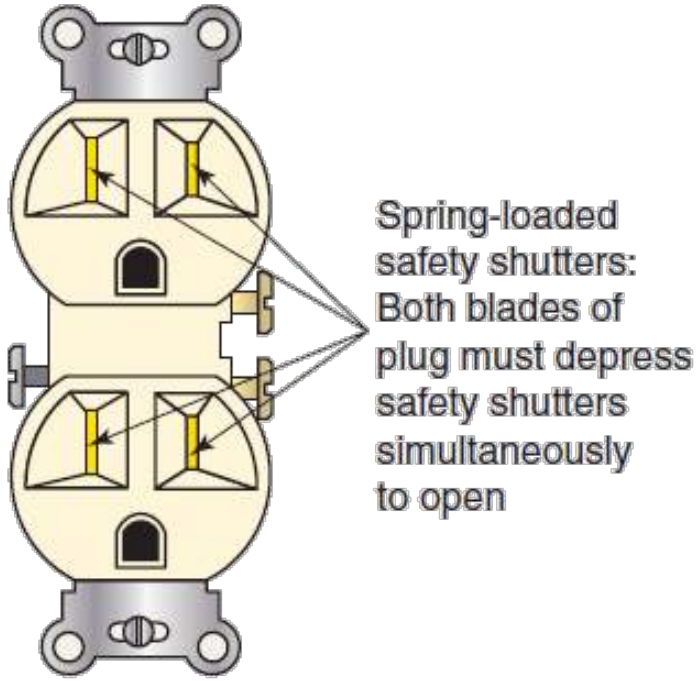
- Detect unwanted arcing in branch circuit wiring
- Open circuit before excessive heat buildup can cause fire
- Installed in service panel or subpanel
- Required for
  - Living areas, Hallways, and Closets

Receptacles

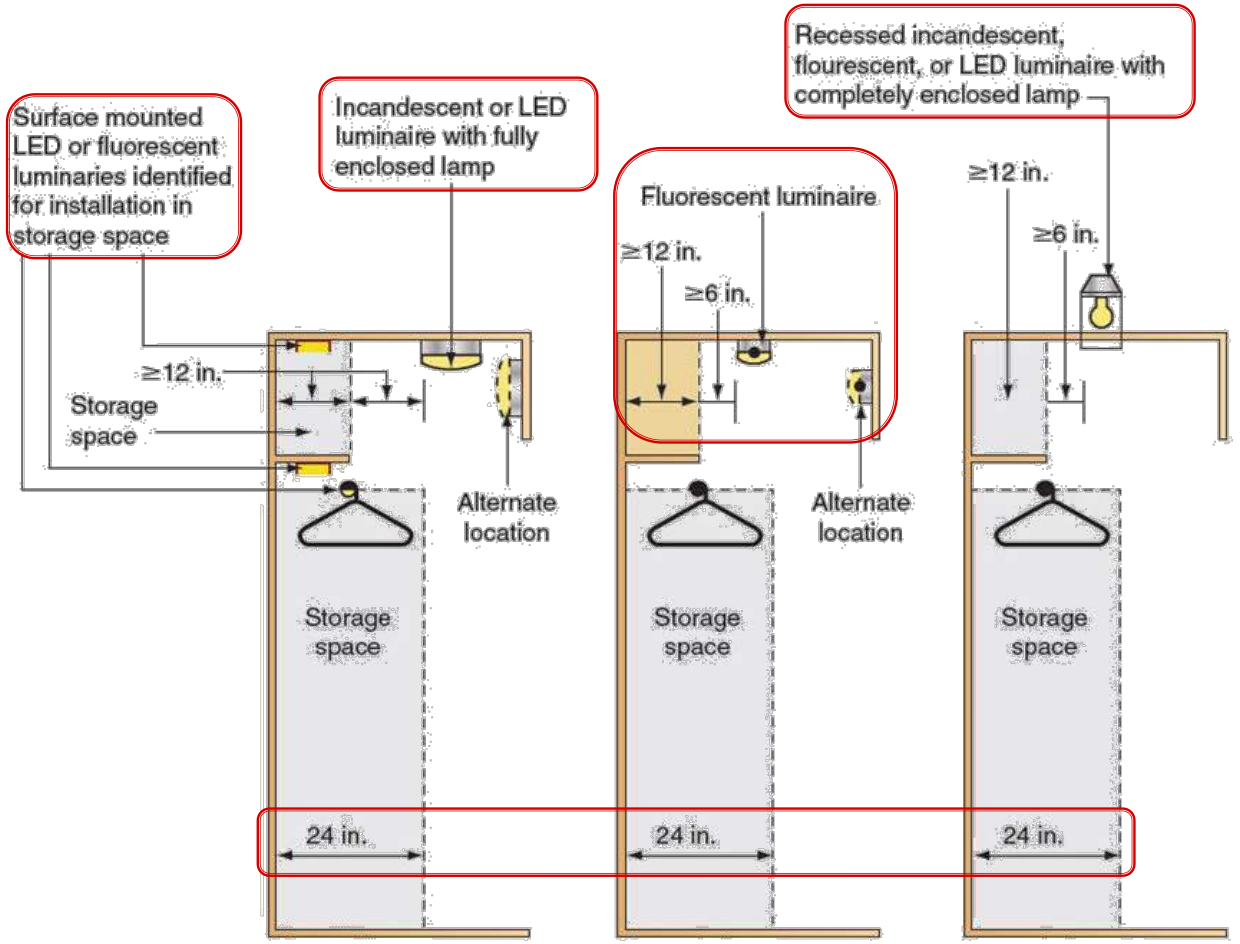
- Wet locations
  - Weatherproof enclosure when cord plugged in
  - Prohibited in or over tubs or showers

