Welcome to the

2018 Annual Conference

Educational Sessions

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

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

Guide to a successful class:

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

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

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

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

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

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

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

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

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

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

No prescribed slope

≥6” fall (5%)

Concrete Patio

≥2% slope

Swale

10 ft

≥6” fall (5%)

Concrete Driveway

≥2% slope

10 ft

10 ft

≥ 6 in. fall

Finish grade

6 in.

10 ft
Structural
## Table R301.2(1)

### Climatic and Geographic Design Criteria

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

<table>
<thead>
<tr>
<th>Ground Snow Load</th>
<th>Wind Design</th>
<th>Seismic Design Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (mph) $V_{ult}$</td>
<td>Topographic Effects</td>
<td>Special Wind Region</td>
</tr>
<tr>
<td>30 psf</td>
<td>115 mph</td>
<td>Yes or No</td>
</tr>
</tbody>
</table>
Table R301.2(1) (Continued)
Climatic and Geographic Design Criteria

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

<table>
<thead>
<tr>
<th>Subject to Damage from</th>
<th>Ice Barrier Underlayment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathering</td>
<td></td>
</tr>
<tr>
<td>Frost Line Depth</td>
<td>42 in.</td>
</tr>
<tr>
<td>Termite</td>
<td>Yes or No</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Negligible or Moderate or Severe</td>
<td>Yes or No</td>
</tr>
</tbody>
</table>
**Table R301.2(1) (Continued)**
Climatic and Geographic Design Criteria

<table>
<thead>
<tr>
<th>Winter Design Temp</th>
<th>Flood Hazards</th>
<th>Air Freezing Index</th>
<th>Mean Annual Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>2°F</td>
<td>Date NFIP, Etc.</td>
<td>1197</td>
<td>51°F</td>
</tr>
</tbody>
</table>
### Table R301.2(1) (Continued)
Climatic and Geographic Design Criteria

<table>
<thead>
<tr>
<th>Manual J Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Prescriptive and Performance

- Prescriptive requirements
  - A specific set of rules to follow

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

- Conventional construction
  - Engineered design can be used for structural elements that:
    - Exceed the limits in the code; or
    - Are not included in the code

- Alternative to wood framing provisions
  - Wood Frame Construction Manual published by the American Wood Council
    - WFCM addresses wind speeds up to 150 mph
    - IRC wind speeds are less than 110 mph

For example, the sizing of wide flange steel beams
# Live Loads

**IRC Table R301.5**

Minimum Uniformly Distributed Live Loads

<table>
<thead>
<tr>
<th>USE</th>
<th>LIVE LOAD (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninhabitable attics without storage</td>
<td>10</td>
</tr>
<tr>
<td>Uninhabitable attics with limited storage</td>
<td>20</td>
</tr>
<tr>
<td>Habitable attics and attics served with fixed stairs</td>
<td>30</td>
</tr>
<tr>
<td>Balconies (exterior) and decks</td>
<td>40</td>
</tr>
<tr>
<td>Fire escapes</td>
<td>40</td>
</tr>
<tr>
<td>Rooms other than sleeping rooms</td>
<td>40</td>
</tr>
<tr>
<td>Sleeping rooms</td>
<td>30</td>
</tr>
</tbody>
</table>
**Live Loads (Continued)**

**IRC Table R301.5**

**Minimum Uniformly Distributed Live Loads**

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

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

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

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

- Table R301.7
  - $L = \text{span length}$
  - $H = \text{span height}$

<table>
<thead>
<tr>
<th>Structural Member</th>
<th>Allowable Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rafters having slopes greater than 3:12 with no finished ceiling attached to rafters</td>
<td>$L/180$</td>
</tr>
<tr>
<td>Interior walls and partitions</td>
<td>$H/180$</td>
</tr>
<tr>
<td>Floors/ceilings with plaster or stucco finish</td>
<td>$L/360$</td>
</tr>
<tr>
<td>All other structural members</td>
<td>$L/240$</td>
</tr>
<tr>
<td>Exterior walls—wind loads with plaster or stucco finish</td>
<td>$H/360$</td>
</tr>
<tr>
<td>Exterior walls with other brittle finishes</td>
<td>$H/240$</td>
</tr>
<tr>
<td>Exterior walls with flexible finishes</td>
<td>$H/120$</td>
</tr>
<tr>
<td>Lintels supporting masonry veneer walls</td>
<td>$L/600$</td>
</tr>
</tbody>
</table>
Example 4-1 Floor Joist Deflection

