Welcome to the

2018 Annual Conference

Educational Sessions

2018 IRC® Essentials

Based on the 2018 International Residential Code® (IRC®)
Apply the critical concepts provisions of the 2018 *International Residential Code®*. 
OBJECTIVES

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

Guide to a successful class:

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

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

Health and Safety
Ceiling Height

- Generally 7 ft. 0 in.
- 6 ft. 8 in.:
  - Bathrooms
  - Toilet rooms
  - Laundry rooms
  - Basements w/o habitable space or hallways
- 6 ft. 4 in. basements:
  - Beams
  - Girders
  - Ducts
  - Other obstructions
Means of Egress

“Means of egress” describes the path of travel from any location in the dwelling to the exterior

- Stairways
- Ramps
- Hallways
- Doors
  - One 3 - 0 × 6 - 8 side-swinging egress door to exterior
  - No size or type requirements for other doors
  - No limits on travel distance
Means of Egress

- Designed to provide a safe path to exterior
  - Does not pass through a garage
  - ½” gypsum board on enclosures under stairs
  - Egress components securely anchored to the structure
- Required egress door can be opened without a 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 the door
  - \( \geq 36 \text{ in.} \) in the direction of travel
- Max. landing slope = \( \frac{1}{4} / 12 \)
- No elevation requirements in Section R311.3
- Exception for balconies
Landings at Exterior Doors

- Required egress door
- Landings or finished floors ≤ 1½ in. below top of threshold
- Exception
  - Door swings in
  - Exterior landing can be a maximum of 7¾ inches below top of the threshold
- Access to grade
Landings at Exterior Doors

- Other than required egress door
- Landing on either side:
  - $\leq 7\frac{3}{4}$ in. below top of the threshold
- Door swings either direction
Stairs at Exterior Doors

- Door other than required egress door
- Exception
  - Stairs allowed on exterior side
    - Door cannot swing out over stairs
  - Stairs can have a maximum of 2 risers
Stair treads and risers

- Riser $\leq 7\frac{3}{4}$ in.
- Tread $\geq 10$ in.
- Variance $\leq \frac{3}{8}$ in.
- Nosing projection $\frac{3}{4} - 1\frac{1}{4}$ in.
Stair treads and risers

- Treads > 30 in. above floor or grade
  - Solid risers, or
  - 4-in. diameter sphere cannot pass through
Stairway Width

- Minimum clear width of 36”
  - Required above the handrail; and
  - Below the required headroom height
  - ≤ 4½” handrail projection either side
Stairway Headroom

- Minimum headroom
  - 6 ft. 8 in.
  - Above plane of tread nosings
Winder Stairs

- Nonparallel edges
- Tread depth of 6” at the 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 direction of travel
- Maximum 147” vertically between landings
- Exception allows a door at the top of an interior flight of stairs, provided the door does not swing over the step
Handrail

- Max. 4½-inch projection from wall
- Min. 1 ½-inch clearance to wall
- Graspable shape
Handrail continuity

- Flight 1 and Flight 2
- Landing
- Ends returned
- Continuous transition
- Starting newel permitted on bottom tread
- Interruption not permitted
- Handrail is permitted to be interrupted by newel post at a turn
- A volute, turnout, starting easing or starting newel is permitted on the lowest tread
Guards

- A walking surface >30 inches above any point within 36 inches horizontally
- Min. guard height 36 in.
  - 34 in. at stairs
Guards

- Openings shall not allow a 4-in. sphere to pass through
  - 4 3/8 in. along stairs
- Top rail to resist a single concentrated load of 200 lbs. applied 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”
- Alternatives to 24” sill height
  - Window opening control device
  - Window fall prevention device
  - Fixed glazing
Emergency Escape and Rescue Openings

- Basements
- Habitable attics
- Sleeping rooms
  - Exceptions:
    - Storm shelters
    - Basements ≤ 200 sq. ft. used only to house mechanical equipment
Emergency Escape and Rescue Openings

Minimum width = 20”
Minimum height = 24”
Minimum area = 5.0 ft² for grade floor or below grade openings

Minimum area = 5.7 ft²
Minimum width = 20”
Minimum height = 24”

Double- or single-hung window

Casement window

Sliding window

Finish floor
Safety Glazing – Adjacent Doors

Safety glazing not required

Safety glazing required

> 24 in.