Tamper-resistant Receptacles

- Required where accessible to children
- Not required when
  - >5½’ above floor
  - Part of luminaire or appliance
  - In dedicated appliance space



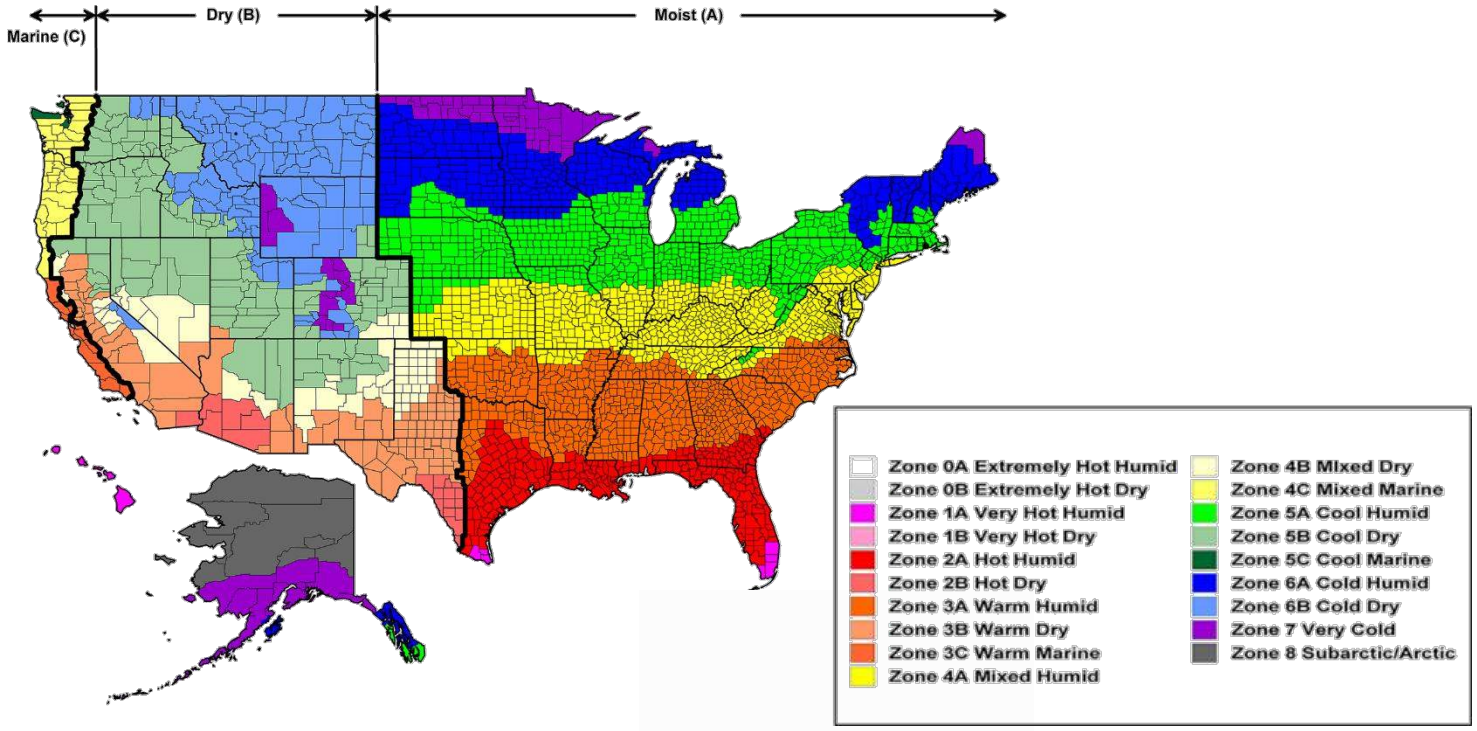
Luminaires in Clothes Closets



Energy Conservation

Energy Efficiency

- IRC Chapter 11 is extracted from IECC applicable provisions



Compliance Paths

