Introductions

What is your primary job function?

a. Inspector
b. Plans Reviewer
c. Building Official
d. Fire Official
e. Designer/Engineer
f. Contractor/Builder
g. Permit Technician

Introductions

Where in the World do you work?

Introductions

How many years have you worked in the construction industry?

a. 0-5
b. 6-10
c. 11-20
d. 21-30
e. 30+
GOAL & OBJECTIVES

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 for Success

- 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!!!!
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 one document

Dwellings and Townhouses
### Habitable Attic

- Habitable attic above 3rd story not a story if
  - Sprinkler system
  - Area limited to 1/2 area of story below

### 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
- \( \leq 3 \) 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
- App J offers compliance alternatives for construction on existing buildings
  - Categorized as repair, renovation, alteration or reconstruction

IRC Adoption

- 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
Local and State Laws

- Zoning ordinances may be more restrictive
- Other ordinances
  - Storm water management
  - Erosion control
  - Public/private sewers and wells
  - Energy conservation
  - Manufactured/modular housing
  - Accessibility
  - Licensed RDP circumstances

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

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

Permits

- Construction requires a permit before work begins
- Exempt work
  - 1-story tool and storage sheds, playhouses, and similar uses ≤ 200 ft²
  - Decks
    - ≤ 200 ft² and ≤ 30” above grade
    - Not attached to a dwelling and does not serve required exit door
  - Fences ≤ 7’ height

Plan Review

- Verify that design is code compliant
- Submittal documents
  - Manufacturer’s installation instructions
  - Braced wall designs
  - Flood hazard areas
  - Storm shelters
Fees

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

Required Inspections

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

Certificate of Occupancy
Board of Appeals

- Public has due process to appeal a building official decision
- 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

Site Development
Chapters 3 & 4

- Measured perpendicular to exterior wall
- Measured between building and lot lines
- Centerline of 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 undisturbed ground level
  - Protected against frost

- All footings must bear on
  - Natural soil or
  - Compacted engineered fill
Load-bearing Values & Properties of Soils

<table>
<thead>
<tr>
<th>Classification</th>
<th>Soil Description</th>
<th>Load Bearing Pressure (psf)</th>
<th>Change Potential</th>
<th>Expansion Potential</th>
<th>Frost Heave Potential</th>
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<tr>
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</tbody>
</table>
Storm Drainage

- Final grade
  - Minimum fall 6” within 10’ of foundation (5%)  
  - Exception for local site conditions
    - Water can be directed to swales or drains  
  - Concrete surfaces within 10’ of foundation need 2% slope

Flood Hazard Areas

- State or local floodplain management ordinances often supersede IRC flood-resistance provisions
- Minimum standards
  - National Flood Insurance Program (NFIP) by Federal Emergency Management Agency (FEMA)
### Climatic & Geographic Design Criteria

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

<table>
<thead>
<tr>
<th>Ground Snow Load</th>
<th>Snow (mph)</th>
<th>Wind Design</th>
<th>Seismic Design Category</th>
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<tbody>
<tr>
<td>30 psf</td>
<td>V = 115 mph</td>
<td>Yes or No</td>
<td>Yes or No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes or No</td>
<td>Identify or No</td>
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<td></td>
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</table>

Table R301.2

### Climatic & Geographic Design Criteria

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

<table>
<thead>
<tr>
<th>Subject to Damage from</th>
<th>Weathering</th>
<th>Frost Line Depth</th>
<th>Termite</th>
<th>Ice Barrier Underlayment Required</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Negligible or Moderately Severe</td>
<td>-42 in.</td>
<td>Yes or No</td>
<td>Yes or No</td>
</tr>
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</table>

Table R301.2
Climatic & Geographic Design Criteria

- IRC adoption: jurisdiction completes table with applicable data—example

<table>
<thead>
<tr>
<th>Flood Hazards</th>
<th>Air Freezing Index</th>
<th>Mean Annual Temp</th>
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</thead>
<tbody>
<tr>
<td>Date NFIP, Etc.</td>
<td>1197</td>
<td>52°F</td>
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</table>

Table R301.2

Climatic & Geographic Design Criteria

Manual J Design Criteria

- Altitude Correction Factor
- Outdoor Wet Bulb Temp
- Indoor Wet Bulb Temp
- Outdoor Dry Bulb Temp
- Indoor Dry Bulb Temp
- Heating Temp. Difference

- Latitude
- Daily Range
- Summer Design glacier
- Wind Velocity
- Cooling Temp. Difference
- Outdoor Summer Dry Bulb Temp
- Indoor Summer Dry Bulb Temp

Table R301.2

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
  - Not included in the code
- Wood framing alternative
  - Wood Frame Construction Manual published by AWC
  - Wind speeds up to 195 mph
  - IRC wind speeds <140 mph

Example: sizing wide flange steel beams

Live Loads

Minimum Uniformly Distributed Loads

<table>
<thead>
<tr>
<th>USE</th>
<th>LOAD (psf)</th>
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<tbody>
<tr>
<td>Attics without storage</td>
<td>10</td>
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<tr>
<td>Attics with limited storage</td>
<td>20</td>
</tr>
<tr>
<td>Habitable attics and attics served by fixed stairs</td>
<td>30</td>
</tr>
<tr>
<td>Sleeping areas</td>
<td>30</td>
</tr>
<tr>
<td>Areas other than sleeping areas and stairs</td>
<td>40</td>
</tr>
<tr>
<td>Balconies (interior) and decks</td>
<td>40</td>
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<tr>
<td>Passenger vehicle garages</td>
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Table R301.5

