

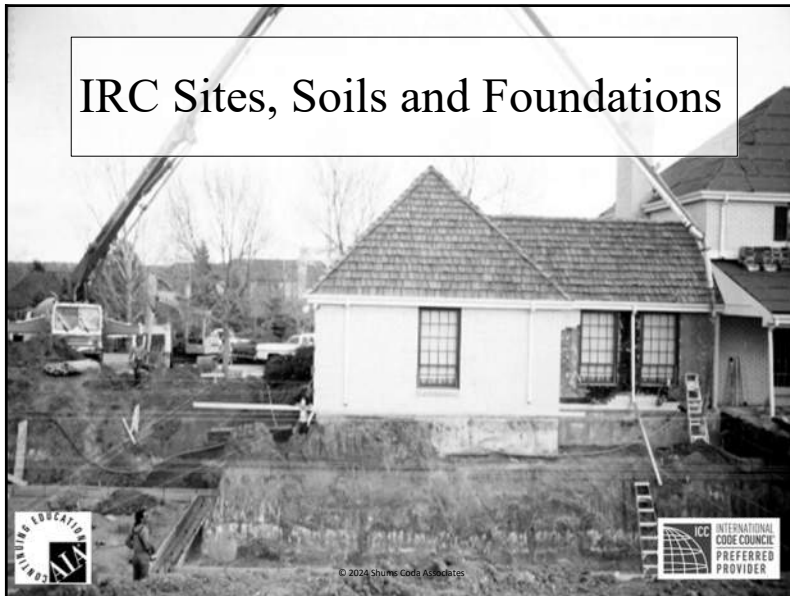
IRC Sites, Soils and Foundations



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IRC Sites, Soils and Foundations



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Instructor

Gil Rossmiller



- In the construction industry for over 40 years
- ICC – IRC Plumbing & Mechanical Code Development Committee 2009/2012
- ICC- IECC Commercial Energy Code Development Committee 2015/2018
- ICC- IECC Residential Energy Code Development Committee 2021/2024
- ICC – Code Correlation Committee
- 2003-2016 Building Official
Parker, Colorado

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Class Summary

- Building Location
- Reading & Understanding soils reports
- Foundation Design/Inspections
- Based on 2021 International Residential Code
- Effective use of the code



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Exterior Walls R302.1

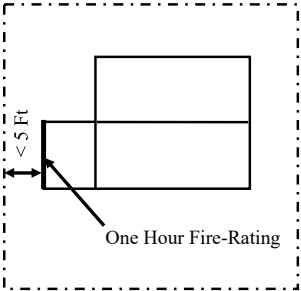
- Construction, projections, openings and penetrations of exterior walls of dwellings and accessory buildings shall comply with Table R302.1(1);
- or dwellings equipped throughout with an automatic sprinkler system installed in accordance with Section P2904 shall comply with Table R302.1(2).

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E119, UL 263 or Section 703.3 of the <i>International Building Code</i> with exposure from both sides	0 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood ^a	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	NA	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

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Exterior Walls - R302.1(1)

- Exterior walls less than 5 feet from property line
- One Hour Fire Resistance



EXTERIOR WALL ELEMENT	FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	0 feet
	Not fire-resistance rated	≥ 5 feet

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R302.1(1) – Projections

- <2'
- Not Permitted
- 2' - less than 5'
- 1 hour on underside
- 5'+
- No rating required



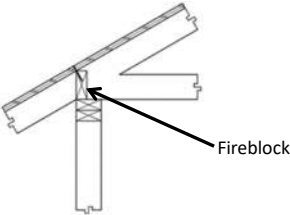
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood ^{1,2}	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet

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Table R302.1(1) Footnotes

a. The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave overhang if fireblocking is provided from the wall top plate to the underside of the roof sheathing.



b. The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the rake overhang where gable vent openings are not installed.



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R302.1(1) - Openings

- <3'
- Not Permitted
- 3-5'
- 25% of wall area maximum
- 5' and greater
- Unlimited



Openings in walls	Not allowed	NA	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet

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R302.1(1) - Penetrations

- Any that are <3' to be protected per R302.4.



Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet



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Exterior Walls R302.1(2) Sprinklered Buildings

TABLE R302.1(2)
EXTERIOR WALLS—DWELLINGS WITH FIRE SPRINKLERS

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E119, UL 263 or Section 703.3 of the <i>International Building Code</i> with exposure from the outside	0 feet
	Not fire-resistance rated	0 hours	3 feet*
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, or heavy timber, or fire-retardant-treated wood ^a	2 feet*
Openings in walls	Not fire-resistance rated	0 hours	3 feet
	Not allowed	NA	< 3 feet
Penetrations	Unlimited	0 hours	3 feet*
	All	Comply with Section R302.4	< 3 feet
		None required	3 feet*



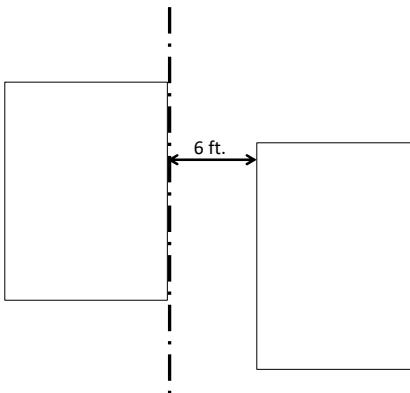
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Exterior Walls R302.1(2) Sprinklered Buildings

- Footnote a.
- For residential subdivisions where all dwellings are equipped throughout with an automatic sprinkler system installed in accordance with Section P2904, the fire separation distance for nonrated exterior walls and rated projections shall be permitted to be reduced to 0 feet, and unlimited unprotected openings and penetrations shall be permitted, where the adjoining lot provides an open setback yard that is 6 feet or more in width on the opposite side of the property line.



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R302.1 Exterior Walls Exceptions

- Walls, projections, openings or penetrations in walls perpendicular to the line used to determine the fire separation distance.
- Walls of dwellings and accessory structures located on the same lot.
- Detached tool sheds and storage sheds, playhouses and similar structures exempted from permits are not required to provide wall protection based on location on the lot. Projections beyond the exterior wall shall not extend over the lot line.



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R302.1 Exterior Walls Exceptions

4. Detached garages accessory to a dwelling located within 2 feet of a lot line are permitted to have roof eave projections not exceeding 4 inches.
5. Foundation vents installed in compliance with this code are permitted.



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FOUNDATIONS CHAPTER 4



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Application R401.1



- The provisions of this chapter shall control the design and construction of the foundation and foundation spaces for buildings.
- In addition to the provisions of this chapter, the design and construction of foundations in flood hazard areas as established by Table R301.2(1) shall meet the provisions of Section R322.
- Wood foundations shall be designed and installed in accordance with AWC PWF.

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Application R401.1 Exceptions

- The provisions of this chapter shall be permitted to be used for wood foundations only in the following situations:
 - In buildings that have no more than two floors and a roof.
 - Where interior basement and foundation walls are constructed at intervals not exceeding 50 feet.
- Wood foundations in Seismic Design Category D0, D1 or D2 shall be designed in accordance with accepted engineering practice.



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Requirements R401.2

- Foundation construction shall be capable of accommodating all loads according to Section R301 and of transmitting the resulting loads to the supporting soil.



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Requirements R401.2

- Fill soils that support footings and foundations shall be designed, installed and tested in accordance with accepted engineering practice.



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Drainage R401.3

- Drain away from foundation
- Grade shall fall 6" within first 10'
 - Exception:
 - Where lot lines, walls, slopes or other physical barriers prohibit 6 inches of fall within 10 feet, drains or swales shall be constructed to ensure drainage away from the structure.
 - Impervious surfaces within 10 feet of the building foundation shall be sloped a minimum of 2%.



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Soils Tests R401.4

- Building Official shall determine need
 - Where quantifiable data created by accepted soil science methodologies indicate expansive soils, compressible soils, shifting soils or other questionable soil characteristics are likely to be present, the building official shall determine whether to require a soil test to determine the soil's characteristics at a particular location.
 - This test shall be done by an *approved* agency using an *approved* method.
 - What is an *approved* method?



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Geotechnical Investigations IBC Section 1803.1



- Must be conducted in conformance with Sections 1803.2 and reported in accordance with Section 1803.6.
- Where required by the building official or where geotechnical investigations involve in-situ testing, laboratory testing or engineering calculations, such investigations shall be conducted by a registered design professional .



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Investigations Required 1803.2

- Geotechnical investigations shall be conducted in accordance with Sections 1803.3 through 1803.5.
 - Building official may waive requirements where satisfactory data from adjacent areas demonstrate an investigation is not necessary for any of the conditions in Sections 1803.5.1 through 1803.5.6 and Sections 1803.5.10 and 1803.5.11.



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Basis of Investigation 1803.3



- Soil classification shall be based on observation and any necessary tests of the materials disclosed by borings, test pits or other subsurface exploration made in appropriate locations.
- Additional studies shall be made as necessary to evaluate slope stability, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on soil-bearing capacity, compressibility, liquefaction and expansiveness.



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Scope of investigation 1803.3.1

- The scope of the geotechnical investigation including the number and types of borings or soundings, the equipment used to drill or sample, the in-situ testing equipment and the laboratory testing program shall be determined by a registered design professional.



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Qualified Representative 1803.4



- The investigation procedure and apparatus shall be in accordance with generally accepted engineering practice.
- The registered design professional shall have a fully qualified representative on site during all boring or sampling operations.



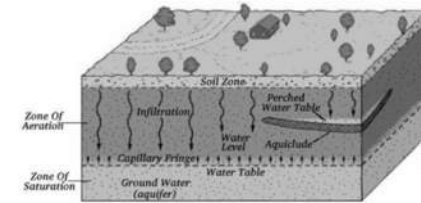
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Investigated Conditions 1803.5

- Classification
 - ASTM D 2487
- Questionable soil
- Expansive soil
- Ground-Water table
- Deep foundations
- Rock strata



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Investigated Conditions 1803.5

- Excavation near foundations
- Compacted fill material
- Controlled low-strength material (CLSM)
- Alternate setback and clearance



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Investigated Conditions 1803.5

- Seismic Design C-F
 - Slope instability
 - Liquefaction
 - Differential settlement
 - Surface displacement due to faulting or lateral spreading



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Investigated Conditions 1803.5

- Seismic Design D-F
 - Lateral pressures
 - Potential for liquefaction and soil strength loss
 - Assessment of potential consequences of liquefaction and soil strength loss
 - Discussion of mitigation measures



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Reporting 1803.6

- A plot showing the location of test borings and/or excavations.