≤ 24 in.
Safety Glazing – Windows

- Exposed area of an individual pane > 9 sq. ft.
- Bottom edge of glazing < 18 in. above floor
- Top edge of glazing > 36 in. above floor
  - Exception:
    - Horizontal rail installed 34 to 38 in. above walking surface
Safety Glazing – Wet Surfaces

Plan view

Section view

Bathtub, whirlpool tub or hot tub

<60 in.

<60 in.

<60 in.

Floor

SG

SG

SG

SG
Safety Glazing – Adjacent Stairs

SG = Safety glazing required
NR = Not required to be safety glazing
Measurements are to exposed glazing
Safety Glazing – Adjacent Bottom Landing

Glazing less than 36 inches above the floor and installed in area adjacent to bottom landing must be safety glazing.

≤ 60 in.

≥ 36 in.
Smoke Alarms

- In each sleeping room
- Outside each sleeping area
- On each story
- Building wiring system to provide primary power
- Battery backup
- Interconnection
Smoke Alarms in Existing Dwellings

- Retrofit smoke alarms when a permit is required:
  - Interior alterations or repairs
  - Additions
- Battery-operated smoke alarms
- Exception – provisions do not apply for:
  - Minor work that does not require a permit
  - Exterior work such as roofing or siding
  - Replacing doors or windows
  - Addition of a deck or porch
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 and townhouses
Exterior Walls

Dwelling without fire sprinklers

Dwelling with fire sprinklers

NR wall Unlimited openings

\[ \geq 3 \text{ ft.} \]
Eave Projections

Dwelling without fire sprinklers

No protection required

1-HR protection

Projection

Lot line

≥ 5 ft
Eave Projections

Dwelling with fire sprinklers

No protection required

1-HR protection

≥ 3 ft
Two-Family Dwelling Separation

- 1-hour separation
  - Continuous foundation to roof
- Exception
  - 5/8-inch gypsum board ceiling
  - ½-inch gypsum board on bearing walls
  - Draft stop in attic
Townhouse Separation

With Sprinklers

1-hour FR rated common wall

2-hour FR rated common wall

Fire-resistant penetration requirements for electrical boxes

No plumbing or mechanical

Without sprinklers

Townhouse dwelling unit A

Townhouse dwelling unit B
Townhouse Separation

Two 1-hour wall

1-hour common wall

2-hour common wall

Alternate assembly using shaft liner with frame wall on each side

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

No roof openings or penetrations

Min. 4 ft

Min. 4 ft

Fire-retardant treated (FRT) roof sheathing

Common fire-resistance-rated wall

Top chord of roof truss

Alternatives to FRT sheathing:
- Non-combustible sheathing
- 5/8-in. type X gypsum board below sheathing

Townhouse Unit A

Townhouse Unit B
Dwelling Separation from Garage

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

Habitable space above garage

Option 1

Option 2

Supporting walls must have ½” gypsum board

No habitable space above garage
Dwelling Separation from Garage

- Penetrations not rated
- No openings from garage into a sleeping room
- Self-closing door
  - 1 3/8”-thick solid-core wood
  - 1 3/8”-thick solid-core steel
  - 1 3/8”-thick honeycomb-core steel
- 20-minute fire-resistance-rated
Fire Protection of Floors

- Underside of floor assembly
  - ½” gypsum board
  - ⅝” wood structural panel
  - equivalent material

- Exceptions
  - ≥ 2 ×10 dimension or SCL
  - Sprinklers below
  - ≤ 80 ft² area
  - Crawl space with no storage or fuel-fired appliances
Light and Ventilation