Minimum Concentrated Loads

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<tr>
<th>USE</th>
<th>LOAD (lbs)</th>
<th>NOTES</th>
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<td>Guard in-fill components</td>
<td>50</td>
<td>Horizontally applied on area of 1 ft²</td>
</tr>
<tr>
<td>Handrails</td>
<td>200</td>
<td>Applied in any direction</td>
</tr>
<tr>
<td>Guards</td>
<td>200</td>
<td>Applied downward and outward if not acting as a handrail</td>
</tr>
<tr>
<td>Stairs</td>
<td>300</td>
<td>300-lb concentrated load / 4 in²</td>
</tr>
<tr>
<td>Passenger vehicle garages</td>
<td>2,000</td>
<td>Applied on 4.5&quot; x 4.5&quot; area for elevated garage floors</td>
</tr>
</tbody>
</table>

Table R301.5
Dead Loads

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

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>WEIGHT (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof dead load (framing, sheathing, asphalt shingles, insulation, drywall)</td>
<td>10</td>
</tr>
<tr>
<td>Exterior wall (2” x 4 framing, sheathing, siding, insulation, drywall)</td>
<td>11</td>
</tr>
<tr>
<td>Floor (pour, sheathing, carpeting, drywall)</td>
<td>16</td>
</tr>
<tr>
<td>Concrete wall, 6 in. thick</td>
<td>100</td>
</tr>
<tr>
<td>10 in. thick</td>
<td>105</td>
</tr>
<tr>
<td>12 in. thick</td>
<td>110</td>
</tr>
<tr>
<td>Solid C400 density 19Kpcf wall, 8 in. thick</td>
<td>81</td>
</tr>
<tr>
<td>Insulated C4MI density 19Kpcf wall, 8 in. thick, ground at 40°F c.</td>
<td>44</td>
</tr>
</tbody>
</table>

Deflection

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

<table>
<thead>
<tr>
<th>STRUCTURAL MEMBER</th>
<th>ALLOWABLE DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rafter, slope &gt; 1/12 no finished ceiling attached to rafters</td>
<td>L/180</td>
</tr>
<tr>
<td>Rafter, slope &gt; 1/12, gypsum board ceiling attached to rafters</td>
<td>L/360</td>
</tr>
<tr>
<td>Trusses, trussed rafters</td>
<td>L/360</td>
</tr>
<tr>
<td>Master ceilings</td>
<td>L/360</td>
</tr>
<tr>
<td>Floors</td>
<td>L/360</td>
</tr>
<tr>
<td>All other structural members</td>
<td>L/360</td>
</tr>
</tbody>
</table>

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

- IRC conventional framing limits wind speed to 140 mph
- 130 in hurricane-prone areas
- If limits exceeded
  - AWDC – Wood Frame Construction Manual (WFCM)
  - ICC 600 – Standard for Residential Construction in High-Wind Regions
  - 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, ice or similar for ≥ 5,000 ft

Wind Design Required

- Map showing wind design regions

---
Hurricane-prone and Windborne Debris Regions

- Hurricane-prone regions
  - $V_{cu} > 115$ mph
- Windborne debris regions
  - $V_{cu} \geq 140$ mph
  - $V_{cu} \geq 130$ mph; ≤1 mile of the coast

Protection of Openings

- Windborne debris regions
- Prescriptive provisions
  - WSP and screws
  - $V_{cu} < 180$ mph

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

<table>
<thead>
<tr>
<th>SDC</th>
<th>1- and 2-Family Dwellings</th>
<th>Townhouses</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; B</td>
<td>No seismic requirements</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>No seismic requirements</td>
<td>Seismic Requirements Apply</td>
</tr>
<tr>
<td>D0</td>
<td>Seismic Requirements Apply</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Seismic Requirements Apply</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Seismic Requirements Apply</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Engineered Design Required</td>
<td></td>
</tr>
</tbody>
</table>

Regularly shaped buildings
- Uniform distribution of forces
- More predictable response characteristics

Irregularly shaped buildings
- Force concentrations
- Less effective resisting earthquake load effects
Earthquakes – Irregular Buildings

- Roof in projections
- Roof off projections
- Site unshored
- Site shored

Flood Openings

EXAMPLE

- Doors and windows do not satisfy flood opening requirements
- Overhead door
- Flood openings
- Example: 576 sq. ft.
- Flood openings
- Garage below required elevation used for parking and storage only

Flood Opening Requirements

- Two openings required on two sides of the building
- Total 576 sq. in. net area (1 sq. in. per sq. ft. of enclosed area)
- 576/4 = 144 sq. in. net area per opening (not less than 3” on any dimension)
- The bottom of each opening no more than 12 in. above grade

Story Height

- Applicable to wood frame, balloon frame, load-bearing concrete frame and engineered steel frame
- Exception: Maximum story height = 12’ for second story with or without second story overhang
- Maximum story height = 10’
- Minimum story height = 8’
Which type of foundation is common in your area?

a. Basement
b. Crawlspace
c. Slab-on-grade
d. Piles

Foundation Materials

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

Concrete Minimum Compressive Strength

<table>
<thead>
<tr>
<th>TYPE OR LOCATION OF CONCRETE CONSTRUCTION</th>
<th>MINIMUM SPECIFIED COMPRESSIVE STRENGTH AT 28 DAYS (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weathering Potential</td>
</tr>
<tr>
<td>Basement walls, foundations and other concrete not exposed to the weather</td>
<td>2,500</td>
</tr>
<tr>
<td>Basement slab and interior slab on grade, except Garage slab</td>
<td>1,500</td>
</tr>
<tr>
<td>Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather</td>
<td>1,500</td>
</tr>
<tr>
<td>Pavers, concrete slabs and steps exposed to the weather and garage floor slabs</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Note: See ICC for additional requirements.
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