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Reporting 1803.6

A complete record of the soil boring and penetration test logs and soil samples.



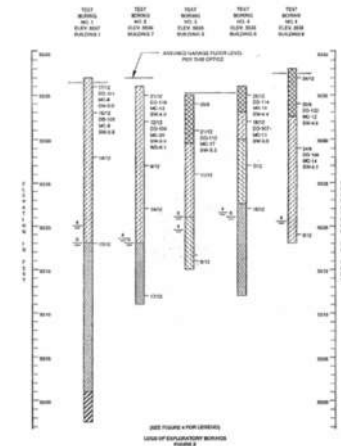
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Reporting 1803.6

A record of the soil profile.



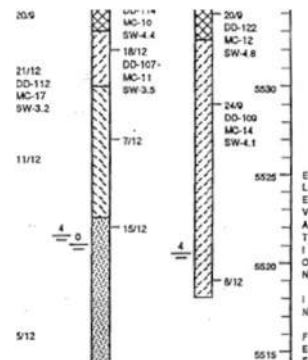
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Reporting 1803.6

Elevation of the water table, if encountered.



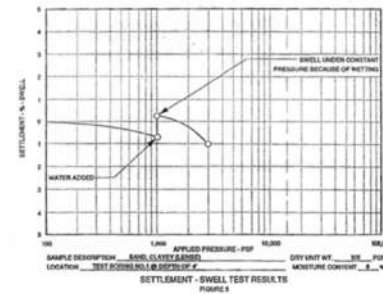
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Reporting 1803.6

- Expected total and differential settlement.



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Reporting 1803.6

- Recommendations for foundation type and design criteria, including but not limited to:
 - bearing capacity of natural or compacted soil;
 - provisions to mitigate the effects of expansive soils;
 - mitigation of the effects of liquefaction, differential settlement and varying soil strength;
 - and the effects of adjacent loads.

(Soil and Foundation Study)
Central Plaza II
Northeast of South Buckhorn Road and South Pagosa Way
Durango, Colorado
July 28, 1994
Issued May 1, 1999

PURPOSE
This report presents the results of a soil and foundation study and recommendations to be followed at Central Plaza II, a proposed 10-story office building, located at the intersection of South Buckhorn Road and South Pagosa Way, Durango, Colorado. The study was made to assist in determining design criteria for planning, site development, foundation systems, and on-grade and below-grade construction. Field data generated during the field and laboratory work is summarized on Figures 1 through 10 attached. Our opinions and recommendations presented in this report are based on the data generated during this field investigation, laboratory testing, and our experience with similar type projects.

PROPOSED CONSTRUCTION
We understand the proposed construction will consist of a 10-story, 4,400 sq. ft. structure with three roof gables and two stories above. Construction materials, we assume, will consist of steel frame with partial moment-resisting walls. We do not anticipate foundation loading to be unusual for this type and height of construction. The locations of our test borings are shown on Figure 1 and our suggested floor levels are shown on Figures 2, 3, and 4. If the actual floor levels vary by more than two feet from those shown, we should be notified and the recommendations of this report amended.



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Reporting 1803.6

- Deep foundation information in accordance with Section 1803.5.5.



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Reporting 1803.6

- Special design and construction provisions for footings or foundations founded on expansive soils, as necessary.



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Reporting 1803.6

- Compacted fill material properties and testing in accordance with Section 1803.5.8.



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Reporting 1803.6

- Controlled low-strength material properties (CLSM) and testing in accordance with Section 1803.5.9.



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Unified Soil Classification System

TABLE R405.1
PROPERTIES OF SOILS CLASSIFIED ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL GROUP	UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOL	SOIL DESCRIPTION	DRAINAGE CHARACTERISTICS*	FROST HEAVE POTENTIAL	VOLUME CHANGE POTENTIAL EXPANSION [†]
Group I	GW	Well-graded gravels, gravel sand mixtures, little or no fines	Good	Low	Low
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low
	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low
	GM	Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low
Group II	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low
	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Medium	High	Low
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium to Low
Group III	CH	Inorganic clays of high plasticity, fat clays	Poor	Medium	High
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High
Group IV	OL	Organic silts and organic silty clays of low plasticity	Poor	Medium	Medium
	OH	Organic clays of medium to high plasticity, organic silts	Unsatisfactory	Medium	High
	Pt	Peat and other highly organic soils	Unsatisfactory	Medium	High



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R401.4.1 Geotechnical evaluation

- In lieu of a complete geotechnical evaluation, the load-bearing values in Table R401.4.1 shall be assumed.

**TABLE R401.4.1
PRESUMPTIVE LOAD-BEARING VALUES OF
FOUNDATION MATERIALS^a**

CLASS OF MATERIAL	LOAD-BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	17,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy, silty clay, clayey silt, silt and sandy silty clay (CL, ML, MH and CH)	1,500 ^b

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R401.4.2 Compressible or shifting soil

- Instead of a complete geotechnical evaluation, where top or subsoils are compressible or shifting, they shall be removed to a depth and width sufficient to ensure stable moisture content in each active zone and shall not be used as fill or stabilized within each active zone by chemical, dewatering or presaturation.

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Wood Foundations R402.1

- stainless steel fasteners required below grade
- Stainless steel, silicone bronze, copper, hot-dipped galvanized fasteners required
- pressure treated lumber and plywood
 - field treatment
- AF&PA Report No. 7

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Concrete R402.2

- Concrete
 - Based on Weathering Probability Map – Figure 301.2(1)
 - Minimum compressive strength per table R402.2



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Concrete R402.2

TABLE R402.2
MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH ^a (f' _c)		
	Weathering Potential ^b		
	Negligible	Moderate	Severe
Basement walls, foundations and other concrete not exposed to the weather	2,500	2,500	2,500 ^c
Basement slabs and interior slabs on grade, except garage floor slabs	2,500	2,500	2,500 ^c
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	2,500	3,000 ^d	3,000 ^d
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	2,500	3,000 ^{d, e, f}	3,500 ^{d, e, f}

- Strength at 28 days psi.
- See Table R301.2(1) for weathering potential.
- Concrete in these locations that may be subject to freezing and thawing during construction shall be air-entrained concrete in accordance with Footnote d.
- Concrete shall be air-entrained. Total air content (percent by volume of concrete) shall be not less than 5 percent or more than 7 percent.
- See Section R402.2 for maximum cementitious materials content.
- For garage floors with a steel troweled finish, reduction of the total air content (percent by volume of concrete) to not less than 3 percent is permitted if the specified compressive strength of the concrete is increased to not less than 4,000 psi.



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Concrete R402.2

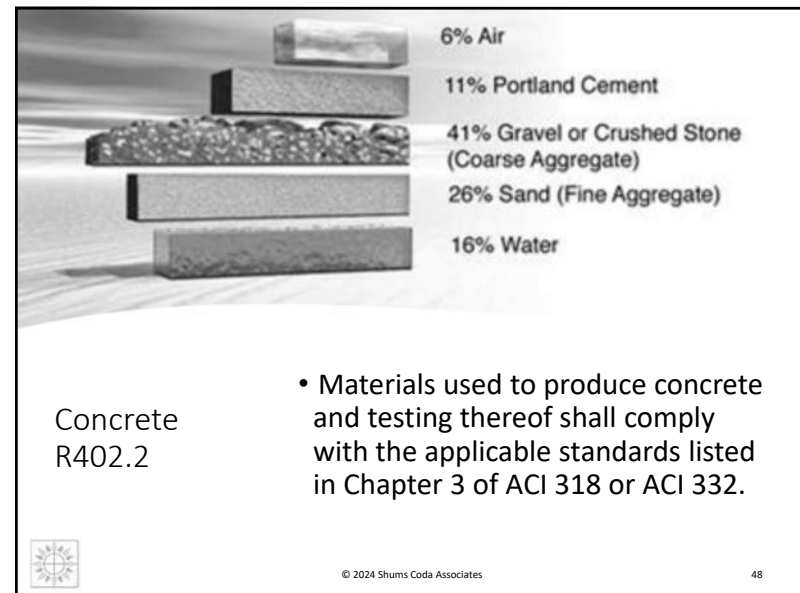
- The maximum weight of fly ash, other pozzolans, silica fume, slag or blended cements that is included in concrete mixtures for garage floor slabs and for exterior porches, carport slabs and steps that will be exposed to deicing chemicals shall not exceed the percentages of the total weight of cementitious materials specified in Section 19.3.3.4 of ACI 318.



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Concrete R402.2

- Materials used to produce concrete and testing thereof shall comply with the applicable standards listed in Chapter 3 of ACI 318 or ACI 332.



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R402.2.1 Materials for concrete

- Materials for concrete shall comply with the requirements of Section R608.5.1.



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Concrete, materials for concrete, and forms – R608.5.1

- Materials used in concrete, the concrete itself and forms shall conform to requirements of this section, PCA 100 or ACI 318.



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Concrete mixing and delivery R608.5.1..2

- Mixing and delivery of concrete shall comply with ASTM C 94 or ASTM C 685.



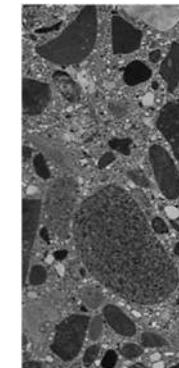
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Maximum aggregate size 608.5.1.3

- The nominal maximum size of coarse aggregate shall not exceed one-fifth the narrowest distance between sides of forms, or three-fourths the clear spacing between reinforcing bars or between a bar and the side of the form.
- Exception: When approved, these limitations shall not apply where removable forms are used and workability and methods of consolidation permit concrete to be placed without honeycombs or voids.



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Proportioning and slump of concrete R608.5.1.4



- Proportions of materials for concrete shall be established to provide workability and consistency to permit concrete to be worked readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.
- Slump of concrete placed in removable forms shall not exceed 6 inches



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Proportioning and slump of concrete R608.5.1.4

- Exception: When approved, the slump is permitted to exceed 6 inches for concrete mixtures that are resistant to segregation, and are in accordance with the form manufacturer's recommendations.



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Proportioning and slump of concrete R608.5.1.4



- Slump of concrete placed in stay-in-place forms shall exceed 6 inches.
- Slump of concrete shall be determined in accordance with ASTM C 143.