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

\[
L = 14' \times 12'' = 168''
\]

\[
168 \div 360 = 0.47
\]

Allowable deflection is 0.47”

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

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

- **Exposure B**
  - Some wind protection with trees and buildings
  - Default

- **Exposure C**
  - Open terrain with scattered obstructions

- **Exposure D**
  - Flat, unobstructed areas exposed to open water, smooth mud flats, salt flats and unbroken ice for $\geq 5,000$ ft
Hurricane-prone regions

- **Hurricane-prone regions.** Areas vulnerable to hurricanes, defined as the U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed, Vult, is greater than 115 miles per hour, and Hawaii, Puerto Rico, Guam, Virgin Islands and America Samoa.

- **Windborne debris region.** Areas within hurricane-prone regions located in accordance with one of the following:
  1. Within 1 mile of the coastal mean high water line where the ultimate design wind speed, Vult, is 130 mph or greater.
  2. In areas where the ultimate design wind speed, Vult, is 140 mph or greater; or Hawaii.
Snow Loads

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

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

<table>
<thead>
<tr>
<th>Seismic Design Category</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>No seismic requirements</td>
</tr>
<tr>
<td>C</td>
<td>No seismic requirements</td>
<td>Seismic Requirements Apply</td>
</tr>
<tr>
<td>D₀, D₁, D₂</td>
<td>Seismic Requirements Apply</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Engineered Design Required</td>
<td></td>
</tr>
</tbody>
</table>

2018 IRC Essentials
Earthquakes

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

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

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

## Conventional Light-Frame Construction

<table>
<thead>
<tr>
<th>Snow load</th>
<th>Type of foundation</th>
<th>Load bearing value of soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 psf</td>
<td></td>
<td>1,500</td>
</tr>
<tr>
<td>1-story</td>
<td>Slab-on-grade</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td>With crawl space</td>
<td>13 x 6</td>
</tr>
<tr>
<td></td>
<td>Plus basement</td>
<td>19 x 6</td>
</tr>
<tr>
<td>2-story</td>
<td>Slab-on-grade</td>
<td>12 x 6</td>
</tr>
<tr>
<td></td>
<td>With crawl space</td>
<td>17 x 6</td>
</tr>
<tr>
<td></td>
<td>Plus basement</td>
<td>23 x 6</td>
</tr>
</tbody>
</table>

**Projection “P” ≥ 2 in. and ≤ T**

**Thickness “T” ≥ 6 in.**

**Width “W” per table**
Example 5-1
Footing Size

- Determine minimum width (W), projection (P) and thickness (T) of a continuous spread footing

- Given:
  - 2-story dwelling with basement
  - 1500 psf assumed soil bearing capacity
  - 30 psf snow load
  - Conventional construction:
    a) Light-frame construction with siding
    b) Light-frame construction with brick veneer
### Example 5-1
#### Footing Size

<table>
<thead>
<tr>
<th>Snow load</th>
<th>Type of foundation</th>
<th>Load bearing value of soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 psf</td>
<td>Conventional Light-Frame Construction</td>
<td>1,500</td>
</tr>
<tr>
<td></td>
<td>2-story Plus basement</td>
<td>23 x 6</td>
</tr>
<tr>
<td></td>
<td>With Brick Veneer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-story Plus basement</td>
<td>27 x 9</td>
</tr>
</tbody>
</table>

P ≤ T
Example 5-2
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 5-2

Isolated Footing Size

- Soil load-bearing capacity
  - 1500 psf

- Tributary column load
  - $120 \text{ ft}^2 \times 50 \text{ lbs.} = 6,000 \text{ lbs.}$

6,000 lbs. ÷ 1,500 psf = 4 ft$^2$

- Thickness (T) Min. 6”

- Projection (P) cannot exceed footing thickness
Foundation Anchorage

- Anchor bolts
  - $\frac{1}{2}$-inch diameter
  - 7-inch embedment
  - Middle 1/3 of plate
Foundation Anchorage

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

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

Standard washer and nut on each bolt

Max 12 in. Min. 7 bolt dia.