Stepped Footings

Concrete Footing Size

<table>
<thead>
<tr>
<th>Ground Snow Load = 30 psf</th>
<th>Soil Bearing (psf)</th>
<th>Type of Foundation</th>
<th>1-story</th>
<th>2-story</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,500</td>
<td>Slab-on-grade</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>With crawl space</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td>2,500</td>
<td>Plus basement</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slab-on-grade</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With crawl space</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plus basement</td>
<td>12 x 6</td>
<td>12 x 6</td>
</tr>
</tbody>
</table>
Concrete Footing Size

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

Footing Size

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

EXAMPLE

<table>
<thead>
<tr>
<th>Ground Snow Load</th>
<th>Foundation</th>
<th>Load bearing value of soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 psf</td>
<td>Light frame w/ siding</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>2-story</td>
<td>Plus basement</td>
<td>10 psf</td>
</tr>
</tbody>
</table>
**EXAMPLE**

**Footing Size**

<table>
<thead>
<tr>
<th>Ground Snow Load</th>
<th>Foundation</th>
<th>Load bearing value of soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 psf</td>
<td>Light frame w/ brick</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>2-story</td>
<td>Plus basement</td>
<td>24 x8</td>
</tr>
</tbody>
</table>

Table R403.1(1)

---

**EXAMPLE**

**Isolated Footing Size**

- **Given**
  - Column supports tributary floor area of 120 ft² at 50 psf
  - 1,500 psf assumed soil-bearing capacity
  - Determine minimum footing size

---

**EXAMPLE**

**Isolated Footing Size**

- Soil load-bearing capacity
  - 1500 psf
- Tributary column load
  - 120 ft² x 50 lbs = 6,000 lbs
  - 6,000 lbs ÷ 1,500 psf = 4 ft²
Concrete Slabs

Foundation Anchorage – SDC D₀, D₁, D₂

Foundation Anchorage

- Anchor Bolts
**Foundation Anchorage**

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

- Wood sill plate for seismic
  - Dwellings and townhouses in SDC D0, D1, and D2
  - Townhouses in SDC C
  - 3” x 3” x 1⁄2” plate washers
  - 4’ o.c. for 3-story buildings

**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
  - Difference in height between exterior finish ground level and top of interior basement floor
Concrete Foundation Walls

- Horizontal reinforcing required for basement walls
  - Table R404.1.2(1)
    - Maximum Unsupported Basement Wall Height
    - Location of Horizontal Reinforcement
      - ≤ 8 feet: One No. 4 bar within 12" of top of wall and one No. 4 bar near mid-height of wall
      - >8 feet: One No. 4 bar within 12" of top of wall and one No. 4 bar near third points of wall

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

---

EXAMPLE

Soil class = CL inorganic sandy clay

<table>
<thead>
<tr>
<th>Soil class</th>
<th>Backfill Ht.</th>
<th>Wall Ht.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC, ML-CL, and Inorganic CL</td>
<td>8&quot;</td>
<td>10&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>6 @ 30</td>
<td>NA</td>
</tr>
<tr>
<td>7&quot;</td>
<td>6 @ 26</td>
<td>6 @ 37</td>
</tr>
<tr>
<td>8&quot;</td>
<td>6 @ 40</td>
<td>6 @ 37</td>
</tr>
</tbody>
</table>

Table R404.1.2(8)
### Vertical Reinforcing Cover

- Example

### Plain Masonry Wall

- All buildings SDC A and B
- Dwellings SDC C

<table>
<thead>
<tr>
<th>Soil class</th>
<th>Minimum Nominal Wall Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW, GP, SW and SP</td>
<td>8&quot;</td>
</tr>
<tr>
<td>SW and SP</td>
<td>5&quot;</td>
</tr>
</tbody>
</table>

### Reinforced Masonry Wall

- Example

<table>
<thead>
<tr>
<th>Soil class</th>
<th>Minimum Nominal Wall Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM, SC</td>
<td>6&quot;</td>
</tr>
<tr>
<td>SM, SM-SC &amp; ML</td>
<td>5&quot;</td>
</tr>
<tr>
<td>SM, SM-SC &amp; ML</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

---

Plain Masonry Wall

- All buildings SDC A and B
- Dwellings SDC C

<table>
<thead>
<tr>
<th>Soil class</th>
<th>Minimum Nominal Wall Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW, GP, SW and SP</td>
<td>8&quot;</td>
</tr>
<tr>
<td>SW and SP</td>
<td>5&quot;</td>
</tr>
</tbody>
</table>

Reinforced Masonry Wall

- Example

<table>
<thead>
<tr>
<th>Soil class</th>
<th>Minimum Nominal Wall Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM, SC</td>
<td>6&quot;</td>
</tr>
<tr>
<td>SM, SM-SC &amp; ML</td>
<td>5&quot;</td>
</tr>
<tr>
<td>SM, SM-SC &amp; ML</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>
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
What is the maximum anchor bolt spacing in a sill plate?
a) 2 ft  
b) 4 ft  
c) 6 ft  
d) 8 ft

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
  - Design loads
  - Slope or depth
  - Span and spacing
  - Required bearing widths
  - Lumber size, species and grade
  - Connection requirements
  - Required permanent bracing locations

