Ohio Board of Building Standards
Building on the Code Education Series

Residential Code of Ohio Chapter 4
March 1, 2013

Presentation Handout
Welcome

- I am...
- You are...

Overview

- Site Requirements
- Soil Determination
- Foundation Materials
- Footings
- Reinforcing
- Concrete Quality
- Foundation and Retaining Walls
- Wall Coverings
- Foundation Drainage
- Waterproofing and Damproofing
- Crawlspace
- Backfill and Grading
Objectives

- Upon completion, you will be better able to:
  - Locate general topics in Chapter 4 of the 2013 RCO.
  - Locate applicable tables in Chapter 4 of the 2013 RCO.
  - Apply code requirements to clear-cut cases.
  - Explain the intent behind a given code requirement.
  - Use judgment to identify and resolve borderline scenarios.

Introduction

- This chapter regulates foundations designed and constructed under the RCO.

- A foundation system consists of:
  - The foundation structure.
  - The supporting soil.
Site preparation

- Two basic site considerations:
  - soil characteristics related to the support and stability of foundations.
  - grading to provide surface drainage away from foundations.

Lot line identification

- Determine lot line location:
  - Required setbacks (Zoning)
  - Correspond to approved plans
  - Necessary to verify surface drainage
  - Exterior wall fire-resistance requirements based on location

Lot drainage – 401.3

- Surface drainage to
  - storm sewer, or
  - other approved point of collection that does not create a hazard.
- Lots must be graded to drain surface water away from foundation walls.
Lot drainage – 401.3 (continued)

- Final grade:
  - Minimum fall 6 inches within 10 feet away from foundation.
  - Exception for local site conditions—use swale (no prescribed slope).
  - Concrete surfaces within 10 feet of the foundation need 2 percent slope (1/4:12).

Soil Determination

Soil types – Table 405.1
Fill – 401.2

- Fill soils supporting footings and foundations must be designed, installed and tested in accordance with accepted engineering practice.

Bearing capacity

- Foundations transmit loads to supporting soil.
- Soil-bearing capacity is a measurement of the strength of the soil to support those loads.

Soil tests – 401.4

- Building official may require soil tests where data shows that the soil’s characteristics are likely:
  - Expansive;
  - Compressive;
  - Shifting; or
  - Questionable.
Soil tests not required – 401.4.1

- Based on experience and known local soil conditions, a presumptive load-bearing value without soil testing or a geotechnical report may be used.
- Table 401.4.1: Presumptive Load-bearing Values
- Suitable soil verified through inspection

Presumptive load-bearing values – Table 401.4.1

<table>
<thead>
<tr>
<th>CLASS OF MATERIAL</th>
<th>LOAD-BEARING PRESSURE (pounds per square foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline bedrock</td>
<td>12,000</td>
</tr>
<tr>
<td>Sedimentary and tilled rock</td>
<td>4,000</td>
</tr>
<tr>
<td>Sandy gravel and/or gravel (GW and GP)</td>
<td>3,000</td>
</tr>
<tr>
<td>Sand, silty sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)</td>
<td>2,000</td>
</tr>
<tr>
<td>Clay, sandy clay, clayey silt, silty clayey silt (CL, ML, MH and CH)</td>
<td>1,500</td>
</tr>
</tbody>
</table>

a. When soil tests are required by Section 401.4, the allowable bearing capacities of the soil shall be part of the recommendations.

b. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation.

Controlled low-strength material (CLSM) – 401.4.2

- Alternative to engineered fill
- CLSM is a self-compact, cementitious material
  - composed of water, portland cement, aggregate, and fly ash
  - fluid material with the consistency of a milk shake
Compressible or shifting soil – 401.5

- Option to remove compressible or shifting soils as an alternative to a complete geotechnical evaluation
- Removed to a depth and width sufficient to ensure stable moisture content

Foundations on expansive soils – 403.1.8

- Foundation and floor slabs for buildings located on expansive soils shall be designed in accordance with Section 1808.6 of the Ohio Building Code.
  - Exception subject to approval of building official
**Wood foundations – 402.1**