Max 6 ft.
Foundation Anchorage

- Wood sill plate anchorage
  - Seismic
    - Dwellings and townhouses in SDC D₀, D₁ and D₂
    - Townhouses in SDC C

3” x 3” plate washers approximately ¼” thick

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

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

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

<table>
<thead>
<tr>
<th>Maximum Unsupported Height of Basement Wall</th>
<th>Location of Horizontal Reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤8 feet</td>
<td>One No. 4 bar within 12” of the top of the wall and one No. 4 bar near mid-height of the wall story</td>
</tr>
<tr>
<td>&gt;8 feet</td>
<td>One No. 4 bar within 12” of the top of the wall and one No. 4 bar near third points the wall story</td>
</tr>
</tbody>
</table>

- Vertical reinforcing required
  - Tables R404.1.2(2) through R404.1.2(9)
Horizontal Reinforcing in Concrete Basement Wall

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

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

<table>
<thead>
<tr>
<th>Wall Hgt.</th>
<th>Unbal. backfill</th>
<th>Soil class</th>
</tr>
</thead>
<tbody>
<tr>
<td>6”</td>
<td>6 of 6 @ 36</td>
<td>SC, ML-CL and inorganic CL</td>
</tr>
<tr>
<td>8”</td>
<td>6 @ 39</td>
<td></td>
</tr>
<tr>
<td>10”</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>12”</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>9”</td>
<td>7 of 6 @ 33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 @ 38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 @ 37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>8”</td>
<td>8 of 6 @ 24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 @ 29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 @ 39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 @ 48</td>
<td></td>
</tr>
</tbody>
</table>
Height Above Finished Grade

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

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

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

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

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

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

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

Naturally durable or preservative treated wood required for beam, joist, and decking.

Minimum ground clearance dimensions shown for non-treated wood. When closer to the ground, wood must be naturally durable or preservative treated.

Clearance above grade

Concrete footing

Wood beam

Preservative treated wood post approved for ground contact

Concrete footing

Grade

Decking

2 × 10 joist

2-2 × 12 beam

6 × 6 pressure preservative treated post approved for ground contact

Wood structural panel wall sheathing

Wood siding

Wood sill plate

Floor sheathing

Finish grade

Crawl space

Minimum 6 in.

Minimum 12 in.

Minimum 18 in.
Boring and Notching
Floor and Ceiling Joists

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

- Notch 25% of stud depth maximum
- Bored holes in single studs
  Maximum diameter 40% of stud depth
- Maximum diameter 60% of stud depth
  Studs must be doubled
  No more than two successive doubled studs so bored

5/8 in. minimum from edge of stud
Boring and Notching Nonbearing Walls

Hole size in 2’ x 4’ stud
Stud depth = 3½”
Largest hole ≤60%
60% x 3½ = 2¹/₈”
5/₈” + 2¹/₈” + 5/₈” = 3³/₈”
Boring and Notching
Top Plate of Bearing Wall

Notch greater than 50% of width of plate

Minimum 16 ga. by 1 1/2 in. galvanized steel plate tie attached to top plate with at least 8 0.148 in. dia. x 1 1/2 in. long nails on each side of notch

Approved fastener and joist hanger nail

3 1/2 in. 0.162 in.
16d common

3 in. 0.148 in.
10d common

1 1/2 in. 0.148 in.
Fireblocking

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

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

- Nominal 2” lumber
- Layers of structural wood panels
- Glass fiber insulation secured in place
- Vents & ducts at floor & ceiling levels
Draftstopping

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

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

- Prescriptive tables for:
  - Beams and girders
    - No. 2 grade Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir
    - Various support conditions
  - Floor joists
    - Specific grade and species of lumber
    - Live load 30 or 40 psf
    - Dead load 10 or 20 psf
Example 6-1
Beam Size and Bearing Support

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

<table>
<thead>
<tr>
<th>Girder supporting</th>
<th>Size</th>
<th>Building width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Span</td>
<td>Span</td>
</tr>
<tr>
<td>Two floors</td>
<td>3-2x10</td>
<td>6-2</td>
</tr>
<tr>
<td></td>
<td>3-2x12</td>
<td>7-2</td>
</tr>
<tr>
<td></td>
<td>4-2x8</td>
<td>6-1</td>
</tr>
<tr>
<td></td>
<td>4-2x10</td>
<td>7-2</td>
</tr>
</tbody>
</table>

Table R602.7(2)
- Three 2 x 12 or
- Four 2 x 10
Example 6-2
Joist Size and Spacing

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

Table R502.3.1(2)

<table>
<thead>
<tr>
<th>Joist Spacing</th>
<th>Joist Size</th>
<th>Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>12” O.C.</td>
<td>2 x 8</td>
<td>14 – 2</td>
</tr>
<tr>
<td>16” O.C.</td>
<td>2 x 10</td>
<td>15 – 7</td>
</tr>
<tr>
<td>19.2” O.C.</td>
<td>2 x 10</td>
<td>14 – 3</td>
</tr>
<tr>
<td>24” O.C.</td>
<td>2 x 12</td>
<td>14 – 9</td>
</tr>
</tbody>
</table>
# Fastener Schedule for Floor Framing