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Compressive strength R608.5.1.5

- The minimum specified compressive strength of concrete, f'_c , shall comply with Section R402.2 and shall be not less than 2,500 psi at 28 days.



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Consolidation of concrete R608.5.1.6

- Concrete shall be consolidated by suitable means during placement and shall be worked around embedded items and reinforcement and into corners of forms. Where stay-in-place forms are used, concrete shall be consolidated by internal vibration.



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Consolidation of concrete R608.5.1.6



- Exception: When approved for concrete to be placed in stay-in-place forms, self-consolidating concrete mixtures with slumps equal to or greater than 8 inches that are specifically designed for placement without internal vibration need not be internally vibrated.



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Admixtures

- Air-Entraining**
 - purposely places microscopic air bubbles into the concrete & improve resistance to freezing when exposed to water and deicing chemicals
- Water Reducing**
 - reduce the required water content for a concrete mixture by about 5 to 10 percent
- Retarding**
 - slow the setting rate of concrete
- Accelerating**
 - increase the rate of early strength development, reduce the time required for proper curing and protection, and speed up the start of finishing operations
- Plasticizers (Superplasticizers)**
 - reduce water content by 12 to 30% and can be added to concrete with a low-to-normal slump and water-cement ratio to make high-slump flowing concrete



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Precast Concrete R402.3

- Precast concrete foundations shall be designed in accordance with Section R404.5 and shall be installed in accordance with the provisions of this code and the manufacturer's installation instructions.



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Precast concrete foundation materials

R402.3.1

1. All concrete used in the manufacture of precast concrete foundations shall have a minimum compressive strength of 5,000 psi at 28 days. Concrete exposed to a freezing and thawing environment shall be air entrained with a minimum total air content of 5 percent.
2. Structural reinforcing steel shall meet the requirements of ASTM A 615, A 706 or A 996. The minimum yield strength of reinforcing steel shall be 40,000 psi (Grade 40). Steel reinforcement for precast concrete foundation walls shall have a minimum concrete cover of 3/4 inch.
3. Panel-to-panel connections shall be made with Grade II steel fasteners.
4. The use of nonstructural fibers shall conform to ASTM C 1116.
5. Grout used for bedding precast foundations placed upon concrete footings shall meet ASTM C 1107.

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R402.4 Masonry

- Masonry systems shall be designed and installed in accordance with this chapter and shall have a minimum specified compressive strength of 1,500 psi.



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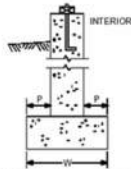
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Footings

R403

- All exterior walls shall be supported on continuous solid or fully grouted masonry or concrete footings, crushed stone footings, wood foundations, or other approved structural systems
- Sufficient design to accommodate all loads and to transmit the resulting loads to the soil
- Footings shall be supported on undisturbed natural soils or engineered fill.



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R403.1.1 Minimum size

- The minimum width, W, and thickness, T, for concrete footings shall be in accordance with Tables R403.1(1) through R403.1(3) and Figure R403.1(1) or R403.1.3, as applicable.
- The footing width shall be based on the load-bearing value of the soil in accordance with Table R401.4.1.



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R403.1(1) Minimum size

YFGQJW9586-6.

R NSR ZR % NI YM % SI % MNHPS JXX % KT W % HTS HWJYJ % KT YNS LX % KT W %
QNL MYZK WFR J % HTS XYWZHYNS % rshmjx. %

GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH LIGHT FRAME	LOAD-BEARING VALUE OF SOIL (psf)					
		1,500	2,000	2,500	3,000	3,500	4,000
20 psf roof live load or 25 psf ground snow load	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—plus basement	22 × 7	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
30 psf	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	16 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	3 story—plus basement	22 × 7	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6



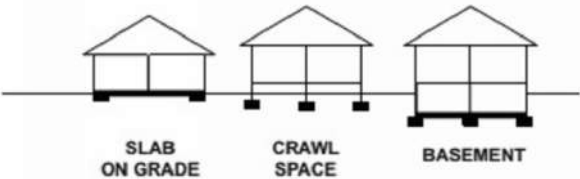
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R403.1.1 Minimum size

- a. Interpolation allowed. Extrapolation is not allowed.
- b. The table is based on the following conditions and loads: Building width: 32 feet; Wall height: 9 feet; Basement wall height: 8 feet; Dead loads: 15 psf roof and ceiling assembly, 10 psf floor assembly, 12 psf wall assembly; Live loads: Roof and ground snow loads as listed, 40 psf first floor, 30 psf second and third floors. Footing sizes are calculated assuming a clear span roof/ceiling assembly and an interior bearing wall or beam at each floor.
- c. Where the building width perpendicular to the wall footing is greater than 32 feet, the footing width shall be increased by 2 inches and footing depth shall be increased by 1 inch for every 4 feet of increase in building width.
- d. Where the building width perpendicular to the wall footing is less than 32 feet, a 2-inch decrease in footing width and 1-inch decrease in footing depth is permitted for every 4 feet of decrease in building width provided that the minimum width is 12 inches and minimum depth is 6 inches



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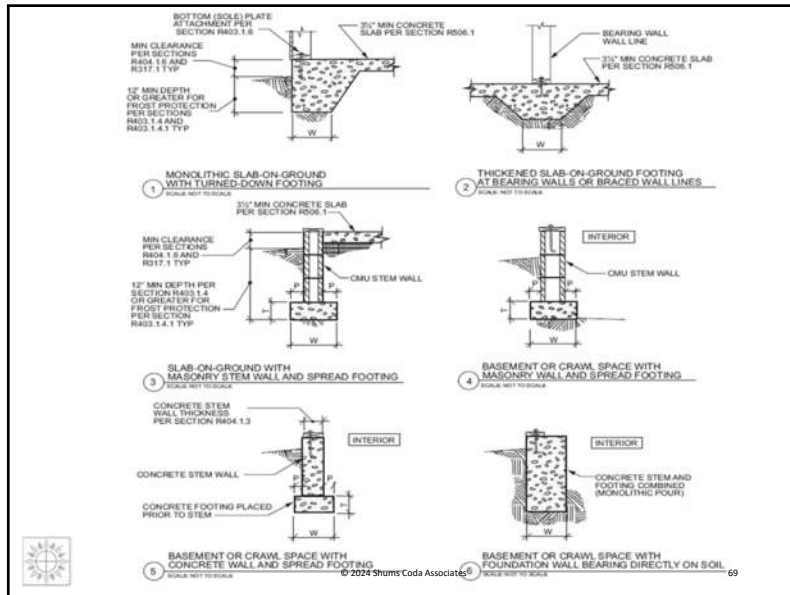
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TABLE R403.1(2) MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION WITH BRICK VENEER OR LATH AND PLASTER (inches) ^{a,b,c,d}							
GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH BRICK VENEER	LOAD-BEARING VALUE OF SOIL (psf)					
		1,500	2,000	2,500	3,000	3,500	4,000
20 psf roof live load or 25 psf ground snow load	1 story—slab-on-grade	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	18 × 6	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	23 × 8	17 × 6	14 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	23 × 8	17 × 6	14 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	25 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—plus basement	29 × 11	21 × 7	17 × 6	14 × 6	12 × 6	12 × 6
	3 story—with crawl space	26 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
30 psf	1 story—slab-on-grade	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	20 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	24 × 8	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	23 × 8	18 × 6	14 × 6	12 × 6	12 × 6	12 × 6
	3 story—with crawl space	26 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—plus basement	29 × 11	22 × 7	17 × 6	14 × 6	12 × 6	12 × 6
	3 story—with crawl space	26 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6

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TABLE R403.1(3) MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS WITH CAST-IN-PLACE CONCRETE OR PARTIALLY GROUTED MASONRY WALL CONSTRUCTION (inches) ^{a,b,c,d}							
GROUND SNOW LOAD OR ROOF LIVE LOAD	STORY AND TYPE OF STRUCTURE WITH CMU OR CONCRETE	LOAD-BEARING VALUE OF SOIL (psf)					
		1,500	2,000	2,500	3,000	3,500	4,000
20 psf roof live load or 25 psf ground snow load	1 story—slab-on-grade	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	19 × 6	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	22 × 7	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	25 × 9	19 × 6	15 × 6	12 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	25 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—with crawl space	28 × 10	21 × 7	17 × 6	14 × 6	12 × 6	12 × 6
	3 story—plus basement	31 × 12	23 × 8	18 × 6	15 × 6	13 × 6	12 × 6
	3 story—with crawl space	28 × 10	21 × 7	17 × 6	14 × 6	12 × 6	12 × 6
30 psf	1 story—slab-on-grade	13 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—with crawl space	16 × 6	12 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	1 story—plus basement	19 × 7	14 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—slab-on-grade	19 × 6	15 × 6	12 × 6	12 × 6	12 × 6	12 × 6
	2 story—with crawl space	22 × 7	16 × 6	13 × 6	12 × 6	12 × 6	12 × 6
	2 story—plus basement	25 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—slab-on-grade	26 × 9	19 × 6	15 × 6	13 × 6	12 × 6	12 × 6
	3 story—with crawl space	28 × 10	21 × 7	17 × 6	14 × 6	12 × 6	12 × 6
	3 story—plus basement	31 × 12	23 × 8	18 × 6	15 × 6	13 × 6	12 × 6
	3 story—with crawl space	28 × 10	21 × 7	17 × 6	14 × 6	12 × 6	12 × 6

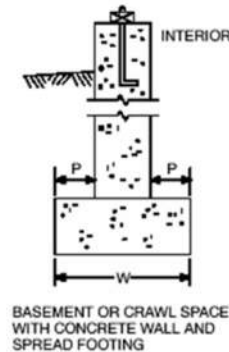
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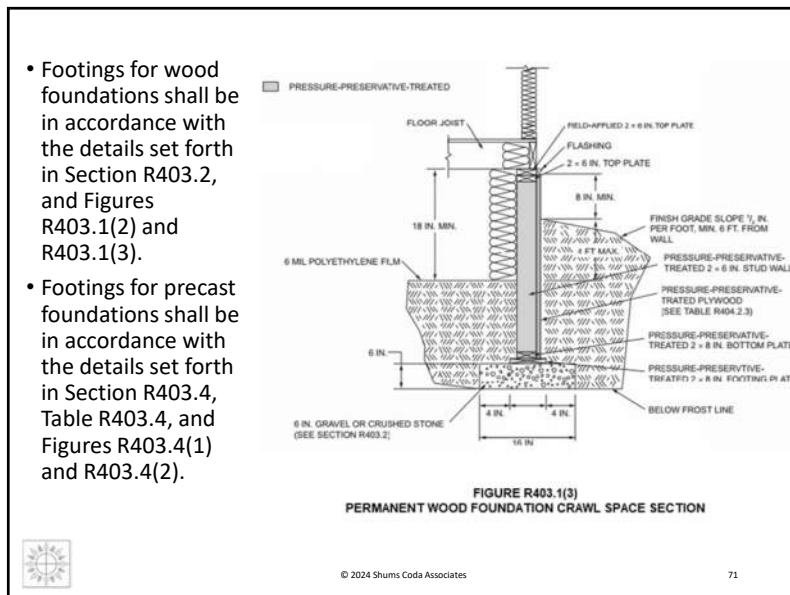
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R403.1.1 Minimum size

- Footing projections, P, shall be not less than 2 inches and shall not exceed the thickness of the footing.
- Footing thickness and projection for fireplaces shall be in accordance with Section R1001.2.
- The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table R401.4.1.