§R502.11 & R802.10

Wood Treatment

- Wood in locations subject to decay requires
  - Preservative-treated wood
  - Naturally durable wood
    - Redwood
    - Cedar
    - Black locust
    - Black walnut

§R317

Protection Against Decay
Boring and Notching

**Bearing walls**

- Maximum diameter 60% of stud depth
- Holes not concentric

**Nonbearing Walls**

- Hole size in 2' x 4' stud
  - Stud depth = 3½" (89 mm)
  - Largest hole ≤ 60%
  - 60% x 3½ = 21/8"
  - 5/8" + 21/8" + 5/8" = 33/8"

**Approximate Notch and Hole Limitations in Inches**

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Actual Depth 'D' in Inches</th>
<th>D/3</th>
<th>D/4</th>
<th>D/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 4</td>
<td>3½</td>
<td>1½</td>
<td>1₁⁄₈</td>
<td>1₄</td>
</tr>
<tr>
<td>2 x 6</td>
<td>5₄</td>
<td>1 ½</td>
<td>1½</td>
<td>1₄</td>
</tr>
<tr>
<td>2 x 8</td>
<td>7₄</td>
<td>1½</td>
<td>1½</td>
<td>1½</td>
</tr>
<tr>
<td>2 x 10</td>
<td>9₄</td>
<td>3</td>
<td>1½</td>
<td>1½</td>
</tr>
<tr>
<td>2 x 12</td>
<td>11/₄</td>
<td>3</td>
<td>3/₄</td>
<td>3/₄</td>
</tr>
</tbody>
</table>

**Wood Studs**

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Actual Depth 'D' in Inches</th>
<th>60% Limit</th>
<th>40% Limit</th>
<th>33% Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 4</td>
<td>3½</td>
<td>1½</td>
<td>1½</td>
<td>1½</td>
</tr>
<tr>
<td>2 x 6</td>
<td>5₄</td>
<td>1½</td>
<td>1½</td>
<td>1½</td>
</tr>
<tr>
<td>2 x 8</td>
<td>7₄</td>
<td>1½</td>
<td>1½</td>
<td>1½</td>
</tr>
</tbody>
</table>

Hole may not be in the same area section as rebars.
### Boring and Notching

- **Bearing wall top plate**
- Not a nailer plate for pipe protection
- Maintains top plate load path

### Fireblocking

- Stop fire spread in wood frame construction concealed spaces

- Walls at floor & ceiling levels
- Connection of horizontal & vertical spaces

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

- Vents & ducts at floor & ceiling levels
Draftstopping

- Divide concealed floor assembly spaces into areas of ≤1000 ft²
- 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

Beam Size and Bearing

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

<table>
<thead>
<tr>
<th>Order supporting size</th>
<th>Building width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Two floor</td>
<td></td>
</tr>
<tr>
<td>3.5x12</td>
<td>8.8</td>
</tr>
<tr>
<td>6.5x10</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Table R602.7(2)
**Beam Size and Bearing**

- **Continuous multi-span beam**
  
  \[
  R = \frac{wL}{25\%} \quad (25\% \text{ more load})
  \]

- **Simple span beams**
  
  \[
  R = \frac{wL}{2} \quad (1\% \text{ dead load})
  \]

**Joist Size and Spacing**

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

<table>
<thead>
<tr>
<th>Span</th>
<th>Joist Size</th>
<th>Joist Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>14' – 2&quot;</td>
<td>2 x 8</td>
<td>2 x 12</td>
</tr>
<tr>
<td>15' – 7&quot;</td>
<td>2 x 10</td>
<td>2 x 12</td>
</tr>
<tr>
<td>14' – 9&quot;</td>
<td>2 x 12</td>
<td>2 x 12</td>
</tr>
</tbody>
</table>

**Fastener Schedule – Floor Framing**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>NUMBER AND SIZE OF NAILS</th>
<th>SPACING, LOCATION AND METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joist to sill, top plate or gird</td>
<td>3-1/4-in. nails 1.50 x 0.50</td>
<td>toe nail</td>
</tr>
<tr>
<td>Inner joist, nailing to blocking to sill</td>
<td>1/2 x 3.5</td>
<td>6 in. c.c. top nail</td>
</tr>
<tr>
<td>Banded or toenailed to post</td>
<td>4-1/4-in. nails 1.50 x 0.50</td>
<td>end nail</td>
</tr>
<tr>
<td>Built-up girds and beams, return</td>
<td>3-1/2-in. nails 1.50 x 0.50</td>
<td>1/4 in. face nail at top and bottom</td>
</tr>
</tbody>
</table>
Framing at Openings

- Header span ≥ 4 ft
- Double headers
- Double trimmers
- Single trimmer
- Only if header ≤ 3 ft trimmer bearing

Deck Footings

EXAMPLE

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

<table>
<thead>
<tr>
<th>LIVE OR GRAVITY LOAD (psf)</th>
<th>TRIBUTARY AREA (ft²)</th>
<th>1,000 lb of a Round</th>
<th>SOIL BEARING CAPACITY (psf)</th>
<th>Diamer of a Round Footing</th>
<th>Thickness</th>
<th>1,000 lb of a Round</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>13</td>
<td>14</td>
<td>6</td>
<td>14</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
<td>17</td>
<td>6</td>
<td>17</td>
<td>15</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>100</td>
<td>22</td>
<td>17</td>
<td>6</td>
<td>17</td>
<td>15</td>
<td>17</td>
<td>15</td>
</tr>
</tbody>
</table>