- Habitable rooms:
  - Glazing $\geq 8\%$ or lighting $\geq 6$ footcandles
  - Openings $\geq 4\%$ or mechanical ventilation

- Bathrooms:
  - Glazing $\geq 3$ ft$^2$ or electric lighting
  - Openings $\geq 1.5$ ft$^2$ or mechanical exhaust
Whole-house Mechanical Ventilation System

- Required if
  - Blower door test performed and
  - Air infiltration rate ≤ 5 ACH
- Prescriptive air flow rate based on
  - Area of dwelling
  - Number of bedrooms
  - Continuous or intermittent operation
Stairway Illumination

- Interior stairways
  - Treads and landings ≥ 1 foot-candle
  - Wall switch at each floor level ≥ 6 risers.
- Exterior stairways
  - Light source at top landing
  - Bottom landing providing access to a basement
Carbon Monoxide (CO) Alarms

- Required if
  - Fuel-fired appliance or
  - Attached garage communicating with dwelling unit

- Locations
  - Outside of each separate sleeping area adjacent to bedrooms
  - Within bedroom with fuel-burning appliance located within bedroom or attached bathroom

- Power
  - House wiring with battery backup
Chimneys and Fireplaces

- Masonry fireplaces
- Masonry chimneys
- Factory-built fireplaces
- Factory-built chimneys
- Exterior Air Supply

Per manufacturer’s instructions
Masonry Chimney Termination

- 3 feet above roof penetration
- 2 feet higher than any portion of a building within 10 feet
- Flashing to weatherproof the chimney penetration at the roof
- Crickets required for chimneys ≥30” wide
- Chimney cap required
- Rain cap optional
Part VI

Building Utilities
Appliances
Installation and Location

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

Exception

Other exceptions for:
1. Direct-vent appliances
2. Vented room heaters
3. Vented wall furnaces
4. Vented gas fireplaces
Appliances
Installation and Location

- In garages, the ignition source ≥18” above the floor
  - Unless the appliance is listed as flammable-vapor-ignition resistant
- In all locations, protected from impact by vehicles
Access to Appliances

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

- Finish access opening
  - $\geq 20 \times 30$
    - (R807.1 Rough 22 x 30)
- Passageway
  - $\geq 22 \times 30$ h
  - $\geq 24$-in. wide flooring
  - $\leq 20$-ft. length
- Exception
  - $\leq 6$-ft. high x 50 ft. long
Clothes Dryer Exhaust Systems

- Termination
  - Backdraft damper
  - No screen
  - ≥ 3 ft. from openings
- Length
  - Deductions for fittings
  - Label when > 35 ft.
  - Label ≤ 6 ft. from dryer
- Listed transition duct
Clothes Dryer Exhaust Systems

- Dryer Exhaust Duct Power Ventilator (DEDPV)
  - Per manufacturer
- Protection of concealed dryer duct
  - < 1¼ inches
  - ≥ 2 in. above sole plates, below top plates
Dryer Exhaust Duct

- 4-in. smooth metal duct
  - Min. No. 28 gage
- Insert in direction of flow
- Max. ⅛-in. screw penetration
Whole-house Mechanical Ventilation system

- Prescriptive airflow rate based on:
  - Floor area of dwelling unit
  - Number of bedrooms
  - Continuous or intermittent

- System design
  - One or more supply or exhaust fans, or a combination
  - Outdoor air ducts connected to the return permitted to supply ventilation.