Projects shall comply with one of the following options

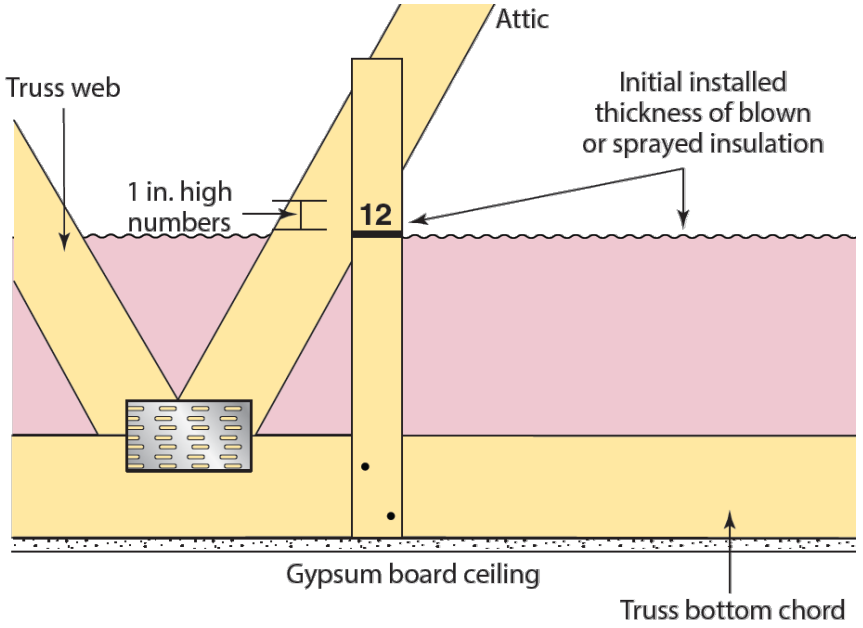
- Prescriptive
- Total Building Performance
- Energy rating index (ERI)
- Tropical Climate Region

Building Insulation

- Pieces of insulation ≥ 12” width must have
  - Visible R-value mark or
  - Installer certification
    - Insulation type
    - Manufacturer
    - R-value