Table R507.3.1
**Deck Footings**

**EXAMPLE**

- 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 ft²

**EXAMPLE**

- 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 ft²

**EXAMPLE**

- Footing size – **Corner post (30 ft²)**
  - Min. 14” diameter (12” interpolated)
  - Min. 6” thick

<table>
<thead>
<tr>
<th>Tributary Area (ft²)</th>
<th>Diameter of a Round Footing</th>
<th>Side of a Square Footing</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>12</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>80</td>
<td>19</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>21</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>120</td>
<td>23</td>
<td>21</td>
<td>7</td>
</tr>
</tbody>
</table>

*Table R507.3.1*
### Deck Footings

- Footing size – Interior post (60 ft²)
  - Min. 17” diameter
  - Min. 6” thick

<table>
<thead>
<tr>
<th>TRIBUTARY AREA (ft²)</th>
<th>Diameter of Round Footing</th>
<th>Side of a Square Footing</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>17</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>80</td>
<td>19</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>120</td>
<td>21</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>160</td>
<td>23</td>
<td>21</td>
<td>7</td>
</tr>
</tbody>
</table>

Table R507.3.1

### Post Size

- Given
  - Southern pine No. 2
  - 50 psf ground snow load
  - 10 ft tall posts
  - Tributary area = 220 ft²
- Determine post size

Solution: 6x6 No. 2 Southern Pine
EXAMPLE

Beam and Joist Sizes

- Ground Snow Load = 50 psf
- Beam: 2-ply Southern Pine 2x10
- Joist: Southern Pine with 14’ span
- Assumes 1/4 cantilever = 3.5’
- Determine allowable beam span and joist size

EXAMPLE

Beam Size

<table>
<thead>
<tr>
<th>LOAD (psf)</th>
<th>SPECIES</th>
<th>SIZE</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-50</td>
<td>Southern pine</td>
<td>2x10</td>
<td>10-1</td>
<td>9-1</td>
<td>8-0</td>
<td>7-0</td>
<td>6-0</td>
</tr>
<tr>
<td>3-50</td>
<td>2x12</td>
<td>11-11</td>
<td>10-11</td>
<td>9-0</td>
<td>8-0</td>
<td>7-0</td>
<td>6-0</td>
</tr>
<tr>
<td>2x12</td>
<td>12-12</td>
<td>10-11</td>
<td>9-0</td>
<td>8-0</td>
<td>7-0</td>
<td>6-0</td>
<td>5-0</td>
</tr>
<tr>
<td>2x14</td>
<td>13-11</td>
<td>11-11</td>
<td>10-0</td>
<td>9-0</td>
<td>8-0</td>
<td>7-0</td>
<td>6-0</td>
</tr>
<tr>
<td>2x16</td>
<td>14-11</td>
<td>11-11</td>
<td>10-0</td>
<td>9-0</td>
<td>8-0</td>
<td>7-0</td>
<td>6-0</td>
</tr>
</tbody>
</table>

Solution: Two No. 2 Southern Pine 2x10s span 6'-7”

EXAMPLE

Joist Size

<table>
<thead>
<tr>
<th>LOAD (psf)</th>
<th>SPECIES</th>
<th>SIZE</th>
<th>ALLOWABLE JOIST SPAN (inches)</th>
<th>LINEN JOIST SPAN (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-50</td>
<td>Southern pine</td>
<td>2x10</td>
<td>15-5</td>
<td>12-1</td>
</tr>
<tr>
<td>3-50</td>
<td>2x12</td>
<td>16-0</td>
<td>13-0</td>
<td>9-0</td>
</tr>
<tr>
<td>2x12</td>
<td>17-0</td>
<td>14-0</td>
<td>11-0</td>
<td>8-0</td>
</tr>
</tbody>
</table>

Solution: No. 2 Southern Pine 2x12 at 10'-0” o.c.
Deck Beams and Posts – Bearing at Splice

- Bolt end distance may drive bearing length
- 3½” minimum at splice

Fig R507.5.1(1) & (2)

Deck Beams and Posts – Bearing at Splice

- Bearing width prescriptively set
- Minimum post size at beam splice based on bearing length and width

Fig R507.5.1(1) & (2)

Deck Ledger Attachment

- Positive anchorage
- No toenails or nails in withdrawal
Deck Ledger Attachment

- Shall not
  - Support concentrated loads from beams or girders
  - Be supported on stone or masonry veneer

Deck Ledger Attachment – Gravity Loads
Deck Ledger Attachment – Lateral Loads

Option 1 – Two @ 1500 lbs
Option 2 – Four @ 750 lbs

Deck Guards

EXAMPLE
Deck Guards

- When mounted on top of decking
- Connect to framing or blocking

Wood Wall Framing

- Size and spacing of studs is related to:
  - Number of floors supported
  - Roof-ceiling assembly
  - Wind speed
Stud Size and Spacing

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

<table>
<thead>
<tr>
<th>Stud Size (inches)</th>
<th>Bearing Walls Lateral Unsupported Stud Height</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 4</td>
<td>16” (12&quot;)</td>
<td>24”</td>
</tr>
<tr>
<td>2 x 6</td>
<td>16” (12&quot;)</td>
<td>24”</td>
</tr>
</tbody>
</table>

Table R602.3(5)

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
**Exterior Wall Headers**

**EXAMPLE**

<table>
<thead>
<tr>
<th>Supporting</th>
<th>Size</th>
<th>Span</th>
<th>Jack studs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof, ceiling, two center-bearing floors</td>
<td>3-2x10</td>
<td>5-11</td>
<td>2</td>
</tr>
<tr>
<td>3-2x12</td>
<td>7-0</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Ground snow load = 30 psf**

Building width = 24 feet

---

**Exterior Wall Headers**

**EXAMPLE**

Table R602.7(1)

---

**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

APPLICATION

What percentage of the roofs you see are trusses vs rafters?