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- Footings for wood foundations shall be in accordance with the details set forth in Section R403.2, and Figures R403.1(2) and R403.1(3).
- Footings for precast foundations shall be in accordance with the details set forth in Section R403.4, Table R403.4, and Figures R403.4(1) and R403.4(2).

Continuous footing in Seismic Design Categories D0, D1 and D2 - R403.1.2



- Exterior walls shall be supported by continuous solid or fully grouted masonry or concrete footings.
- Other footing materials or systems shall be designed in accordance with accepted engineering practice.
- All required interior braced wall panels with plan dimensions greater than 50 feet shall be supported by continuous solid or fully grouted masonry or concrete footings in accordance with Section R403.1.3.4, except for two-story buildings in Seismic Design Category D2, in which all braced wall panels, interior and exterior, shall be supported on continuous foundations.

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Continuous footing in Seismic Design Categories D0, D1 and D2 - R403.1.2

- Exception: Two-story buildings shall be permitted to have interior braced wall panels supported on continuous foundations at intervals not exceeding 50 feet provided that:

1. The height of cripple walls does not exceed 4 feet.
2. First-floor braced wall panels are supported on doubled floor joists, continuous blocking or floor beams.
3. The distance between bracing lines does not exceed twice the building width measured parallel to the braced wall line.



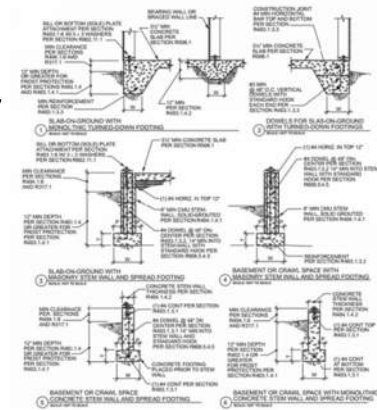
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Seismic Reinforcing R403.1.3

- Concrete footings located in Seismic Design Categories D0, D1 and D2, as established in Table R301.2(1), shall have minimum reinforcement in accordance with this section and Figure R403.1.3.
- Reinforcement shall be installed with support and cover in accordance with Section R403.1.3.5.

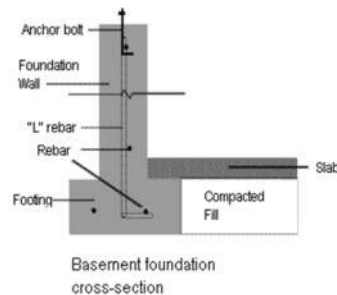


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R403.1.3.1 Concrete stem walls with concrete footings



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- In Seismic Design Categories D0, D1 and D2 where a construction joint is created between a concrete footing and a concrete stem wall, a minimum of one No. 4 vertical bar shall be installed at not more than 4 feet on center.
- The vertical bar shall have a standard hook and extend to the bottom of the footing and shall have support and cover as specified in Section R403.1.3.5.3 and extend a minimum of 14 inches into the stem wall.
- Standard hooks shall comply with Section R608.5.4.5.
- A minimum of one No. 4 horizontal bar shall be installed within 12 inches of the top of the stem wall and one No. 4 horizontal bar shall be located 3 to 4 inches from the bottom of the footing.

R403.1.3.2 Masonry stem walls with concrete footings

- In Seismic Design Categories D0, D1 and D2 where a masonry stem wall is supported on a concrete footing, a minimum of one No. 4 vertical bar shall be installed at not more than 4 feet on center.
- The vertical bar shall have a standard hook and extend to the bottom of the footing and shall have support and cover as specified in Section R403.1.3.5.3 and extend a minimum of 14 inches into the stem wall.
- Standard hooks shall comply with Section R608.5.4.5. A minimum of one No. 4 horizontal bar shall be installed within 12 inches of the top of the wall and one No. 4 horizontal bar shall be located 3 to 4 inches from the bottom of the footing.
- Masonry stem walls shall be solid grouted.



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R403.1.3.3 Slabs-on-ground with turned-down footings

- In Seismic Design Categories D0, D1 and D2, slabs on ground cast monolithically with turned-down footings shall have a minimum of one No. 4 bar at the top and the bottom of the footing or one No. 5 bar or two No. 4 bars in the middle third of the footing depth.
- Where the slab is not cast monolithically with the footing, No. 3 or larger vertical dowels with standard hooks on each end shall be installed at not more than 4 feet on center in accordance with Figure R403.1.3, Detail 2. Standard hooks shall comply with Section R608.5.4.5.

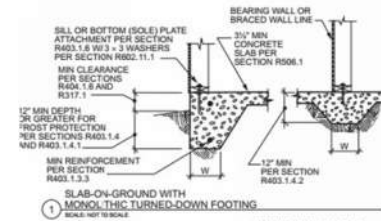


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R403.1.3.4 Interior bearing and braced wall panel footings in Seismic Design Categories D0, D1 and D2



- In Seismic Design Categories D0, D1 and D2, interior footings supporting bearing walls or braced wall panels, and cast monolithically with a slab on grade, shall extend to a depth of not less than 12 inches below the top of the slab.



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R403.1.3.5 Reinforcement

- Footing and stem wall reinforcement shall comply with Sections R403.1.3.5.1 through R403.1.3.5.4.
 - ASTM A 615, A706, or A996
 - 40,000 psi (Grade 40)
 - Center of vertical reinforcement in stem walls shall be located at the centerline of the wall.

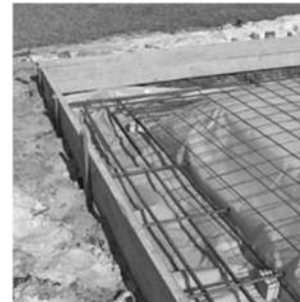


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R403.1.3.5.3 Support and cover



- Reinforcement shall be secured in the proper location in the forms with tie wire or other bar support system to prevent displacement during the concrete placement operation.
- Concrete cast against the earth
 - minimum cover of 3 inches.
- Concrete cast in removable forms that will be exposed to the earth or weather
 - 1½ inches for No. 5 bars and smaller
 - 2 inches for No. 6 bars and larger.
- Concrete cast in removable forms that will not be exposed to the earth or weather, and for concrete cast in stay-in-place forms
 - minimum cover shall be 3/4 inch.



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R403.1.3.5.4 Lap splices

- Vertical and horizontal reinforcement shall be the longest lengths practical.
- Where splices are necessary in reinforcement, the length of lap splice shall be in accordance with Table R608.5.4(1) and Figure R608.5.4(1).
- The maximum gap between noncontact parallel bars at a lap splice shall not exceed the smaller of one-fifth the required lap length and 6 inches [see Figure R608.5.4(1)].

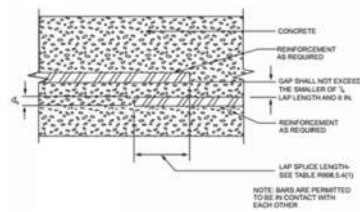


TABLE R608.5.4(1)
LAP SPlice AND TENSION DEVELOPMENT LENGTHS

	BAR SIZE NO.	YIELD STRENGTH OF STEEL, f_y (ksi) (MPa)	
		40,000 (276)	50,000 (345)
		Splice length or tension development length (inches)	
Lap splice length tension	4	20	30
	5	25	38
	6	30	45
Tension development length for straight bar	4	15	23
	5	19	28
	6	23	34
Tension development length for: a. 90-degree and 180-degree standard hooks with not less than $2\frac{1}{2}$ inches of side cover perpendicular to plane of hook, and b. 90-degree standard hooks with not less than 2 inches of cover on the bar extension beyond the hook.	4	6	9
	5	7	11
	6	8	13
	4	9	12
	5	10	15
	6	12	16

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R403.1.3.6 Isolated concrete footings

- In detached one- and two-family dwellings that are three stories or less in height and constructed with stud bearing walls, isolated plain concrete footings supporting columns or pedestals are permitted.



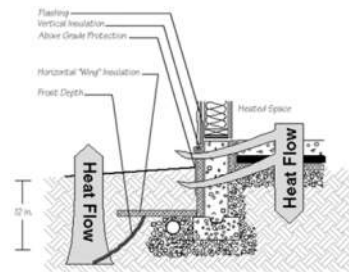
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Footing Minimum Depth R403.1.4

- Must extend below frost line or minimum of 12 inches below the undisturbed ground.
 - Frost Protection
 - Seismic Conditions



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Frost Protection R403.1.4

- Except where otherwise protected from frost, foundation walls, piers and other permanent supports of buildings and structures shall be protected from frost by one or more of the following methods:
 - Extend below the frost line
 - Frost Protected Shallow Foundations
 - Constructing per ASCE32-01
 - Erected on solid rock



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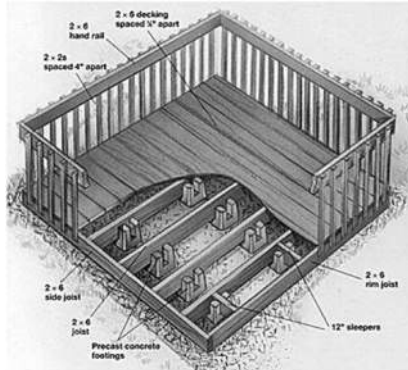
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Frost Protection R403.1.4.1

• Exceptions:

- 600 sq.ft. light framed construction freestanding accessory structure, 10 feet eave height
- 400 sq.ft. other than light framed, free standing accessory structure, 10 feet eave height
- Decks not supported by a dwelling



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Frost Protection R403.1.4.1



- Footings shall not bear on frozen soil unless frozen condition is permanent character



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Footing Slope R403.1.5



- The top surface of footings shall be level.
- The bottom surface of footings shall not have a slope exceeding one unit vertical in 10 units horizontal (10% slope).