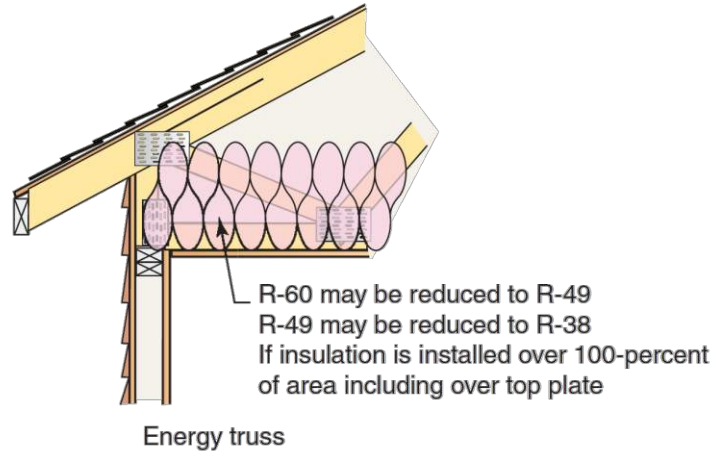
Blown-in or Sprayed Insulation

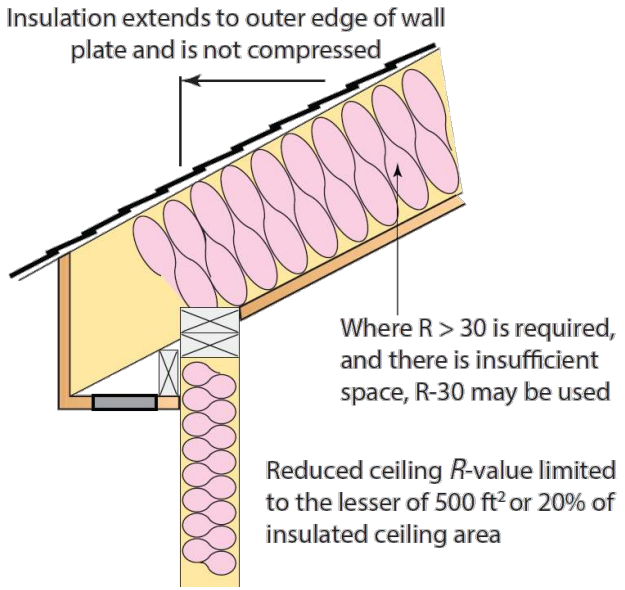
- Attic markers each 300 ft^2
- Certificate indicating
  - Initial installed thickness
  - Settled thickness
  - Settled R-value
  - Installed density and Coverage area
  - Number of bags installed



Roof Insulation

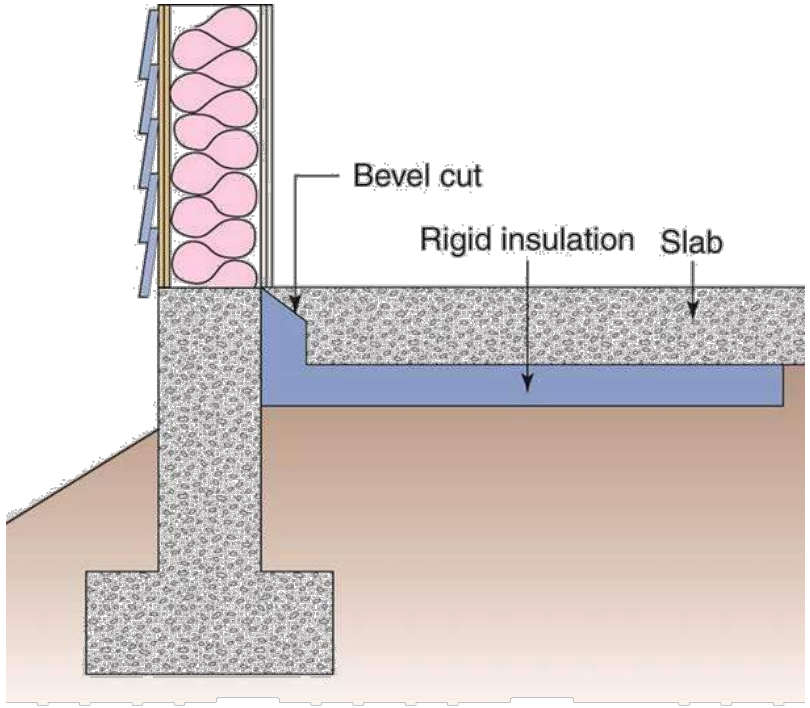
- Minimum R-values based on CZ
- Exceptions
  - Energy truss or raised-heel roof truss
  - Reduced R-values in shallow rafters
  - CFS requires higher insulation R-values and CI thermal break