<table>
<thead>
<tr>
<th>Floor Area</th>
<th>2 – 3</th>
<th>4 – 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFM Airflow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1500</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>1501 – 3000</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>3001 – 4500</td>
<td>75</td>
<td>90</td>
</tr>
</tbody>
</table>
Combustion Air from Inside the Building

- Combustion air can draw from an adjacent room if:
  - Volume of adjacent space is >50 ft$^3$ per 1000 Btu/h
  - At least 2 openings provide air from the adjacent room
  - Free area of openings based on:
    - Btu/h input rating of all appliances
    - 1 in$^2$ per 1000 Btu/h
    - Minimum 100 in$^2$ per opening

Furnace = 100,000 Btu/h
Water heater = 35,000 Btu/h
Combined input = 135,000 Btu/h
Combustion Air from Two Outdoor Openings

- Direct opening or vertical duct
  - Free area of $\geq 1 \text{ in}^2$ per 4000 Btu/h of total input rating

- Direct opening or horizontal ducts
  - Free area of $\geq 1 \text{ in}^2$ per 2000 Btu/h of total input rating

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

\[
\frac{67.5}{2,000} = 33.75 \text{ in}^2 \text{ net free area per opening}
\]
Combustion Air from Single Outdoor Opening

- Free area of the opening in² per 3000 Btu/h
- Free area must equal the sum of the areas of all vent connectors in the space
- Minimum clearances required around the appliances for free circulation of air

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

7” diameter = 38.5 in²
4” diameter = 12.5 in²
Combined = 51.0 in²

Larger of the two = 51 in²
Gas Vent Roof Termination

- Termination height for gas vents with a cross section <12” and at least 8’ from a vertical wall is based on the roof slope.

<table>
<thead>
<tr>
<th>Roof Slope</th>
<th>Minimum Height from Roof to Lowest Discharge Opening (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤6/12</td>
<td>1.0</td>
</tr>
<tr>
<td>&gt;6/12 to ≤7/12</td>
<td>1.25</td>
</tr>
<tr>
<td>&gt;7/12 to ≤8/12</td>
<td>1.5</td>
</tr>
<tr>
<td>&gt;8/12 to ≤9/12</td>
<td>2.0</td>
</tr>
<tr>
<td>&gt;9/12 to ≤10/12</td>
<td>2.5</td>
</tr>
<tr>
<td>&gt;10/12 to ≤11/12</td>
<td>3.25</td>
</tr>
<tr>
<td>&gt;11/12 to ≤12/12</td>
<td>4.0</td>
</tr>
<tr>
<td>&gt;12/12 to ≤14/12</td>
<td>5.0</td>
</tr>
<tr>
<td>&gt;14/12 to ≤16/12</td>
<td>6.0</td>
</tr>
<tr>
<td>&gt;16/12 to ≤18/12</td>
<td>7.0</td>
</tr>
<tr>
<td>&gt;18/12 to ≤20/12</td>
<td>7.5</td>
</tr>
<tr>
<td>&gt;20/12 to ≤21/12</td>
<td>8.0</td>
</tr>
</tbody>
</table>
Gas Pipe Materials

- Schedule 40 steel
- Approved seamless metallic tubing
  - Gas used cannot be corrosive to the 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 an air duct
  - Within a clothes chute
  - Within a chimney
  - Within a gas vent
  - 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 the nearest edge of the member or
  - Protected by No. 16 Gage nail shield plates
  - Except Schedule 40 black or galvanized steel gas piping
- CSST gas tubing requires protection in accordance with the code and the manufacturer’s installation instructions
Other Gas Piping Installation Requirements

- Above-ground gas piping outdoors
  - ≥ 3½” above ground and above roof surface
  - Protection from corrosion for ferrous metal
    - Painting
    - Galvanizing

- Underground gas piping
  - Steel pipe wrapped with approved material for corrosion protection
  - Galvanizing is not approved protection from corrosion
  - Buried ≥ 12” deep
Gas Appliance Connections

- Appliance connector materials
- Appliance connector installation
  - Can pass through the appliance housing in accordance with manufacturer’s instructions
    - Rigid metallic piping
    - CSST
    - Listed and labeled appliance connectors
    - Listed and labeled quick disconnect appliance connectors
- Shut-off valve
  - ≤6’, or
  - <50’ when connected to manifold

Cannot pass through walls, floors, partitions, ceilings.
Plumbing Piping Protection from Damage