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Stepped Footings R403.1.5



- Footings shall be stepped where it is necessary to change the elevation of the top surface of the footings or where the slope of the bottom surface of the footings will exceed one unit vertical in ten units horizontal (10% slope).



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R403.1.6 Foundation anchorage

- Wood sill plates and wood walls supported directly on continuous foundations shall be anchored to the foundation in accordance with this section.



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R403.1.6 Foundation anchorage

- Cold-formed steel framing shall be anchored directly to the foundation or fastened to wood sill plates in accordance with Section R505.3.1 or R603.3.1, as applicable.
- Wood sill plates supporting cold-formed steel framing shall be anchored to the foundation in accordance with this section.



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Foundation Anchorage R403.1.6

- Wood sole plates at all exterior walls on monolithic slabs, wood sole plates of braced wall panels at building interiors on monolithic slabs and all wood sill plates shall be anchored to the foundation with anchor bolts spaced a maximum of 6 feet on center.
- Bolts shall be at least 1/2 inch in diameter and shall extend a minimum of 7 inches into concrete or grouted cells of concrete masonry units.
- A nut and washer shall be tightened on each anchor bolt.



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Foundation Anchorage R403.1.6

- There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches or less than seven bolt diameters from each end of the plate section.

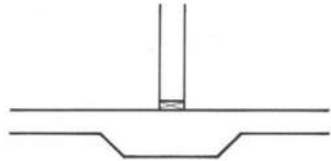


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Foundation Anchorage R403.1.6



- Interior bearing wall sole plates on monolithic slab foundation that are not part of a braced wall panel shall be positively anchored with *approved* fasteners.



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Foundation Anchorage R403.1.6

- Sill plates and sole plates shall be protected against decay and termites where required by Sections R317 and R318.



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Foundation Anchorage R403.1.6

Exceptions

- Walls 24 inches total length or shorter connecting offset braced wall panels shall be anchored to the foundation with a minimum of one anchor bolt located in the center third of the plate section.
- Walls 12 inches total length or shorter connecting offset braced wall panels shall be permitted to be connected to the foundation without anchor bolts.



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Foundation anchorage in Seismic Design Categories C, D0, D1 and D2 - R403.1.6.1



- In addition to the requirements of Section R403.1.6, the following requirements shall apply to wood light-frame structures in Seismic Design Categories D0, D1 and D2 and wood light-frame townhouses in Seismic Design Category C.



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Foundation anchorage in Seismic Design Categories C, D0, D1 and D2 - R403.1.6.1

1. Plate washers conforming to Section R602.11.1 shall be provided for all anchor bolts over the full length of required braced wall lines except where approved anchor straps are used. Properly sized cut washers shall be permitted for anchor bolts in wall lines not containing braced wall panels.
2. Interior braced wall plates shall have anchor bolts spaced at not more than 6 feet on center and located within 12 inches of the ends of each plate section when supported on a continuous foundation.
3. Interior bearing wall sole plates shall have anchor bolts spaced at not more than 6 feet on center and located within 12 inches of the ends of each plate section when supported on a continuous foundation.



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Foundation anchorage in Seismic Design Categories C, D0, D1 and D2 - R403.1.6.1

4. The maximum anchor bolt spacing shall be 4 feet for buildings over two stories in height.
5. Stepped cripple walls shall conform to Section R602.11.3.
6. Where continuous wood foundations in accordance with Section R404.2 are used, the force transfer shall have a capacity equal to or greater than the connections required by Section R602.11.1 or the braced wall panel shall be connected to the wood foundations in accordance with the braced wall panel-to-floor fastening requirements of Table R602.3(1).



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Footings Adjacent To Slopes R403.1.7

- The placement of buildings and structures on or adjacent to slopes steeper than one unit vertical in three units horizontal (33.3-percent slope) shall conform to Sections R403.1.7.1 through R403.1.7.4.



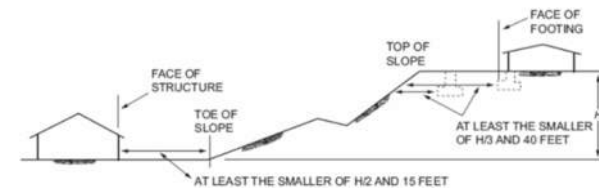
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Footings Adjacent To Slopes R403.1.7

- Buildings below slopes shall be set a sufficient distance from the slope to provide protection from slope drainage, erosion and shallow failures.
- Except as provided in Section R403.1.7.4 and Figure R403.1.7.1, the following criteria will be assumed to provide this protection.

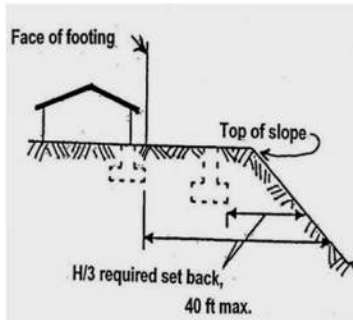


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Footings Adjacent To Slopes R403.1.7



- Buildings at top of slope to be protected from movement due to detrimental settlement
- Figure R403.1.7.1 indicates complying setback from top of slope to face of footing
- Additional criteria for slopes exceeding 1:1



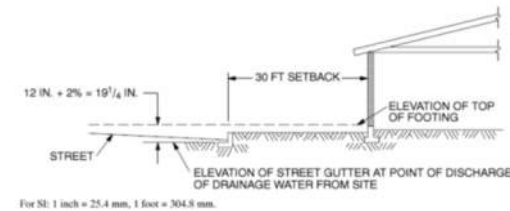
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Foundation Elevation R403.1.7.3

- On graded sites, the top of any exterior foundation shall extend above the elevation of the street gutter at point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Figure R403.1.7.4
DETERMINATION OF FOUNDATION ELEVATION ON GRADED SITES



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Foundation Elevation R403.1.7.3



- Alternate elevations are permitted subject to the approval of the building official, provided it can be demonstrated that required drainage to the point of discharge and away from the structure is provided at all locations on the site.



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Alternate Setback And Clearances R403.1.7.4

- The building official is permitted to require an investigation and recommendation of a qualified engineer to demonstrate that the intent of this section has been satisfied.
- Such an investigation shall include consideration of material, height of slope, slope gradient, load intensity and erosion characteristics of slope material.



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Foundations on Expansive Soils R403.1.8

- Foundation and floor slabs for buildings located on expansive soils shall be designed in accordance with Section 1805.8 of the International Building Code.
- Exception
 - Slab on grade foundations subject to building official approval.



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R403.1.8.1 Expansive soils classifications

- Soils meeting all of the following provisions shall be considered to be expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:



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Expansive Soils Classification R403.1.8.1

1. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D 4318.



Atterberg Limit Test



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Expansive Soils Classification R403.1.8.1

2. More than 10 percent of the soil particles pass a No. 200 sieve, determined in accordance with ASTM D 422.



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Expansive Soils Classification R403.1.8.1

3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.



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Expansive Soils Classification R403.1.8.1

4. Expansion Index greater than 20, determined in accordance with ASTM D 4829.



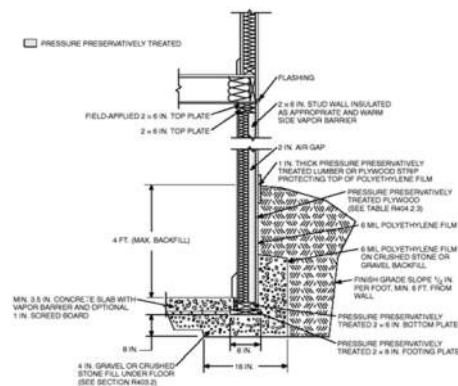
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Footings for Wood Foundations R403.2

- Figures R403.1 (2) & (3)
- Washed gravel
- Maximum 3/4" stone
- Sand
- 1/2" Crushed stone



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Frost Protected Shallow Foundations (FPSF)- 403.3

- For buildings where the monthly mean temperature of the building is maintained at a minimum of 64°F, footings are not required to extend below the frost line when protected from frost by insulation in accordance with Figure R403.3(1) and Table R403.3(1).



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Frost Protected Shallow Foundations (FPSF)- 403.3

- Cannot be used for unheated spaces such as porches, utility rooms, garages and carports, and shall not be attached to basements or crawl spaces that are not maintained at a minimum monthly mean temperature of 64° F.



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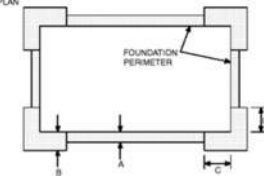
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Frost Protected Shallow Foundations (FPSF)- 403.3

TABLE R403.3(1)
MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS*

AIR FREEZING INDEX ("F-days)" ^a	MINIMUM FOOTING DEPTH, D (inches)	VERTICAL INSULATION R-VALUE ^{c, d}	HORIZONTAL INSULATION R-VALUE ^{e, f}		HORIZONTAL INSULATION DIMENSIONS PER FIGURE R403.3(1) (inches)		
			Along walls	At corners	A	B	C
1,500 or less	12	4.5	Not required	Not required	Not required	Not required	Not required
2,000	14	5.6	Not required	Not required	Not required	Not required	Not required
2,500	16	6.7	1.7	4.9	12	24	40
3,000	16	7.8	6.5	8.6	12	24	40
3,500	16	9.0	8.0	11.2	24	30	60
4,000	16	10.1	10.5	13.1	24	36	60

HORIZONTAL INSULATION PLAN



For 50: 1 inch = 25.4 mm.



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Frost Protected Shallow Foundations (FPSF)- 403.3

- Insulation requirements are for protection against frost damage in heated buildings. Greater values could be required to meet energy conservation standards.
- See Figure R403.3(2) or Table R403.3(2) for Air Freezing Index values.
- Insulation materials shall provide the stated minimum R-values under long-term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene (EPS)-3.2 R per inch for vertical insulation and 2.6 R per inch for horizontal insulation; Type IX expanded polystyrene (EPS)-3.4 R per inch for vertical insulation and 2.8 R per inch for horizontal insulation; Types IV, V, VI, VII, and X extruded polystyrene (XPS)-4.5 R per inch for vertical insulation and 4.0 R per inch for horizontal insulation.
- Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.
- Horizontal insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.