- a. 100% trusses
- b. 90% trusses : 10% rafters
- c. 75% trusses : 25% rafters
- d. 50% trusses : 50% rafters
- e. 10% trusses : 90% rafters
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

§R802.5

Ceiling Joists

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

§R802.5

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

§R802.4 & R802.5
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

EXAMPLE

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

EXAMPLE

Rafter Size and Spacing

<table>
<thead>
<tr>
<th>Rafter spacing (inches)</th>
<th>Species and Grade</th>
<th>DL = 10 psf, GL = 0 psf</th>
<th>2 x 6</th>
<th>2 x 8</th>
<th>2 x 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Spruce-pine-fir #2</td>
<td>Minimum Rafter Span</td>
<td>13-11</td>
<td>15-12</td>
<td>16-5</td>
</tr>
<tr>
<td>24</td>
<td>Spruce-pine-fir #2</td>
<td>9-9</td>
<td>12-4</td>
<td>15-1</td>
<td></td>
</tr>
</tbody>
</table>
Rafter Ties and Collar Ties

Minimum 1" x 4" collar ties at 4 ft o.c. to resist uplift. Installed in upper 1/3 of attic space.

Minimum 2" x 4" rafter ties.

Rafter spans are reduced if no ceiling plates or rafter ties are located higher in the attic space.

§R802.4.6 & R802.5.2.2

Ridge Beams

Approved connectors

Beam required if no ceiling plates or rafter ties to resist outward rafter thrust on walls is present.

Finish ceiling materials applied directly to rafters or turned out for insulation or aesthetic purposes.

§R802.3

Fastener Schedule for Roof Framing

<table>
<thead>
<tr>
<th>Description</th>
<th>Nails</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplift Rafter or roof truss to plate</td>
<td>4-10d box</td>
<td>Toe nail: 2 on one side and 1 on opposite side</td>
</tr>
<tr>
<td>Uplift Roof rafters to 2x ridge beam</td>
<td>3-10d box</td>
<td>End nail</td>
</tr>
<tr>
<td>Uplift Ceiling joints to plate</td>
<td>3-10d box</td>
<td>Toe nail</td>
</tr>
<tr>
<td>Uplift Collar tie to rafter</td>
<td>4-10d box</td>
<td>Face nail</td>
</tr>
<tr>
<td>Thrust Rafter/ceiling joist head joint connection</td>
<td>Table R802.5.2(1)</td>
<td>Face nail</td>
</tr>
</tbody>
</table>
**Fastener Schedule for Roof Framing**

<table>
<thead>
<tr>
<th>Ground Snow Load (psf)</th>
<th>Rafter Spacing (inches)</th>
<th>Rafter Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

6.156 box head nails

6.100 common nails for 16" oc. rafters at 5'-0" Rafter Spacing for 24" oc. rafters

---

**Roof Uplift Connections**

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

**EXAMPLE**

**Roof Uplift Connection**

<table>
<thead>
<tr>
<th>Uplift Load, lbs</th>
<th>Roof Pitch</th>
<th>Roof Span (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>≤ 5:12</td>
<td>≤ 5:12</td>
</tr>
<tr>
<td>161</td>
<td>≤ 5:12</td>
<td>&gt; 5:12</td>
</tr>
</tbody>
</table>

**TABLE 6-17**

- Rafter or Truss Spacing (inches)
- Roof Span (feet)
- Exposure B
- Ultimate Desired Wind Speed (mph)
- 115

<table>
<thead>
<tr>
<th>Rafter or Truss Spacing (inches)</th>
<th>Roof Span (feet)</th>
<th>Exposure B</th>
<th>Ultimate Desired Wind Speed (mph)</th>
<th>115</th>
</tr>
</thead>
<tbody>
<tr>
<td>24&quot;</td>
<td>186</td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24&quot;</td>
<td>218</td>
<td>204</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35&quot;</td>
<td>260</td>
<td>212</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Roof Sheathing

<table>
<thead>
<tr>
<th>Span Rating</th>
<th>Minimum Nominal Panel Thickness (in.)</th>
<th>Maximum Span (in.)</th>
<th>Load (psf)</th>
<th>Without Edge Support</th>
<th>With Edge Support</th>
<th>Total Load</th>
<th>Live Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>16/0</td>
<td>3/8</td>
<td>16</td>
<td>16</td>
<td>40</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20/0</td>
<td>3/8</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24/0</td>
<td>3/8</td>
<td>24</td>
<td>20</td>
<td>40</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24/16</td>
<td>7/16</td>
<td>24</td>
<td>24</td>
<td>50</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Excerpted from Table R503.2.1.1(1)

Roof Sheathing – Fastener Schedule

<table>
<thead>
<tr>
<th>WSP Nominal Thickness (in.)</th>
<th>Nail</th>
<th>Edge (in.)</th>
<th>Field (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 – 1/2</td>
<td>8d common or RSRS-01 nail</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>10/32 – 3/4</td>
<td>8d common or RSRS-01 nail</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>7/8 – 1 1/4</td>
<td>10d common</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