- Concealed piping installed through studs, joists or rafters
  - < 1¼ in. from nearest edge
    - Shield plates ≥ 0.0575” thick steel (No. 16 Gage)
      - Covers area where the pipe passes through
      - Extends ≥ 2” above sole 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 the frost line
- Building sewer pipe
  - Depth determined by the Jurisdiction
  - Stipulated in the 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 Plumbing Piping Support

- Horizontal and vertical support spacing based on the pipe material
- A mid-story guide is required for vertical plastic piping ≥ 2-in. diameter

<table>
<thead>
<tr>
<th>Piping Material</th>
<th>Maximum Horizontal Spacing (ft)</th>
<th>Maximum Vertical Spacing (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS pipe</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Cast-iron pipe, &lt;10’ lengths</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Cast-iron pipe, 10’ lengths</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Copper or copper alloy pipe</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>PEX pipe</td>
<td>2.67</td>
<td>10</td>
</tr>
<tr>
<td>PVC pipe</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>
Water Service

- When pipe for building sewer is listed for underground use within a building:
  - Water service pipe is permitted in the same trench with a building sewer (e.g. cast-iron or schedule 40 PVC DWV)

- For building sewer pipe not approved for underground use within a building:
  - 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 the highest point of the building sewer
Water Supply System Design Criteria

- Water service at the building entrance
  - 40–80 psi
  - $\geq \frac{3}{4}$” pipe size

- Distribution system pipe size based on
  - Fixture unit values
  - Developed length of piping
  - Water pressure

- Flow rates and consumption are limited for plumbing fixtures to conserve water

- Valves
  - Main shut-off valve
  - At each fixture other than showers and tubs
Water Supply Protection

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

- Approved fittings for change in direction

![Diagram showing approved fittings for change in direction](image-url)
Cleanouts

- Cleanouts required where:
  - Horizontal drain lines change direction >45°
  - Within 10 ft. of building drain / building sewer connection
- Where more than one change of direction occurs, only one cleanout is required in each 40’
- A readily removable fixture, such as a water closet or a fixture trap of a sink, may serve as a cleanout
Fixtures Vents

- The distance from the trap to the vent is limited
  - Self-siphoning fixtures such as water closets are not limited
- Vent connection is not permitted to be below the trap weir

Fall from trap weir to vent connection ≤1 pipe diameter
Vent Pipe

- Horizontal wet venting is permitted for fixtures of one or two bathroom groups located on the same floor
- Diameter of vent piping
  - At least $\frac{1}{2}$ of the required diameter of the drain served
  - $>1\frac{1}{4}''$
  - For vents $>40'$, increase of one pipe size
Vent Termination

- Open vents
  - ≥ 6 in. above roof
  - ≥ 6 in. above anticipated snow accumulation

- Frost closure
  - 97.5% outside design temperature ≤ 0°F
  - Increase to 3 in. at point ≥ 12 in. inside building envelope
## Protection Against Scalding

- Temperature control devices are required on the water outlets of bathing fixtures and bidets to prevent scalding.

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Maximum Temperature</th>
<th>Approved Device</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shower or Tub/Shower</td>
<td>120°F</td>
<td>Pressure-balanced control valve</td>
<td>ASSE 1016 / ASME A112.1016/CSA B125.1</td>
</tr>
<tr>
<td>Combination</td>
<td></td>
<td>Thermostatic-mixing control valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combination pressure-balance/thermostatic-mixing control valve</td>
<td></td>
</tr>
<tr>
<td>Bathtub or Whirlpool</td>
<td>120°F</td>
<td>Water-temperature-limiting device</td>
<td>ASSE 1070 or CSA B125.3</td>
</tr>
<tr>
<td>Bidet</td>
<td>110°F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fixture Traps

- Traps provide a water seal with a depth of 2” to 4” to prevent sewer gases from entering the building.
- Floor drains require a trap-primer or deep-seal design to prevent the loss of their water seal by evaporation.
Water Heaters