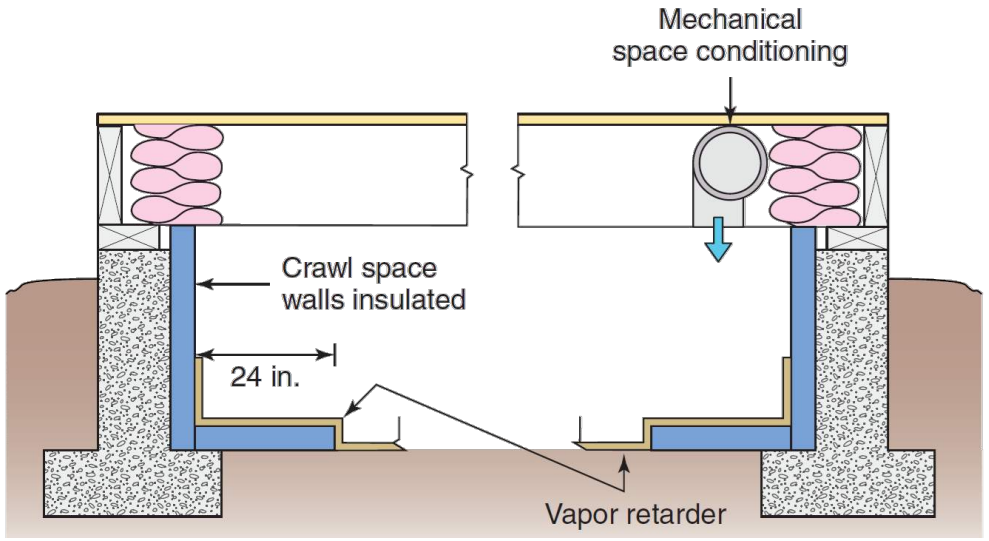
Slab-on-Grade Insulation

- Floor <12” below grade
- Combination of vertical and horizontal insulation
- Heavy termite areas exempt



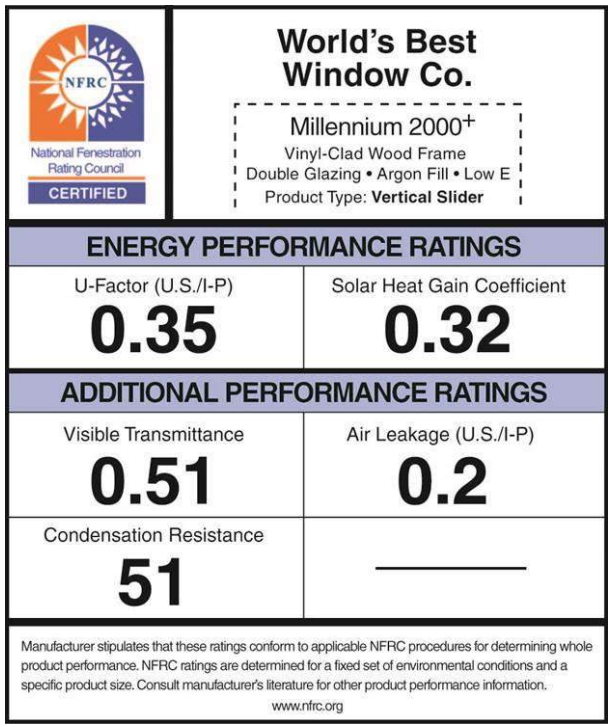
Crawl Space Insulation

- Two options
  - Insulate floor above crawl space
    or
  - Insulate exterior walls
    - When crawl space is not ventilated
    - Vapor retarder on exposed earth