6 For WSP roof sheathing attached to gable end roof framing and to intermediate supporting gables 48 inches of roof edges and ridges, nails shall be spaced at 4 inches, 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/ 45° of roof edge/ridge/cave
- Including gable and roof framing
- Nails at 6 1/4 in.
- Edge & field

Table R602.3(1) Footnote f
Roof Sheathing – Gable Endwall Limits

4’ perimeter nailing

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Roof Sheathing – Gable Endwall Limits

4’ perimeter nailing

Overhang Span
Not to exceed
Lesser of
L/2 or 2'

Required
Blocking

Uplift connection
designed (below)

Gable Endwall

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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 ft², and
  - Attic height >8’
- Access opening
  - Minimum 22” x 30” and
  - 30” headroom above the opening
  - Located in hallway or other accessible location

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APPLICATION

WSP roof sheathing requires nailing to gable end roof framing and intermediate supports at 4" o.c. under which of the following conditions?

a) Within 4 feet of roof edges and ridges
b) Wind speed > 130 mph Exposure B
c) Wind speed > 110 mph Exposure C
d) All of the above

Finishes and Weather Protection
Chapters 7 & 9

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-resistant 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 D0, D1, or D2
  - Reduced height, weight and thickness

Steel Lintel Size

- Determine minimum size of a steel lintel supporting masonry veneer
- Stories above = 1
- Span = 6'0"
Underlayment for Asphalt Shingles

Slope >2:12 and <4:12

Ice Barriers

- Required where water damage due to ice dams at roof eaves occurs
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
  - Bathrooms
  - Laundry rooms
  - Basements w/o habitable space
  - Beams
  - Girders
  - Ducts
  - Other obstructions

- **6'-0"**
  - Basements with habitable space
  - Bathrooms
  - Laundry rooms
  - Basements w/o 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

---

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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 7½" 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 ≤ ¼”
- 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

- Handrails must be continuous from top edge to bottom edge of each flight.
- End returned to wall.
- Handrail is permitted to be interrupted by newel post at a turn.

Guards

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

- Openings <4" sphere
- <4½" 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 ft²

Guards

- Opening <4" sphere
- <4½" 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 ft²

Guards

- Openings <4" sphere
- <4½" 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 ft²
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 ft² used only to house mechanical equipment with 2 ways out
Safety Glazing - Windows

- Exposed area of an individual pane > 9 ft²
- Bottom edge of glazing < 18” above floor
- Top edge of glazing > 36” above floor
- Exception
  - Horizontal rail installed 34” to 38” above walking surface

§R308.4.3

Safety Glazing – Wet Surfaces

§R308.4.5

Safety Glazing – Adjacent Stairs

§R308.4.6
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
Eave Projections – w/ Sprinklers

- Projection
- Lot line
- 0.8 ft
- 0.5 ft

- 1-HR protection

§R302.1

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Eave Projections

- Fire blocking
- No fire-resistant protection required
- Interior fire-resistance-rated interior wall
- NE = No sprinkler system
- S = Sprinkler system

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

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Townhouse Separation

- Common 1-hour fire-resistance-rated wall
- Townhouse unit A
- Townhouse unit B
- Wall sprinklers

Parapet Exception

- Roof flashing
- No roof openings or penetrations
- Min. 4 ft. Common fire-resistance-rated wall
- Min. 4 ft.
- Fire-resistant treated (FRT) roof sheathing
- Alternatives to FRT sheathing:
  - Non-combustible sheathing
  - 1/2 in. Type X gypsum board below sheathing

Note: Diagrams to illustrate specific requirements and exceptions. Customization and variation based on specific building codes.
Dwelling Separation from Garage

- Not a fire-resistance-rated assembly
- \(\frac{3}{8}\)” gypsum board on garage side provides limited fire resistance
- \(\frac{7}{8}\)” Type X gypsum board on ceiling when habitable space above

No 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

Fire Protection of Floors

Light and Ventilation

- Habitable rooms
  - Glazing ≥ 8% or lighting ≥ 6 ft-candles
  - Openings ≥ 4% or mechanical ventilation

- Bathrooms
  - Glazing ≥ 3 ft² or electric lighting
  - Openings ≥ 1.5 ft² or mechanical exhaust
Stairway Illumination

Whole-house Mechanical Ventilation

- Required if
  - Blower door test shows air infiltration rate
    - ≤ 5 ACH or
    - 0.28 cfm/ft²
- 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

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

Building Utilities
Chapters 12-43

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

Exceptions
1. Direct vent appliances
2. Vented room heaters
3. Vented wall furnaces
4. Vented gas fireplace
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

§M1502
&G2439

Clothes Dryer Exhaust Systems

- Dryer Exhaust Duct Power Ventilator
  - Per manufacturer

§M1502
&G2439

Clothes Dryer Exhaust Systems

- Protection of concealed dryer duct

§M1502
&G2439
Dryer Exhaust Duct

- 4" smooth metal duct
- Min. No. 28 gage
- Insert in direction of flow
- Max. ½" 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

<table>
<thead>
<tr>
<th>Floor Area</th>
<th>2–4</th>
<th>4–5</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>1,501–3,000</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>3,001–5,000</td>
<td>75</td>
<td>90</td>
</tr>
</tbody>
</table>

Example Dwelling
- 3500 ft²
- 3 bedrooms

Combustion Air from Inside the Building

- Combustion air can draw from adjacent rooms if
  - Volume of adjacent space > 50 ft³ per 1000 Btu/h
  - At least 2 openings
  - Free area of openings per
    - Btu/h input rating of all appliances
    - 1 in² per 1000 Btu/h