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Figure 403.3(2)



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FIGURE R403.3(2)
AIR-FREEZING INDEX AN ESTIMATE OF THE 100-YEAR RETURN PERIOD
TABLE R403.3(2)
AIR-FREEZING INDEX FOR U.S. LOCATIONS BY COUNTY

STATE	AIR-FREEZING INDEX					
	1500 or less	2000	2500	3000	3500	4000
Alabama	All counties	---	---	---	---	---
Alaska	Ketchikan Gateway, Prince of Wales-Outer Ketchikan (CA), Sitka, Wrangell, Petersburg (CA)	---	Aleutians West (CA), Haines, Juneau, Skagway-Hoonah-Angoon (CA), Yakutat	---	---	All counties not listed
Arizona	All counties	---	---	---	---	---
Arkansas	All counties	---	---	---	---	---
California	All counties not listed	Nevada, Sierra	---	---	---	---
Colorado	All counties not listed	Archuleta, Custer, Fremont, Huerfano, Las Animas, Ouray, Pitkin, San Miguel	Clear Creek, Conejos, Costilla, Dolores, Eagle, La Plata, Park, Routt, San Juan, Summit	Alamosa, Grand, Jackson, Larimer, Moffat, Rio Blanco, Rio Grande	Chaffee, Gunnison, Lake, Saguache	Hinsdale, Mineral
Nevada	All counties not listed	Eko, Esmeralda, Nye, Washoe, White Pine	---	---	---	---

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Attachment to Unheated Slab-on-Ground Structure - R403.3.1.1

- Insulation of FPSF that adjoin a slab-on-ground foundation that does not have a monthly mean temperature maintained at a minimum of 64F, shall be in accordance with Figure R403.3(3) and Table R403.3.
- Vertical insulation shall extend between the FPSF and the adjoining slab foundation.
- Horizontal insulation shall be continuous under the adjoining slab foundation and through any foundation walls adjoining the FPSF.

INSULATION DETAIL

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Attachment to heated structure R403.3.1.2

- Where a FPSF abuts a structure that has a monthly mean temperature maintained at a minimum of 64F, horizontal insulation and vertical wall insulation shall not be required between the FPSF and the adjoining structure
- Where the FPSF abuts the heated structure, the horizontal insulation and vertical wall insulation shall extend along the adjoining foundation in accordance with Figure R403.3(4) a distance not of not less than Dimension A in Table R403.3.

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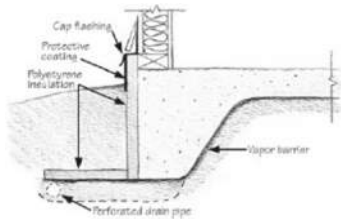
Protection of horizontal insulation below ground - R403.3.2

- Horizontal insulation placed less than 12 inches below the ground surface or that portion of horizontal insulation extending outward more than 24 inches from the foundation edge shall be protected against damage by use of a concrete slab or asphalt paving on the ground surface directly above the insulation or by cementitious board, plywood rated for below-ground use, or other approved materials placed below ground, directly above the top surface of the insulation.

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Drainage R403.3.3



- Final grade shall be sloped in accordance with Section R401.3.
- In other than Group I Soils, gravel or crushed stone beneath horizontal insulation below ground shall drain to daylight or into an approved sewer system.



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Termite Damage R403.3.4

- The use of foam plastic in areas of “very heavy” termite infestation probability shall be in accordance with Section R318.4



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Footings for precast concrete foundations - R403.4

- Footings for precast concrete foundations shall comply with Section R403.4.
 - Crushed Stone
 - Concrete



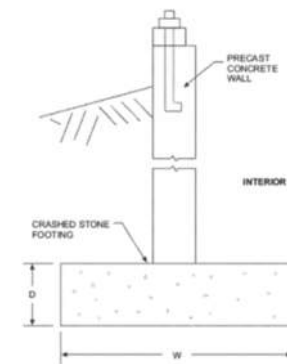
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Crushed stone footings R403.4.1

- Clean crushed stone shall be free from organic, clayey or silty soils.
- Must be angular in nature and meet ASTM C 33, with the maximum size stone not to exceed 1/2 inch and the minimum stone size not to be smaller than 1/16-inch.
- Crushed stone footings for precast foundations shall be installed in accordance with Figure R403.4(1) and Table R403.4.
- Crushed stone footings shall be consolidated using a vibratory plate in a maximum of 8-inch lifts. Crushed stone footings shall be limited to Seismic Design Categories A, B and C.



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TABLE R403.4
MINIMUM DEPTH OF CRUSHED STONE FOOTINGS (D), (inches)

		LOAD BEARING VALUE OF SOIL (psf)															
		1500				2000				3000				4000			
		MH, CH, CL, ML				SC, GC, SM, GM, SP, SW				GP, GW							
		Wall width (inches)				Wall width (inches)				Wall width (inches)				Wall width (inches)			
		6	8	10	12	6	8	10	12	6	8	10	12	6	8	10	12
Conventional light-frame construction																	
1-story	1100 psf	6	4	4	4	6	4	4	4	6	4	4	4	6	4	4	4
2-story	1800 psf	8	6	4	4	6	4	4	4	6	4	4	4	6	4	4	4
3-story	2000 psf	16	14	12	10	10	8	6	6	6	6	4	4	6	4	4	4
4-inch brick veneer over light-frame or 8-inch hollow concrete masonry																	
1-story	1500 psf	6	4	4	4	6	4	4	4	6	4	4	4	6	4	4	4
2-story	2700 psf	14	12	10	8	10	8	6	4	6	4	4	4	6	4	4	4
3-story	4000 psf	22	22	20	18	16	14	12	10	10	8	6	4	6	4	4	4
8-inch solid or fully grouted masonry																	
1-story	2000 psf	10	8	6	4	6	4	4	4	6	4	4	4	6	4	4	4
2-story	3600 psf	20	18	16	14	12	10	8	8	6	4	4	4	6	4	4	4
3-story	5300 psf	32	30	28	26	22	22	20	18	14	12	10	8	10	8	6	4



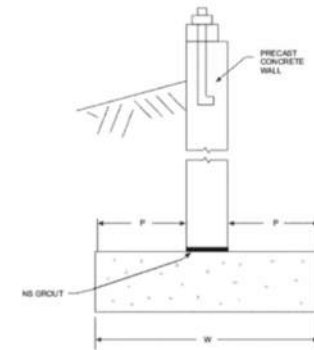
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Concrete footings R403.4.2

- Concrete footings shall be installed in accordance with Section R403.1 and Figure R403.4(2).



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Foundation & Retaining Walls R404



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R404.1.1 Design required

- Concrete or masonry foundation walls shall be designed in accordance with accepted engineering practice where either of the following conditions exists:
 1. Walls are subject to hydrostatic pressure from ground water.
 2. Walls supporting more than 48 inches of unbalanced backfill that do not have permanent lateral support at the top or bottom.



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Design of masonry foundation walls
R404.1.2



- Masonry foundation walls shall be designed and constructed in accordance with the provisions of this section or in accordance with the provisions of TMS 402/ACI 530/ASCE 5.
- When TMS 402/ACI 530/ASCE 5 or the provisions of this section are used to design masonry foundation walls, project drawings, typical details and specifications are not required to bear the seal of the architect or engineer responsible for design, unless otherwise required by the state law of the jurisdiction having authority.



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Masonry foundation walls
R404.1.2.1

- Concrete masonry and clay masonry foundation walls shall be constructed as set forth in Table R404.1.1(1), R404.1.1(2), R404.1.1(3) or R404.1.1(4) and shall also comply with applicable provisions of Sections R606.



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TABLE R404.1.1(1)
PLAIN MASONRY FOUNDATION WALLS^f

MAXIMUM WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^c (feet)	PLAIN MASONRY ^a MINIMUM NOMINAL WALL THICKNESS (inches)		
		Soil classes ^b		
		GW, GP, SW and SP	GM, GC, SM, SM-SC and ML	SC, MH, ML-CL and inorganic CL
5	4	6 solid ^d or 8	6 solid ^d or 8	6 solid ^d or 8
	5	6 solid ^d or 8	8	10
6	4	6 solid ^d or 8	6 solid ^d or 8	6 solid ^d or 8
	5	6 solid ^d or 8	8	10
	6	8	10	12
7	4	6 solid ^d or 8	8	8
	5	6 solid ^d or 8	10	10
	6	10	12	10 solid ^d
	7	12	10 solid ^d	12 solid ^d
8	4	6 solid ^d or 8	6 solid ^d or 8	8
	5	6 solid ^d or 8	10	12
	6	10	12	12 solid ^d
	7	12	12 solid ^d	Footnote e
	8	10 grout ^d	12 grout ^d	Footnote e
9	4	6 grout ^d or 8 solid ^d or 12	6 grout ^d or 8 solid ^d	8 grout ^d or 10 solid ^d
	5	6 grout ^d or 10 solid ^d	8 grout ^d or 12 solid ^d	8 grout ^d
	6	8 grout ^d or 12 solid ^d	10 grout ^d	10 grout ^d
	7	10 grout ^d	10 grout ^d	12 grout ^d
	8	10 grout ^d	12 grout ^d	Footnote e
	9	12 grout	Footnote e	Footnote e

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TABLE R404.1.1(2)
8-INCH MASONRY FOUNDATION WALLS WITH REINFORCING WHERE $d > 5$ INCHES^{a, c}

WALL HEIGHT	HEIGHT OF UNBALANCED BACKFILL ^a	MINIMUM VERTICAL REINFORCEMENT AND SPACING (INCHES) ^{b, c}		
		Soil classes and lateral soil load ^d (psf per foot below grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, ML-CL and inorganic CL soils 60
6 feet 8 inches	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
7 feet 4 inches	6 feet 8 inches	#4 at 48	#5 at 48	#5 at 48
	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
	6 feet	#5 at 48	#5 at 48	#5 at 48
8 feet	7 feet 4 inches	#5 at 48	#6 at 48	#6 at 40
	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#4 at 48
	6 feet	#4 at 48	#5 at 48	#4 at 48
8 feet 8 inches	7 feet	#5 at 48	#5 at 48	#5 at 40
	8 feet	#5 at 48	#6 at 48	#6 at 32
	4 feet (or less)	#4 at 48	#4 at 48	#4 at 48
	5 feet	#4 at 48	#4 at 48	#5 at 48
9 feet 4 inches	6 feet	#4 at 48	#4 at 48	#5 at 48
	7 feet	#5 at 48	#5 at 48	#6 at 40
	8 feet	#6 at 48	#6 at 40	#6 at 24
	9 feet 4 inches	#6 at 40	#6 at 24	#6 at 16
4 feet (or less)		#4 at 48	#4 at 48	#4 at 48
9 feet		#6 at 40	#6 at 24	#6 at 16
10 feet		#6 at 32	#6 at 16	#6 at 16

c. Vertical reinforcement shall be Grade 60 minimum. The distance, d, from the face of the soil side of the wall to the center of vertical reinforcement shall be not less than 5 inches.