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

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

- Deck ledger connection to:
  - 2” band joist; or
  - 1 x 9½ Douglas Fir LVL rim board

- Fasteners
  - ≥½” diameter lag screws or bolts with washers
  - Hot-dipped galvanized or stainless steel
  - Lag screws full-depth through rim joist

Fasteners staggered along length of ledger
Deck Joists and Beams

- Prescriptive methods for joists and beams in deck construction.
  - Spans & bearing requirements
Example 6-3
Deck Footings

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

<table>
<thead>
<tr>
<th>Load Bearing Value of Soil (psf)</th>
<th>1500</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live or Ground Snow Load (psf)</td>
<td>Side of a square footing (in)</td>
<td>Diameter of a round footing (in)</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>40</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>60</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>100</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>120</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>140</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>160</td>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>

[Ref. Excerpt of Table R507.3.1]
Example 6-3
Deck Footings

- **Tributary area – Corner post**
  - Length is $\frac{1}{4}$ of total length = $20 \text{ ft} \times \frac{1}{4} = 5 \text{ ft}$
  - Width is $\frac{1}{2}$ of total width = $12 \text{ ft} \times \frac{1}{2} = 6 \text{ ft}$
  - Area = $5 \text{ ft} \times 6 \text{ ft} = 30 \text{ ft}^2$

- **Tributary area – Interior post**
  - Length is $\frac{1}{2}$ of total length = $20 \text{ ft} \times \frac{1}{2} = 10 \text{ ft}$
  - Width is $\frac{1}{2}$ of total width = $12 \text{ ft} \times \frac{1}{2} = 6 \text{ ft}$
  - Area = $10 \text{ ft} \times 6 \text{ ft} = 60 \text{ ft}^2$

- **Footing size – Corner post**
  - Min. 14 in. diameter
  - Min. 6 in. thick

- **Footing size – Interior post**
  - Min. 17 in. diameter
  - Min. 6 in. thick
Wall Framing

- Size and spacing of studs is related to:
  - Number of floors being supported
  - With or without the additional load of the roof-ceiling assembly
Example 6-3
Stud Size and Spacing

- Determine the minimum size, maximum height and maximum spacing of standard studs in an exterior bearing wall

- Given:
  - 3 stories of wood framing (walk-out basement plus 2 stories)
  - Standard- or stud-grade lumber
### Example 6-3

**Stud Size and Spacing**

- **Table R602.3(5)**

<table>
<thead>
<tr>
<th>Stud Size (inches)</th>
<th>Laterally Unsupported Stud Height (feet)</th>
<th>Bearing Walls</th>
<th>Nonbearing Walls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum Spacing When Supporting a Roof/Ceiling Assembly or a Habitable Attic Assembly Only</td>
<td>Maximum Spacing When Supporting One Floor, Plus a Roof/Ceiling Assembly or a Habitable Attic Assembly</td>
</tr>
<tr>
<td>2 x 3</td>
<td></td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2 x 4</td>
<td>10 ft</td>
<td>24”</td>
<td>16”</td>
</tr>
<tr>
<td>3 x 4</td>
<td>10 ft</td>
<td>24”</td>
<td>24”</td>
</tr>
<tr>
<td>2 x 5</td>
<td>10 ft</td>
<td>24”</td>
<td>24”</td>
</tr>
<tr>
<td>2 x 6</td>
<td>10 ft</td>
<td>24”</td>
<td>24”</td>
</tr>
</tbody>
</table>

Stud height in bearing walls is generally limited to 10’
Example 6-4
Header Size in Exterior Walls

- Given:
  - Ground snow load = 30 psf
  - Clear span roof truss
  - Center bearing floor framing
  - Building width = 28’
  - Header span = 7’
  - #2 Douglas fir-larch
# Example 6-4
## Header Size in Exterior Walls

### Table R602.7.1

<table>
<thead>
<tr>
<th>Supporting</th>
<th>Size</th>
<th>Span</th>
<th>Jack studs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roof &amp; Ceiling</strong></td>
<td>2-2x10</td>
<td>7-3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2-2x12</td>
<td>8-5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Roof, ceiling, one center-bearing floor</strong></td>
<td>2-2x10</td>
<td>6-2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2-2x12</td>
<td>7-1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Roof, ceiling, two center-bearing floors</strong></td>
<td>3-2x10</td>
<td>6-4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3-2x12</td>
<td>7-4</td>
<td>2</td>
</tr>
</tbody>
</table>