- Stainless steel fasteners required for below-grade plywood
- Wood treatment per AWPA U1
  - Use Category 4B Ground Contact, Heavy Duty
  - Field treatment required for cuts and bored holes

**Concrete – 402.2**

<table>
<thead>
<tr>
<th>Type or location of concrete construction</th>
<th>Minimum Specified Compressive Strength (f_c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathering Potential</td>
<td>Negligible</td>
</tr>
<tr>
<td>Basement walls, foundations and other concrete not exposed to the weather</td>
<td>2,500</td>
</tr>
<tr>
<td>Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Strength at 28 days in psi
See footnotes for weathering potential and air-entrained concrete

**Precast concrete – 402.3**

- Designed per Section 404.5
- Installed per code and manufacturer’s instructions
- Minimum materials specifications
  - 5,000 psi concrete
  - Steel reinforcing with 3/4-inch cover
General footing requirements – 403.1

- Exterior walls supported on continuous footings or other approved systems
- Footings bear on undisturbed natural soil, compacted engineered fill or Controlled Low-Strength Materials (CLSM)
- Concrete footings:
  - Section 403, or
  - ACI 332

Minimum footing size – 403.1.1

- Width of continuous footings based on:
  - number of stories supported
  - method of construction
  - the load-bearing value of the soil

<table>
<thead>
<tr>
<th>Footing Type</th>
<th>Width (in)</th>
<th>Depth (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-story</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2-story</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>3-story</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

Note: The table above provides minimum footing sizes for different types of construction. For more detailed specifications, please refer to Section 403 or ACI 332.
Minimum footing size – 403.1.1 (continued)

- Minimum thickness (T) is 6 inches.
- Footing projections (P)
  - at least 2 inches and
  - not greater than thickness of footing

Example – Determine minimum footing size

- Two story dwelling
- Brick veneer over wood frame
- Soil type CL, inorganic sandy clay

Solution – Determine minimum footing size

Table 401.4.1 Presumptive Load-bearing Values of Foundation Materials

<table>
<thead>
<tr>
<th>Class of material</th>
<th>Load bearing pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Table 403.1 Minimum Width of Concrete, Precast or Masonry Footings (inches)

<table>
<thead>
<tr>
<th>Footing</th>
<th>Load-bearing value of soil (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-inch brick veneer over light frame</td>
<td>1,500</td>
</tr>
<tr>
<td>2-story</td>
<td>21</td>
</tr>
</tbody>
</table>
Solution – Determine minimum footing size

- Min. thickness $T$ is 6 in.
- Min. projection $P$ is 2 in.
- $P$ cannot exceed $T$

Minimum footing size

Pier and column footing size – 403.1.1

- Soil type and the total tributary load determine pier and column footing size
- Total load / PSF soil-bearing pressure = minimum square feet of footing

Example – Determine size of isolated column footing – 403.1.1

- Given:
  - Tributary floor load to column is 6,000 lbs.
  - Presumed soil bearing is 1,500 psf.
  - $6,000 / 1,500 = 4$ square feet
  - Minimum 2 feet x 2 feet pad footing is required.
Monolithic slab footings – 403.1.1

- The footing is integral with the concrete slab-on-ground.
- Sizing of the footing portion is the same as for spread footings.

Monolithic slab footings – 403.1.1 and Figure 403.1(1)

Minimum footing depth – 403.1.4

- Exterior footings:
  - At least 12 inches below the undisturbed ground level
  - Protected against frost
Frost protection – 403.1.4.1

- Footings placed below frost depth, or
- Frost-protected shallow foundations utilizing rigid polystyrene insulation (Section 403.3) or
- Erected on solid rock

Frost protection not required – 403.1.4.1

- Frost protection not required for:
  - light-frame accessory buildings ≤ 600 square feet with an eave height ≤ 10 feet
  - other accessory buildings ≤ 400 square feet with an eave height ≤ 10 feet; and
  - decks not supported by a dwelling.