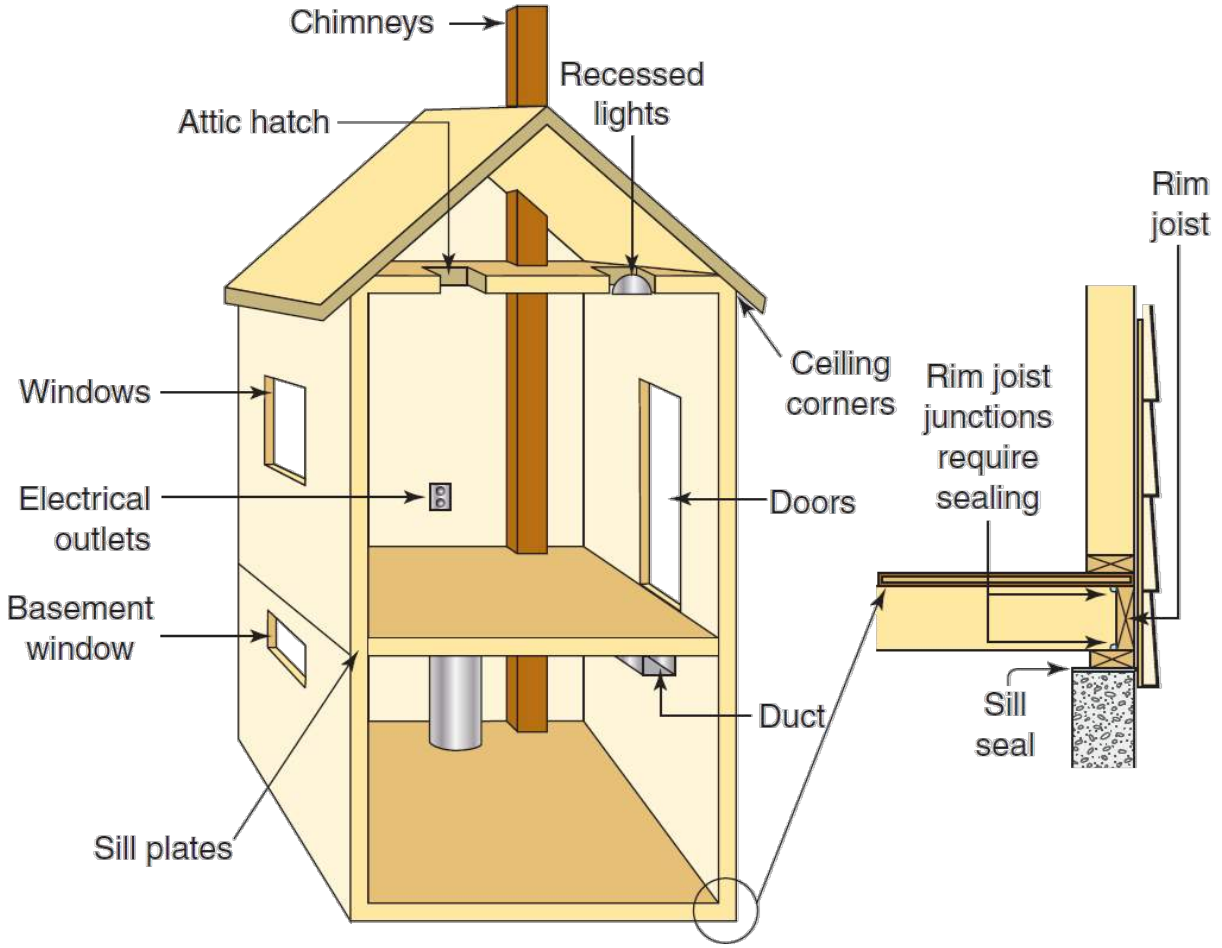


Windows and Doors

- Fenestration
  - Skylights
  - Windows
  - Doors
- U-factor
- Solar Heat Gain Coefficient (SHGC)