*Ground snow load = 30 psf*

*Building width = 28 feet*
Wall Bracing

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

Portal Frame with Hold-Downs

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

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

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

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

- Connection to ceiling joists
  - Rafters are connected to the ceiling joists at the top plate; or
  - 2 x 4 rafter ties are required to resist the outward thrust forces of the rafters on the wall
Example 6-6
Rafter Size and Spacing

- Given:
  - #2 Spruce-pine-fir lumber
  - Span = 15’
  - Ground snow load = 30 psf
  - Dead load = 10 psf
  - Ceiling not attached to rafters
# Example 6-6

## Rafter Size and Spacing

Table 802.5.1(3) - Rafter Spans

<table>
<thead>
<tr>
<th>Rafter Spacing (inches)</th>
<th>Species and Grade</th>
<th>Dead Load = 10 psf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 x 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft - in</td>
</tr>
<tr>
<td>16</td>
<td>Douglas fir-larch #2</td>
<td>12-1</td>
</tr>
<tr>
<td></td>
<td>Southern Pine #2</td>
<td>11-2</td>
</tr>
<tr>
<td></td>
<td>Spruce-pine-fir #2</td>
<td>11-11</td>
</tr>
<tr>
<td>24</td>
<td>Douglas fir-larch #2</td>
<td>9-9</td>
</tr>
<tr>
<td></td>
<td>Southern Pine #2</td>
<td>10-2</td>
</tr>
<tr>
<td></td>
<td>Spruce-pine-fir #2</td>
<td>9-9</td>
</tr>
</tbody>
</table>
Example 6-6

2x8 @ 16 in. o.c.
or
2x10 @ 24 in. o.c.
Rafter Tie Alternatives

- Rafter ties
  - Minimum 1 x 4 collar ties at 4 feet OC to resist uplift installed in upper 1/3 of attic space
  - Ceiling joists perpendicular to rafters
  - Rafter spans are reduced if rafter ties are located higher in the attic space

- Ridge beam
  - Approved connectors
  - Beam required
  - Finish ceiling materials applied directly to rafters or furred out for insulation or aesthetic purposes
  - No ceiling joist or rafter ties to resist outward rafter thrust on walls
### Table R602.3(1)
**Fastener Schedule for Roof Framing**

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

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

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

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

<table>
<thead>
<tr>
<th>Rafter or Truss Spacing</th>
<th>Roof Span (feet)</th>
<th>Roof Pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>24” OC</td>
<td></td>
<td>&lt; 5:12</td>
</tr>
<tr>
<td>28</td>
<td>198</td>
<td>176</td>
</tr>
<tr>
<td>32</td>
<td>218</td>
<td>194</td>
</tr>
<tr>
<td>36</td>
<td>240</td>
<td>212</td>
</tr>
</tbody>
</table>
Attic Ventilation and Access

- Total net free ventilating area must be 1/150 of attic area
  - Reduced to 1/300 when 40% to 50% of ventilating area in upper portion of space
  - Unvented attics may be permitted with certain conditions

- Access to attics required when:
  - Attic area > 30 ft², and
  - Attic height > 30”

- Access
  - Minimum 22” x 30”
  - 30” headroom above the opening
  - Located in a hallway or other readily accessible location
Part IV

Finishes and Weather Protection
Interior Finishes

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

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

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

- SDC A, B or C
  - < 3 stories
  - < 30 feet above noncombustible foundations
  - Additional 8 feet for gable end walls
  - < 5 inches thick
  - Weight < 50 psf weight
- SDC D₀, D₁, or D₂
  - Reduced height, weight and thickness limitations
Example 7-1
Size of a Steel Lintel

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

Table R703.8.3.1
Allowable Spans for Lintels Supporting Masonry Veneer

- Stories above = 1
  - Span = 6’0”
  - Steel angle = 4” x 3” x 1/4”

Long side of steel angle must be in the vertical position
Roof Covering

- Weather protection system:
  - Underlayment
  - Ice barriers
  - Flashing
  - Roofing material
Underlayment for Asphalt Shingles

- **1 layer underlayment**
- **2” horizontal lap**
- **19” horizontal lap**
- **2 layers underlayment**

- **No. 15 asphalt felt**
- **Offset vertical laps by 6’**

Slope >4:12

Slope >2:12 and <4:12
Ice Barriers

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

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

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