Footing slope – 403.1.5

- Top surface of footings shall be level.
- The bottom surface shall not exceed a slope of 1:10 (10 percent).
- Stepped footings required where it is necessary to change elevation.
Footings on or adjacent to slopes – 403.1.7

Footings for wood foundations – 403.2

- Washed and well graded gravel ≤ ¾ inch
- Coarse sand ≥ 1/16-inch grains
- Crushed stone ≤ ½ inch

Frost protected shallow foundations – 403.3

- For heated buildings (≥ 64°F)
Frost-protected shallow foundations – Figure 403.3(1)

**Fig. 403.3(1)\(^{(1)}\)**

Frost-protected shallow foundations – Table 403.3(1)

**Table 403.3(1)**

<table>
<thead>
<tr>
<th>AIR-FREEZING INDEX</th>
<th>1500 or less</th>
<th>2000</th>
<th>2500</th>
<th>3000</th>
<th>3500</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ohio</strong></td>
<td>All counties not listed</td>
<td>Ashland, Crawford, Defiance, Holmes, Huron, Knox, Licking, Morrow, Paulding, Putnam, Richland, Seneca, Williams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frost protected shallow foundations – Table 403.3(2)

**Table 403.3(2)**

<table>
<thead>
<tr>
<th>AIR-FREEZING INDEX</th>
<th>1500 or less</th>
<th>2000</th>
<th>2500</th>
<th>3000</th>
<th>3500</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ohio</strong></td>
<td>All counties not listed</td>
<td>Ashland, Crawford, Defiance, Holmes, Huron, Knox, Licking, Morrow, Paulding, Putnam, Richland, Seneca, Williams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Note: The table and diagram are not fully visible in the image.*
Foundations adjoining frost protected shallow foundations – 403.3.1

- 403.3.1.1 Attachment to unheated slab-on-ground structure
- 403.3.1.2 Attachment to heated structure

Protection of horizontal insulation below ground – 403.3.2

- Protection required for horizontal insulation:
  - < 12 inches below ground surface
  - > 24 inches out from edge of foundation
- Protection methods:
  - concrete slab or asphalt paving
  - cementitious board
  - plywood rated for below-ground use
  - other approved materials

Footings for precast concrete foundations – 403.4

- Clean crushed stone footings:
  - Angular crushed stone meeting ASTM C 33
- Size 1/16 – ½ inch
  - Figure 403.4(1) and Table 403.4
  - Vibratory plate compaction in 8-inch lifts
Footings for precast concrete foundations – Table 403.4

Crushed stone footings for precast concrete foundations – Figure 403.4(1)

Concrete footings for precast concrete foundations – Figure 403.4(2)
Exterior deck footings – 403.5

- Cast-in-place concrete footings:
  - Minimum 8-inch thick
  - Extend below frost depth
  - Sized per Table 403.5

Exterior deck footings – Table 403.5

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Square</th>
<th>Minimum Traction Area Allowed Per Foot (square ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8 x 8</td>
<td>14</td>
</tr>
<tr>
<td>10</td>
<td>9 x 9</td>
<td>32</td>
</tr>
<tr>
<td>12</td>
<td>10 x 10</td>
<td>51.6</td>
</tr>
<tr>
<td>14</td>
<td>13 x 13</td>
<td>42.5</td>
</tr>
<tr>
<td>16</td>
<td>15 x 15</td>
<td>56</td>
</tr>
<tr>
<td>18</td>
<td>16 x 16</td>
<td>70.8</td>
</tr>
<tr>
<td>20</td>
<td>18 x 18</td>
<td>87.2</td>
</tr>
</tbody>
</table>

- Based upon 2000 lbs. per square foot bearing capacity.
- Based upon 40 lbs. per square foot live load and a 10 lbs. per square foot dead load.
Types of reinforcing in concrete

- Structural steel reinforcement
  - Reinforcing bars (rebar)
- Reinforcing primarily to control cracking
  - Welded wire mesh
  - Fibers added to mix

Reinforcement requirements

- Concrete footings – no requirements except in high seismic areas
- Concrete slabs on ground – no requirements
- Monolithic slab with integral footing – no requirements except in high seismic areas
- Foundation walls – Tables 404.1.1(1) through 404.1.2(9)