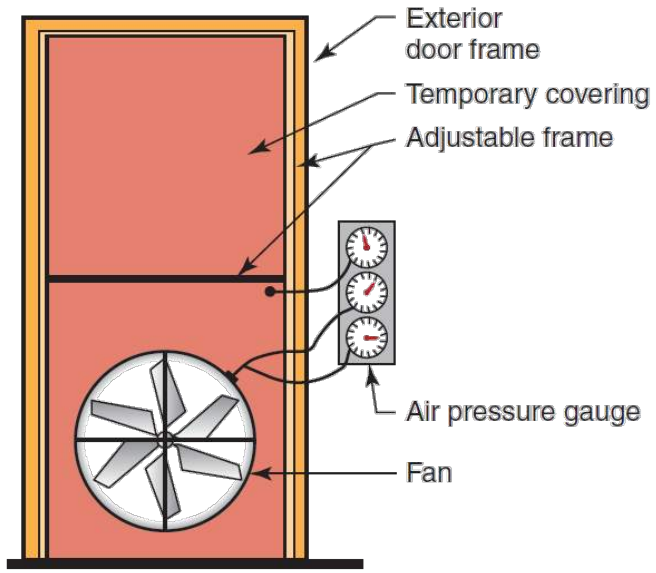


Sealing Against Air Leakage



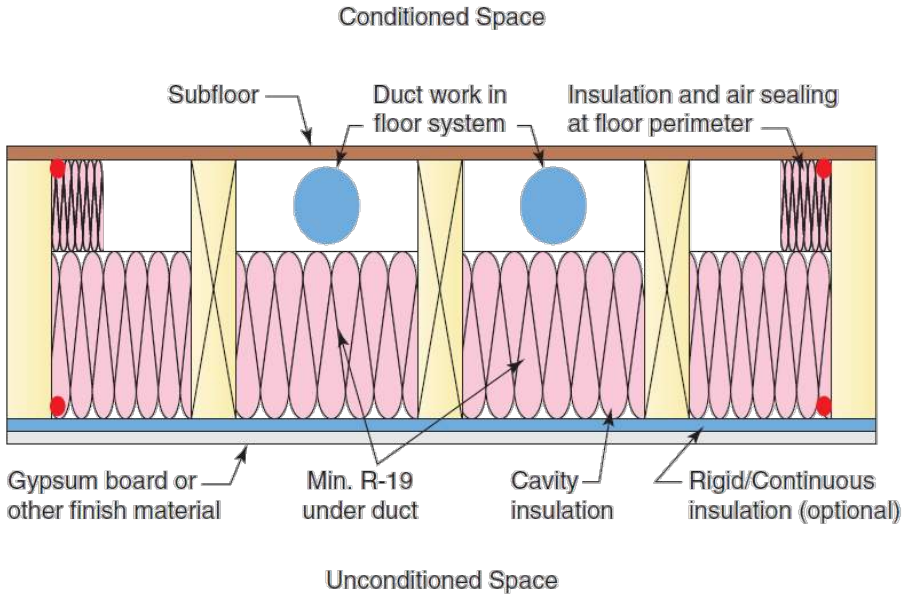
Thermal Envelope Testing

- Blower door test required
- Allowable air-leakage rate via prescriptive path
  - Climate Zones 0 – 2: ≤ 5 ACH
  - Climate Zones 3 – 8: ≤ 3 ACH
- Mechanical ventilation required



Duct Insulation and Sealing

- Insulation in unconditioned space
  - ≥ R-8 for ≥ 3” diameter
  - ≥ R-6 for < 3” diameter
- No duct insulation required in conditioned spaces
- Sealing of all ducts required
- Air leakage test required
- Cavities cannot be used as ducts or plenums