- Connection to the water supply
- Drain pan if damage will occur
- Temperature & pressure relief valve
- Ignition sources elevated
  - $\geq18''$ above garage floor
- Anchorage to walls
  - SDCs $D_0$, $D_1$, and $D_2$
  - Townhouses in SDC C
Electrical Services

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

- Readily accessible service disconnect
- Working space
- Light source nearby
- Spaces above and below the panel are dedicated to the electrical installation
- Not in clothes closets or bathrooms
  - Electrical panels
  - Service disconnects
  - Circuit breakers
Electrical Service Size and Rating

- **Service rating**
  - Minimum 100 amp for single-family dwellings
  - Minimum 60 amperes for other installations

- **Ampacity of ungrounded service conductors and service rating**
  must at least match the load served in the structure
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.
Bonding

- Main bonding jumper at service equipment
  - Connection of the grounding system to the grounded (neutral) conductors occurs at main service disconnect
- Metal water piping must be bonded to the ground system
Conductor Sizing

- Ampacity tables are provided for all wire sizes based on the material and insulation type
- When sizing wires, several variables must be considered:
  - Temperature rating of the conductor insulation
  - Derating for bundled conductors
  - Temperature rating of the terminal

<table>
<thead>
<tr>
<th>Conductors</th>
<th>Circuit Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 amp</td>
</tr>
<tr>
<td>Min. size (AWG) circuit conductors (copper)</td>
<td>14</td>
</tr>
<tr>
<td>Overcurrent-protection device: max. amp rating</td>
<td>15</td>
</tr>
<tr>
<td>Duplex or multiple outlet receptacle rating (amps)</td>
<td>15 max.</td>
</tr>
<tr>
<td>Single receptacle outlet minimum rating (amps)</td>
<td>15</td>
</tr>
<tr>
<td>Max. load (amps)</td>
<td>15</td>
</tr>
</tbody>
</table>
Overcurrent Protection Required

- Circuit breaker or fuse is required to protect all ungrounded branch circuit and feeder conductors
- Overcurrent protective device ratings cannot exceed the allowable ampacity of the conductor

<table>
<thead>
<tr>
<th>Size (AWG)</th>
<th>Maximum overcurrent protection device rating (amps)</th>
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Overcurrent devices located:
1. Where the branch circuit conductors receive their supply
2. At the service panel (typically)
3. So they are readily accessible
4. Where not subject to damage
5. Not in clothes closets or bathrooms
6. Not located above a step
Wiring Methods

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

Type NM cable not permitted:
- Underground
- Wet or damp locations
- Embedded in concrete
Receptacle Outlet Locations

An outlet within 24” measured along wall need an outlet

At least one outlet in each bathroom need an outlet

An outlet within 36” of each lavatory islands with a side >24

Outlets shall have GFCI protection behind range or sink

Outlets shall have GFCI protection

Bathroom requirements

Kitchen requirements

General room requirements
Receptacle Outlet Locations

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

Hallway requirements
Outdoor requirements

1 outlet at the front, and 1 outlet at the back of the dwelling at grade

Located < 6'6" above grade

Balconies, decks and porches which are accessible from inside shall have 1 outlet

Outlets shall have GFCI protection

Foyers >60 sq.ft. require an outlet on each wall ≥3’ wide porches which are

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

Foyer requirements
Outdoor requirements

Foyer > 60 sq. ft.
≥ 3 ft

≤ 6 ft 6 in.