Sizes of steel reinforcing bars

<table>
<thead>
<tr>
<th>Size designation</th>
<th>Nominal diameter in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 3</td>
<td>3/8</td>
</tr>
<tr>
<td>No. 4</td>
<td>1/2</td>
</tr>
<tr>
<td>No. 5</td>
<td>5/8</td>
</tr>
<tr>
<td>No. 6</td>
<td>3/4</td>
</tr>
<tr>
<td>No. 7</td>
<td>7/8</td>
</tr>
<tr>
<td>No. 8</td>
<td>1</td>
</tr>
<tr>
<td>No. 9</td>
<td>1 1/8</td>
</tr>
</tbody>
</table>
Grade for steel reinforcing bars – Tables 404.1.1(1) through 404.1.2(9)

- Vertical bars in masonry and concrete foundation walls – minimum Grade 60 (60,000 psi minimum yield strength)
- Alternate for Grade 40 (40,000 psi minimum yield strength) for vertical bars in concrete [Table 404.1.2(9) and Section 404.1.2.3.7.6]
- Horizontal bars in concrete – Grade 40

Identifying marks on reinforcing steel

- Deformation pattern and markings vary by manufacturer. Samples:

Location of reinforcement in wall – 404.1.2.3.7.2

- Vertical reinforcement in concrete basement walls located as follows:
  - Tables 404.1.2(2) through 404.1.2(7): at the centerline of the wall
  - Table 404.1.2(8): located to provide a maximum cover of 1.25 inches measured from the inside face of the wall
Support and cover – 404.1.2.3.7.4

- Reinforcement shall be secured.
- Minimum cover:
  - 3 inches for concrete cast against earth
  - 1 ½ inches for ≤ No. 5 bars in removable forms and exposed to earth or weather
  - 2 inches for ≥ No. 6 bars in removable forms and exposed to earth or weather
  - ¾ inches in removable forms that will not be exposed to the earth or weather, and for concrete cast in stay-in-place forms

Lap splices – 404.1.2.3.7.5 [ref. to Table 611.5.4(1)]

<table>
<thead>
<tr>
<th>Table 611.5.4(1) (Excerpt)</th>
<th>Yield strength of steel $f_y$ (psi (Mpa))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40,000 (280)</td>
</tr>
<tr>
<td>Splice length or tension development length (inches)</td>
<td>Bar Size No.</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Lap splices – 404.1.2.3.7.5 (continued)

![Diagram of lap splices](image)
Concrete Quality

Concrete materials

- 2,500 psi minimum compressive strength
- Mixing and delivery to comply with
  - ASTM C 94 Standard Specification for Ready-Mixed Concrete, or
  - ASTM C 685 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

Concrete materials (continued)

- Maximum aggregate size
  - 1/5 the narrowest distance between sides of forms, or
  - 3/4 clear spacing between reinforcing bars or between a bar and the side of the form
Proportioning and slump of concrete – 404.1.2.3.4

- Proportions of materials for concrete shall
  - Provide workability and consistency
  - Permit concrete to be worked readily into forms and around reinforcement without segregation

Proportioning and slump of concrete – 404.1.2.3.4 (continued)

- Slump:
  - ≤ 6 inches for removable forms
    - Exception: > 6 inches permitted if resistant to segregation
  - > 6 inches for stay-in-place forms
Concrete and masonry foundation walls – 404.1

- Choice between prescriptive code provisions or referenced design standards (which also contain some prescriptive provisions):
  - Concrete:
    - ACI 318, ACI 332 or PCA 100
  - Masonry:
    - TMS 402/ACI 530/ASCE 5 or NCMA TR68-A

Concrete and masonry foundation walls lateral loads

- Lateral load increases with the height of unbalanced backfill

Concrete and Masonry Foundation Walls – 404.1 (continued)

- Requirements are based on:
  - Masonry:
    - Tables 404.1.1(1) through 404.1.1(4)
  - Concrete:
    - Tables 404.1.2(1) through 404.1.2(9)
Concrete and Masonry Foundation Walls – 404.1 (continued)

- These are prescriptive tables for sizing and reinforcing foundation walls based on soil type and depth of unbalanced fill.
- The depth of unbalanced fill is the difference in height between the exterior finish ground level and the top of the interior basement floor or exposed interior grade in a crawl space.