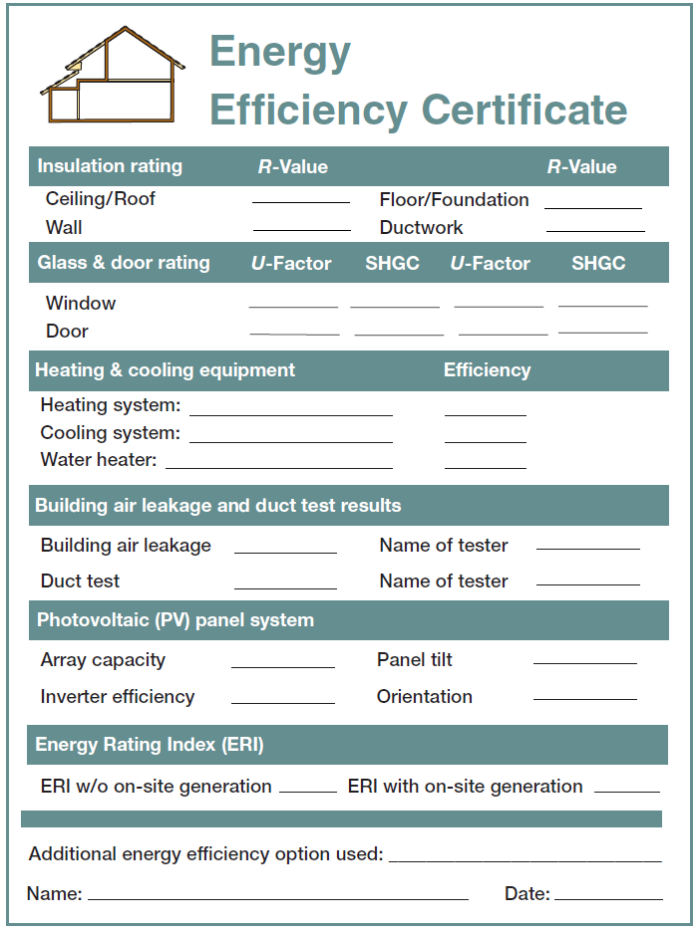
Ductwork considered to be in conditioned space.

Water Pipe Insulation

- ≥ R-3 for
  - ≥ ¾” diameter pipe in conditioned space
  - Piping serving >1 dwelling unit
  - Water Heater to distribution manifold
  - Outside conditioned space or under slab/underground
  - Supply and return piping in circulation and recirculation systems
  - Hydronic heating or cooling tubing

Energy Certificate

- Completed by
  - Builder or Other approved party
- Listing
  - Code edition, Compliance path, Air testing results
  - Insulation & fenestration values
  - Equipment type & efficiency
- Permanent certificate posted in approved indoor location



Energy Efficiency Certificate

Insulation rating	*R*-Value		*R*-Value
Ceiling/Roof	_____	Floor/Foundation	_____
Wall	_____	Ductwork	_____

Glass & door rating	*U*-Factor	SHGC	*U*-Factor	SHGC
Window	_____	_____	_____	_____
Door	_____	_____	_____	_____

Heating & cooling equipment	Efficiency
Heating system: _____	_____
Cooling system: _____	_____
Water heater: _____	_____

Building air leakage and duct test results			
Building air leakage	_____	Name of tester	_____
Duct test	_____	Name of tester	_____

Photovoltaic (PV) panel system			
Array capacity	_____	Panel tilt	_____
Inverter efficiency	_____	Orientation	_____

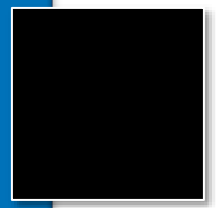
Energy Rating Index (ERI)			
ERI w/o on-site generation	_____	ERI with on-site generation	_____

Additional energy efficiency option used: _____

Name: _____ Date: _____

Discussion

Final Reflection



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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