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Masonry foundation walls

R404.1.2.1



- In buildings assigned to Seismic Design Categories D0, D1 and D2, concrete masonry and clay masonry foundation walls shall also comply with Section R404.1.4.1.
- Rubble stone masonry foundation walls shall be constructed in accordance with Sections R404.1.8 and R607.2.2.
- Rubble stone masonry walls shall not be used in Seismic Design Categories D0, D1 and D2.



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Concrete foundation walls

R404.1.3



- Concrete foundation walls that support light-frame walls shall be designed and constructed in accordance with the provisions of this section, ACI 318, ACI 332 or PCA 100.
- Concrete foundation walls that support above-grade concrete walls that are within the applicability limits of Section R611.2 shall be designed and constructed in accordance with the provisions of this section, ACI 318, ACI 332 or PCA 100.



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Concrete foundation walls

R404.1.3



- Concrete foundation walls that support above-grade concrete walls that are not within the applicability limits of Section R611.2 shall be designed and constructed in accordance with the provisions of ACI 318, ACI 332 or PCA 100.



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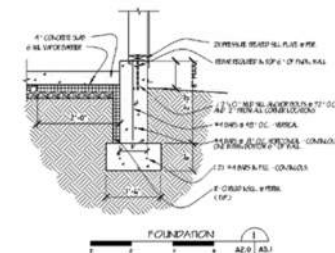
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Concrete foundation walls

R404.1.3

- When ACI 318, ACI 332, PCA 100 or the provisions of this section are used to design concrete foundation walls, project drawings, typical details and specifications are not required to bear the seal of the architect or engineer responsible for design, unless otherwise required by the state law of the jurisdiction having authority.



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Concrete cross-section R404.1.3.1

- Concrete walls constructed in accordance with this code shall comply with the shapes and minimum concrete cross-sectional dimensions required by Table R608.3.
- Other types of forming systems resulting in concrete walls not in compliance with this section and Table R608.3 shall be designed in accordance with ACI 318.

TABLE R608.3
DIMENSIONAL REQUIREMENTS FOR WALLS^{a, b}

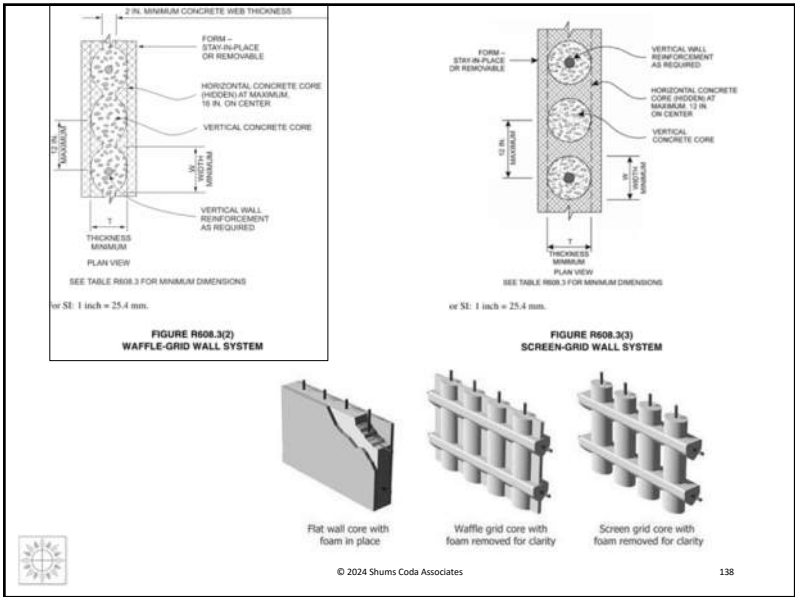
WALL TYPE AND NOMINAL THICKNESS	MAXIMUM WALL WEIGHT ^a (psf)	MINIMUM WIDTH, W, OF VERTICAL CORES (inches)	MINIMUM THICKNESS, T, OF VERTICAL CORES (inches)	MAXIMUM SPACING OF VERTICAL CORES (inches)	MAXIMUM SPACING OF HORIZONTAL CORES (inches)	MINIMUM WEB THICKNESS (inches)
4" Flat ^a	50	N/A	N/A	N/A	N/A	N/A
6" Flat ^a	75	N/A	N/A	N/A	N/A	N/A
8" Flat ^a	100	N/A	N/A	N/A	N/A	N/A
10" Flat ^a	125	N/A	N/A	N/A	N/A	N/A
6" Waffle-grid	56	8 ^b	5.5 ^b	12	16	2
8" Waffle-grid	76	8 ^b	8 ^b	12	16	2
8" Screen-grid	53	6.25 ^b	6.25 ^b	12	12	N/A



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Reinforcement for foundation walls R404.1.3.2

- Concrete foundation walls shall be laterally supported at the top and bottom. Horizontal reinforcement shall be provided in accordance with Table R404.1.2(1).

TABLE R404.1.2(1)
MINIMUM HORIZONTAL REINFORCEMENT FOR CONCRETE BASEMENT WALLS^{a, b}

MAXIMUM UNSUPPORTED HEIGHT OF BASEMENT WALL (feet)	LOCATION OF HORIZONTAL REINFORCEMENT
≤ 8	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.
> 8	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.



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Reinforcement for foundation walls R404.1.3.2

- Vertical reinforcement shall be provided in accordance with Table R404.1.2(2), R404.1.2(3), R404.1.2(4), R404.1.2(5), R404.1.2(6), R404.1.2(7) or R404.1.2(8).



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TABLE R404.1.2(3)
MINIMUM VERTICAL REINFORCEMENT FOR 8-INCH (203 mm) NOMINAL FLAT CONCRETE BASEMENT WALLS^{a, b, c, d, e, f, h, i}

MAXIMUM UNSUPPORTED WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^g (feet)	MINIMUM VERTICAL REINFORCEMENT—BAR SIZE AND SPACING (inches)		
		Soil classes ^a and design lateral soil (psf per foot of depth)		
		GW, GP, SW, SP 30	GM, GC, SM, SM-SC and ML 45	SC, ML-CL and inorganic CL 60
8	4	NR	NR	NR
	5	NR	NR	NR
	6	NR	NR	6 @ 37
	7	NR	6 @ 36	6 @ 35
	8	6 @ 41	6 @ 35	6 @ 26
9	4	NR	NR	NR
	5	NR	NR	NR
	6	NR	NR	6 @ 35
	7	NR	6 @ 35	6 @ 32
	8	6 @ 36	6 @ 32	6 @ 23
10	4	NR	NR	NR
	5	NR	NR	NR
	6	NR	NR	6 @ 35
	7	NR	6 @ 35	6 @ 29
	8	6 @ 35	6 @ 29	6 @ 21
10	9	6 @ 34	6 @ 22	6 @ 16
	10	6 @ 27	6 @ 17	6 @ 13



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TABLE R404.1.2(8)
MINIMUM VERTICAL REINFORCEMENT FOR 6-, 8-, 10-INCH AND 12-INCH NOMINAL FLAT BASEMENT WALLS^{a, b, c, d, e, f, h, i, k, m}

MAXIMUM WALL HEIGHT (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^g (feet)	MINIMUM VERTICAL REINFORCEMENT—BAR SIZE AND SPACING (inches)											
		Soil classes ^a and design lateral soil (psf per foot of depth)											
		GW, GP, SW, SP 30				GM, GC, SM, SM SC and ML 45				SC, ML CL and inorganic CL 60			
		Minimum nominal wall thickness (inches)											
		6	8	10	12	6	8	10	12	6	8	10	12
5	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
6	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR ²	NR	NR	4 @ 35	NR ²	NR	NR
	6	NR	NR	NR	NR	5 @ 48	NR	NR	NR	5 @ 36	NR	NR	NR
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
7	5	NR	NR	NR	NR	NR	NR	NR	NR	5 @ 47	NR	NR	NR
	6	NR	NR	NR	NR	5 @ 42	NR	NR	NR	6 @ 43	5 @ 48	NR ²	NR
	7	5 @ 46	NR	NR	NR	6 @ 42	5 @ 46	NR ²	NR	6 @ 34	6 @ 48	NR	NR
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	4 @ 38	NR ²	NR	NR	5 @ 43	NR	NR	NR
	6	4 @ 37	NR ²	NR	NR	5 @ 37	NR	NR	NR	6 @ 37	5 @ 43	NR ²	NR
8	7	5 @ 40	NR	NR	NR	6 @ 37	5 @ 41	NR ²	NR	6 @ 34	6 @ 43	NR	NR
	8	6 @ 43	5 @ 47	NR ²	NR	6 @ 34	6 @ 43	NR	NR	6 @ 27	6 @ 32	6 @ 44	NR
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	4 @ 35	NR ²	NR	NR	5 @ 40	NR	NR	NR
9	6	4 @ 34	NR ²	NR	NR	6 @ 48	NR	NR	NR	6 @ 36	6 @ 39	NR ²	NR
	7	5 @ 36	NR	NR	NR	6 @ 34	5 @ 37	NR	NR	6 @ 33	6 @ 38	5 @ 37	NR ²
	8	6 @ 38	5 @ 41	NR ²	NR	6 @ 33	6 @ 38	5 @ 37	NR ²	6 @ 24	6 @ 29	6 @ 39	4 @ 48 ^h
	9	6 @ 34	5 @ 46	NR	NR	6 @ 26	6 @ 30	6 @ 41	NR	6 @ 19	6 @ 23	6 @ 30	NR

Reinforcement for foundation walls R404.1.3.2



- In buildings assigned to Seismic Design Category D0, D1 or D2, concrete foundation walls shall also comply with Section R404.1.4.2.