135,000 Btu/h
135 in² net free area
1,000 per opening

Each opening must be 135 in² of free area
**Combustion Air from Two Outdoor Openings**
- Direct openings
- Vertical ducts
  - Free area >1 in² per 4,000 Btu/h of total input rating
- Horizontal ducts
  - Free area >1 in² per 2,000 Btu/h of total input rating

**Combustion Air from Single Outdoor Opening**
- Free area of opening
  - >1 in² per 3,000 Btu/h
- Free area > sum of all vent connector areas in the space
- Minimum clearances required around appliances, must meet manufacturer installation instructions as well

**Gas Vent Roof Termination**
- Termination height for gas vents with cross section ≤12” and ≥8” from a vertical wall based on roof slope
Direct-vent Appliance Vent Termination

Table G2427.8

<table>
<thead>
<tr>
<th>Gas Pipe Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Steel, stainless steel and wrought-iron</td>
</tr>
<tr>
<td>• Minimum Schedule 10</td>
</tr>
<tr>
<td>• Approved seamless metallic tubing</td>
</tr>
<tr>
<td>• Gas not corrosive to pipe material</td>
</tr>
<tr>
<td>• Corrugated stainless steel tubing (CSST)</td>
</tr>
<tr>
<td>• Exterior underground locations only</td>
</tr>
<tr>
<td>• Approved plastic pipe, tubing and fittings</td>
</tr>
</tbody>
</table>
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

§G2420.5 & §G2422

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 < 1½" from edge
- 16-gage steel shield plates
- Excludes 2” above bottom plates and below top plates
- Exception for cast iron and galvanized steel pipe
Protection from Freezing

- Underground water service pipe
  - Buried \( \geq 12" \) deep
  - Buried \( \geq 6" \) 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 \( \leq 2" \) diameter

<table>
<thead>
<tr>
<th>PIPING MATERIAL</th>
<th>MAX. HORIZONTAL SPACING (IN)</th>
<th>MAX. VERTICAL SPACING (IN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Cast-iron, ( &lt; 10 ) ft lengths</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Cast-iron, 10 ft lengths</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Copper or copper alloy, ( &lt; 1 \frac{1}{4} ) in. dia</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>PE, ( &lt; 1 ) in. dia</td>
<td>0.07</td>
<td>10</td>
</tr>
<tr>
<td>PVC</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>
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

Fixture Vents

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

Fall from trap weir to vent connection ≤1 pipe diameter
**Wet Venting**

- Permitted for 1 or 2 bathroom groups on same level
- Vent piping diameter
  - At least ¾ of required diameter of drain served
  - > 1½”
  - Vents > 40’ increase one pipe size

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**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

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Max. Temperature</th>
<th>Approved Device</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water heater</td>
<td>120°F</td>
<td>Balanced temperature or thermostatic mixing valve</td>
<td>ANSI Z315.3-1993</td>
</tr>
<tr>
<td>Stovetop kettle</td>
<td>140°F</td>
<td>Water-tempering mixing device</td>
<td>ANSI Z315.3-1993</td>
</tr>
</tbody>
</table>

**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 D0, D1, and D2
  - 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

Based on the National Electrical Code (NEC) §E3601.2

Equipment Location

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

Section 276

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

Section 277

Section 278
Grounding Electrode System

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

Requires at least one additional electrode if a single ground rod has a resistance of >25 ohms, then a 2nd ground rod is required.

Provides a fault current path to earth.

Bonding

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

As a general rule, the main service disconnect enclosure is the only location where the code permits connection of the grounding system to the grounded (neutral) conductors. They are isolated from each other elsewhere to prevent creating a parallel fault path.

Conductor Sizing

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

<table>
<thead>
<tr>
<th>Conductors</th>
<th>15 amp</th>
<th>20 amp</th>
<th>30 amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single exposed conductors (copper)</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Single exposed conductors (aluminum)</td>
<td>16</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Multiple conductors (copper)</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Multiple conductors (aluminum)</td>
<td>16</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Additional conductors (copper)</td>
<td>16</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Additional conductors (aluminum)</td>
<td>16</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>
Overcurrent Protection Required

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

<table>
<thead>
<tr>
<th>Gauge (AWG)</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Alum</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

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.

Type NM cable not permitted:
- Underground.
- Wet or damp locations.
- Embedded in concrete.

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.

§E3901

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.

§E3901
Receptacle Locations – Bathrooms

- At least one outlet in each bathroom
- Outlets shall have GFCI protection

Receptacle Locations – Hallways

- 1 outlet required when hallway length = 10’
- Length measured along hallway centerline

Receptacle Locations – Foyers

- Foyers > 400 sq. ft. 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
Energy Conservation
Chapter 11

GFCI protection is required for all basement areas, whether finished or unfinished.

a) True
b) False
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 ft²
- 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 shallower rafters

---

**Slab-on-Grade Insulation**

- Floors with <12" below grade
- Combination of vertical and horizontal insulation
- Heavy termite areas exempt
Crawl Space Insulation

- Two options
  - Insulate floor above crawl space
  - 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**
- **Cavities cannot be used as ducts or plenums**

### Water Pipe Insulation

- ≥ R-3 for
  - ≥ 1” 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
    - Designed to carry fluids ≥ 105°F or ≤ 55°F
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

What is the minimum R-value for ceilings in climate zones 4 through 8?

a) R30
b) R49
c) R60
d) R values are no longer applicable
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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