≥ 3 ft
Lighting Outlets

- Wall switch–controlled lighting outlet
  - Habitable rooms
  - Bathrooms
  - Hallways
  - Storage areas
  - Garages
  - Stairways
  - Outside each exterior door
Ground-fault Circuit-Interrupter Protection (GFCI)

- GFCI protection required:
  - Bathroom
  - Kitchen counter
  - Unfinished basement
    - Except fire/burglar alarm system
  - Garage
  - <6’ from sink
  - Exterior
Arc-fault Circuit Interrupter Protection (AFCI)

- AFCI devices
  - Detect unwanted arcing in the wiring of the branch circuit
  - Open the circuit before excessive heat buildup can cause a fire
- AFCI devices are installed in the service panel or subpanel
- AFCI protection required for:
  - Living areas
  - Hallways
  - Closets
Receptacles

- Wet locations
  - Enclosure that is weatherproof
  - when a cord is plugged in
  - Receptacles prohibited within or
  - directly over a bathtub or shower space
- Tamper-resistant receptacle required in locations accessible to children
  - Not required when:
    - >5½’ above the floor
    - Part of a luminaire or appliance
    - In a dedicated space for an appliance
Luminaires in Clothes Closets

- Type of luminaires
- Minimum clearances
- Clearances are measured from the fixture to the nearest point of the defined storage space
Part VII

Energy Conservation
Energy Efficiency

- IRC Chapter 11 is extracted from the applicable provisions of the 2018 IECC
Compliance Paths

Projects shall comply with one of the following:

1. Sections N1101.14 through N1104.

2. Section N1105 and the provisions of Sections N1101.14 through N1104 labeled “Mandatory.”

3. An energy rating index (ERI) approach in Section N1106.
Building Insulation

- Pieces of insulation >12” in width must have:
  - Visible R-value mark; or
  - Installer certification
    - Insulation type
    - Manufacturer
    - R-value
Blown-in or Sprayed Insulation

- Attic markers each 300 sq. ft.
- Certificate indicating:
  - Initial installed thickness
  - Settled thickness
  - Settled R-value
  - Installed density
  - Coverage area
  - Number of bags installed
Insulation Requirements

- Minimum R-values for insulation is based on climate zone
- Exceptions:
  - Energy truss or raised-heel roof truss
  - Reduced R-values in rafter or joist space
  - Cold-formed steel framing requires higher insulation R-values and continuous insulation sheathing to provide a thermal break
Insulation Requirements

- Slab on grade
- Crawl spaces
  - Insulation of the floor above the crawl space; or
  - Insulation of the exterior walls
    - When the crawl space is not ventilated to the outside
    - Vapor retarder on exposed earth of unventilated crawl spaces
Windows and Doors

- Fenestration includes:
  - Skylights
  - Roof windows
  - Vertical windows
  - Opaque doors
  - Glazed doors
  - Glass block
- U-factor
- Solar Heat Gain Coefficient (SHGC)
Sealing Against Air Leakage
(Mandatory)

- Windows and doors
- Sill plate, rim joist, top plate
- Garage separation
- Tubs/showers
- Attic access opening
- Rim joists
- Recessed lighting
- Electrical boxes
Testing of Building Thermal Envelope (Mandatory)

- Blower door test required
- Allowable air-leakage rate:
  - Climate Zones 1 – 2: ≤ 5 ACH
  - Climate Zones 3 – 8: ≤ 3 ACH
- Test results on permanent certificate
Duct Insulation and Sealing

- Supply and return ducts in attics >R-8
- Supply and return ducts in other locations >R-6
- No insulation required for ducts within conditioned spaces
- Sealing of all ducts is required
- Air leakage test except when entire system is installed within the thermal envelope
- Building cavities cannot be used as ducts or plenums
Hot Water Pipe Insulation (Prescriptive)

- Hot water pipe insulation $\geq R$-3 for:
  - $\geq 3/4"$ diameter pipe
  - Water Heater to distribution manifold
  - Outside conditioned space
  - Under slab or underground
  - Piping in recirculation systems other than demand systems
Energy Certificate (Mandatory)

- Completed by:
  - Builder; or
  - Registered design professional
- Listing of
  - Insulation
  - Fenestration
  - Type and efficiency of equipment
  - Results of air testing
- Permanent certificate posted near furnace or approved indoor location
Discussion Activity
Final Reflection

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

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