Concrete foundation walls – 404.1.2

- Engineer-sealed drawings are not required when design follows the code or referenced standards.

Reinforcement for concrete foundation walls – 404.1.2.2

- Horizontal reinforcement in accordance with Table 404.1.2(1)
- Vertical reinforcement in accordance with Tables 404.1.2(2) through 404.1.2(8)
- Vertical reinforcement for flat basement walls permitted to use Table 404.1.2(9)
### Minimum horizontal reinforcement for concrete basement walls – Table 404.1.2(1)

<table>
<thead>
<tr>
<th>Maximum unsupported height of basement wall (feet)</th>
<th>Location of horizontal reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 8</td>
<td>One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near mid-height of the wall story</td>
</tr>
<tr>
<td>&gt; 8</td>
<td>One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near third points in the wall story</td>
</tr>
</tbody>
</table>

**Example - Horizontal reinforcement for 9-foot concrete basement wall**
- 3 rows of No. 4 bars
- One bar within 12 inches of top
- One bar at third points
- Bars in center of wall

### Minimum vertical reinforcement for 6 – 12 inch nominal flat basement walls – Table 404.1.2(8)
Example – Determine minimum vertical reinforcement for 8-inch nominal flat basement wall using Table 404.1.2(8)

- 8-inch thick wall
- 9-feet wall height
- 8-feet unbalanced backfill height
- Soil class CL inorganic sandy clay

Solution – minimum vertical reinforcement for 8-inch nominal flat basement wall using Table 404.1.2(8)

<table>
<thead>
<tr>
<th>Max. wall height (feet)</th>
<th>Max. Unbalanced backfill height (feet)</th>
<th>Min. vert. rebar size and spacing (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>9</td>
<td>6 @ 28 5 @ 37 NR</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>6 @ 29 6 @ 39 4 @ 48</td>
</tr>
<tr>
<td>9</td>
<td>6 @ 23 6 @ 30 6 @ 39</td>
<td></td>
</tr>
</tbody>
</table>

Solution – Minimum cover for vertical reinforcement using Table 404.1.2(8)

Table footnote
- h. Cover of 1 ¼ inches measured from inside face of wall
- Tolerance of 10 percent wall thickness
Design Required – 404.1.3

- Design in accordance with accepted engineering practice is required when:
  - Walls are subject to hydrostatic pressure from groundwater, or
  - Walls support more than 4 feet of unbalanced fill and do not have permanent lateral support at the top or bottom.

Height above Finished Grade – 404.1.6

- Concrete and masonry foundation walls need to extend above the finished grade adjacent to the foundation at all points:
  - A minimum of 4 inches where masonry veneer is used
  - A minimum of 6 inches elsewhere

Foundation anchorage – 403.1.6

- Wood sill plates anchored to foundation with anchor bolts
  - Spacing ≤ 6 feet. o.c.
  - ½-inch bolts extend ≥ 7 inches into concrete
  - Nut and washer tightened on each bolt
  - ≥ 2 bolts per plate section
  - bolt ≤ 12 inches and ≥ 7 bolt diameters from each end of the plate section
Foundation anchorage – 403.1.6 (continued)

- Exceptions
  - Equivalent anchorage methods permitted
  - Walls ≤ 24 inches long at BWP offset require 1 bolt in center third of plate
  - Walls ≤ 12 inches long at BWP offset do not require anchor bolts

Retaining walls – 404.4

- Design is required for retaining walls that
  - Are not laterally supported at the top and
  - Retain > 24 inches of unbalanced fill
Precast concrete foundation walls – 404.5

- Designed in accordance with accepted engineering practice
- Design drawings prepared by a registered design professional where required by statute

Precast concrete foundation design drawings – 404.5.2

- Submitted to the building official and approved prior to installation
- Drawings shall include:
  - Design loading as applicable
  - Footing design and material
  - Concentrated loads and their points of application
  - Soil-bearing capacity
  - Maximum allowable total uniform load
  - Seismic design category
  - Basic wind speed

Wall Coverings
Stay-in-place forms – 404.1.2.3.6.1

- Stay-in-place forms constructed of rigid foam plastic
  - Interior protected with ½-inch gypsum board or approved thermal barrier
  - Exterior protected from sunlight and physical damage
  - Exterior protected from termites in locations subject to “very heavy” termite damage

Protection of exposed foundation insulation – 409.1

- Exterior applied insulation requires a rigid, opaque and weather-resistant protective covering.
  - Prevents degradation of thermal performance
  - Must cover exposed insulation and extend ≥ 6 inches below grade

Foundation Drainage - 405
Concrete or masonry foundation drainage – 405.1

- Foundation drains are required for foundations that retain earth and enclose
  - Habitable space, or
  - Usable space below grade.
- Drains shall discharge to
  - Approved drainage system, or
  - Other approved location
- Other approved location that complies with the Ohio Plumbing Code

Concrete or masonry foundations – 405.1 (continued)

- Gravel or crushed stone drains
- Drainage tile
  - strips of building paper above open joints
- Perforated pipe
  - 2-inch washed gravel base
  - 6-inch washed gravel cover
- Other approved system

Concrete or masonry foundations – 405.1 (continued)

[Diagram showing concrete or masonry foundation with gravel, usable basement, concrete slab, and concrete footing]
Precast concrete foundation drainage – 405.1.1

- Precast concrete walls that retain earth and enclose habitable or useable space below grade and have crushed stone footings require a perforated drainage pipe
  - Interior or exterior side of wall
  - ≥ 1 foot beyond the edge of the wall
  - Filter membrane required for pipe on exterior side

Foundation Waterproofing and Dampproofing – 404

Concrete and masonry foundation dampproofing – 406.1

- Foundation walls that retain earth and enclose interior spaces and floors below grade require dampproofing from the top of the footing to the finished grade.
Concrete and masonry foundation waterproofing – 406.2

- Waterproofing is required in areas where a high water table or other severe soil-water conditions are known to exist.

Precast concrete foundation system dampproofing – 406.4

- Precast concrete foundation walls enclosing habitable or useable spaces below grade require dampproofing or waterproofing (same as concrete and masonry foundation walls).
- Panel joints must be sealed full height with a sealant meeting ASTM C 920:
  - Type S or M, Grade NS, Class 25, Use NT,M or A

Crawlspace – 408

- [Optional content related to crawlspace construction and waterproofing]
**Under-floor ventilation – 408.1, 408.2**

- Minimum net area of ventilation openings:
  - ≥ 1 square feet / 150 square feet of under-floor area
- With Class I vapor retarder and cross ventilation:
  - ≥ 1 square feet / 1500 square feet of under-floor area
- Ventilation opening within 3 feet of each corner

**Unvented crawl space – 408.3**

- Two conditions must be met:
  - Class I vapor retarder over exposed earth
  - Joints overlap 6 inches; sealed or taped
  - Extend ≥ 6 inches up stem wall; attached and sealed

**Unvented crawl space – (continued) 408.3**

- Two conditions must be met:
  - Provide one of the following for the under-floor space:
    - Continuous mechanical exhaust ventilation – 1 cfm / 50 square feet or
    - Conditioned air supply – 1 cfm / 50 square feet or
    - Under-floor space used as plenum in existing structures
Crawl space access – 408.4

- Minimum 18 by 24 inch access opening through floor or
- Minimum 16 by 24 inch access opening through perimeter wall
  - Minimum 16 by 24 inch areaway required for below-grade access
- Section 1305.1.4 for access to mechanical equipment

Removal of debris – 408.5

- Remove all:
  - vegetation and organic material
  - wood forms
  - construction materials

Finished grade – 408.6

- If groundwater or surface drainage issues exist, then:
  - Finished grade must be as high as outside finished grade, or
  - An approved drainage system must be installed.
Flood resistance – 408.7

- In areas prone to flooding,
  - Flood openings are required per Section 322.2.2, and
  - Finish grade of crawl space must be as high as outside finish grade.

Backfill and Grading

- Backfill placement – 404.1.7
  - Backfill shall not be placed until:
    - Wall has sufficient strength and has been anchored to the floor above, or
    - Wall has been sufficiently braced to prevent damage by the backfill