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Concrete foundation stem walls supporting above-grade concrete walls - R404.1.3.2.1

- Foundation stem walls that support above-grade concrete walls shall be designed and constructed in accordance with this section.
 - Stem wall not laterally supported at top.
 - Stem walls laterally supported at top.



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Concrete foundation stem walls supporting light-frame above-grade walls - R404.1.3.2.2

1. Stem walls not laterally supported at top. Concrete stem walls that are not monolithic with slabs-on-ground or are not otherwise laterally supported by slabs-on-ground and retain 48 inches or less of unbalanced fill, measured from the top of the wall, shall be constructed in accordance with Section R404.1.3.

Foundation stem walls that retain more than 48 inches of unbalanced fill, measured from the top of the wall, shall be designed in accordance with Sections R404.1.1 and R404.4.



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Concrete foundation stem walls supporting light-frame above-grade walls - R404.1.3.2.2

2. Stem walls laterally supported at top. Concrete stem walls that are monolithic with slabs-on-ground or are otherwise laterally supported by slabs-on-ground shall be constructed in accordance with Section R404.1.3.

Where the unbalanced backfill retained by the stem wall is greater than 48 inches, the connection between the stem wall and the slab-on-ground, and the portion of the slab-on-ground providing lateral support for the wall shall be designed in accordance with PCA 100 or in accordance with accepted engineering practice.



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R404.1.3.3 Concrete, materials for concrete, and forms

- Materials used in concrete, the concrete itself and forms shall conform to requirements of this section or ACI 318.



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R404.1.3.3.1 Compressive strength



- The minimum specified compressive strength of concrete, f'_c , shall comply with Section R402.2 and shall be not less than 2,500 psi at 28 days in buildings assigned to Seismic Design Category A, B or C and 3000 psi in buildings assigned to Seismic Design Category D0, D1 or D2.



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Form materials and form ties R404.1.3.3.6

- Forms shall be made of wood, steel, aluminum, plastic, a composite of cement and foam insulation, a composite of cement and wood chips, or other approved material suitable for supporting and containing concrete. Forms shall provide sufficient strength to contain concrete during the concrete placement operation.
- Form ties shall be steel, solid plastic, foam plastic, a composite of cement and wood chips, a composite of cement and foam plastic, or other suitable material capable of resisting the forces created by fluid pressure of fresh concrete.



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Stay-in-place forms R404.1.3.3.6.1

1. Surface burning characteristics. The flame-spread index and smoke-developed index of forming material, other than foam plastic, left exposed on the interior shall comply with Section R302. The surface burning characteristics of foam plastic used in insulating concrete forms shall comply with Section R316.3.



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Stay-in-place forms R404.1.3.3.6.1



2. Interior covering.

Stay-in-place forms constructed of rigid foam plastic shall be protected on the interior of the building as required by Section R316.

Where gypsum board is used to protect the foam plastic, it shall be installed with a mechanical fastening system. Use of adhesives in addition to mechanical fasteners is permitted.



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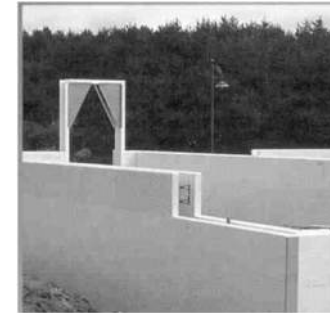
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Stay-in-place forms R404.1.3.3.6.1

3. Exterior wall covering.

Stay-in-place forms constructed of rigid foam plastics shall be protected from sunlight and physical damage by the application of an approved exterior wall covering complying with this code. Exterior surfaces of other stay-in-place forming systems shall be protected in accordance with this code.



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Stay-in-place forms R404.1.3.3.6.1

4. Termite protection.

In areas where the probability of termite infestation is "very heavy" as indicated by Table R301.2(1) or Figure R301.2(6), foam plastic insulation shall be permitted below grade on foundation walls in accordance with Section R318.4.



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R318.4 Foam plastic protection

In areas where the probability of termite infestation is "very heavy" as indicated in Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade.

The clearance between foam plastics installed above grade and exposed earth shall be not less than 6 inches



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R318.4 Foam plastic protection

Exceptions

1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure-preservative-treated wood.
2. Where in addition to the requirements of Section R318.1, an approved method of protecting the foam plastic and structure from subterranean termite damage is used.
3. On the interior side of basement walls.



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Steel reinforcement R404.1.3.3.7.1

- Steel reinforcement shall comply with the requirements of ASTM A 615, A 706, or A 996. ASTM A 996 bars produced from rail steel shall be Type R. In buildings assigned to Seismic Design Category A, B or C, the minimum yield strength of reinforcing steel shall be 40,000 psi (Grade 40).
- In buildings assigned to Seismic Design Category D0, D1 or D2, reinforcing steel shall comply with the requirements of ASTM A 706 for low-alloy steel with a minimum yield strength of 60,000 psi (Grade 60).

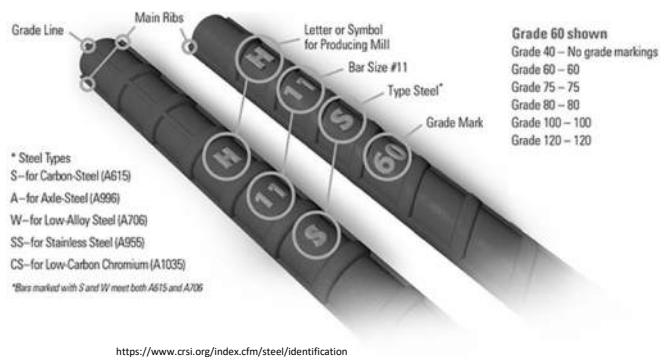


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Reinforcing



<https://www.crsi.org/index.cfm/steel/identification>



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Location of reinforcement in wall R404.1.3.3.7.2



- The center of vertical reinforcement in basement walls determined from Tables R404.1.2(2) through R404.1.2(7) shall be located at the centerline of the wall.
- Vertical reinforcement in basement walls determined from Table R404.1.2(8) shall be located to provide a maximum cover of 1 1/4 inches measured from the inside face of the wall.



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Location of reinforcement in wall R404.1.3.3.7.2

- Regardless of the table used to determine vertical wall reinforcement, the center of the steel shall not vary from the specified location by more than the greater of 10 percent of the wall thickness and 3/8-inch.
- Horizontal and vertical reinforcement shall be located in foundation walls to provide the minimum cover required by Section R404.1.3.3.7.4.



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Wall openings R404.1.3.3.7.3

- Vertical wall reinforcement required by Section R404.1.3.2 that is interrupted by wall openings shall have additional vertical reinforcement of the same size placed within 12 inches of each side of the opening.



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Support and cover R404.1.3.3.7.4

- Reinforcement shall be secured in the proper location in the forms with tie wire or other bar support system to prevent displacement during the concrete placement operation.
- Steel reinforcement in concrete cast against the earth shall have a minimum cover of 3 inches.
- Minimum cover for reinforcement in concrete cast in removable forms that will be exposed to the earth or weather shall be 1 1/2 inches for No. 5 bars and smaller, and 2 inches for No. 6 bars and larger.



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Support and cover R404.1.3.3.7.4

- For concrete cast in removable forms that will not be exposed to the earth or weather, and for concrete cast in stay-in-place forms, minimum cover shall be 3/4 inch. The minus tolerance for cover shall not exceed the smaller of one-third the required cover or 3/8 inch.



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Lap splices R404.1.3.3.7.5

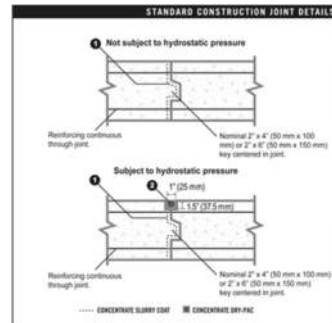
- Vertical and horizontal wall reinforcement shall be the longest lengths practical. Where splices are necessary in reinforcement, the length of lap splice shall be in accordance with Table R608.5.4(1) and Figure R608.5.4(1).
- The maximum gap between noncontact parallel bars at a lap splice shall not exceed the smaller of one-fifth the required lap length and 6 inches [See Figure R608.5.4(1)].

TABLE R608.5.4(1)
LAP SPLICING AND TENSION DEVELOPMENT LENGTHS

BAR SIZE, IN.	WALL THICKNESS t SHALL BE: $t \geq 16$ IN.	
	WALL THICKNESS t SHALL BE: $t \geq 16$ IN.	WALL THICKNESS t SHALL BE: $t < 16$ IN.
NO. 4	36	36
NO. 5	42	42
NO. 6	48	48
NO. 7	54	54
NO. 8	60	60
NO. 9	66	66
NO. 10	72	72
NO. 11	78	78
NO. 12	84	84
NO. 14	96	96
NO. 16	108	108
NO. 18	120	120
NO. 20	132	132
NO. 22	144	144
NO. 24	156	156
NO. 26	168	168
NO. 28	180	180
NO. 30	192	192
NO. 32	204	204
NO. 34	216	216
NO. 36	228	228
NO. 38	240	240
NO. 40	252	252
NO. 42	264	264
NO. 44	276	276
NO. 46	288	288
NO. 48	300	300
NO. 50	312	312
NO. 52	324	324
NO. 54	336	336
NO. 56	348	348
NO. 58	360	360
NO. 60	372	372
NO. 62	384	384
NO. 64	396	396
NO. 66	408	408
NO. 68	420	420
NO. 70	432	432
NO. 72	444	444
NO. 74	456	456
NO. 76	468	468
NO. 78	480	480
NO. 80	492	492
NO. 82	504	504
NO. 84	516	516
NO. 86	528	528
NO. 88	540	540
NO. 90	552	552
NO. 92	564	564
NO. 94	576	576
NO. 96	588	588
NO. 98	600	600
NO. 100	612	612
NO. 102	624	624
NO. 104	636	636
NO. 106	648	648
NO. 108	660	660
NO. 110	672	672
NO. 112	684	684
NO. 114	696	696
NO. 116	708	708
NO. 118	720	720
NO. 120	732	732
NO. 122	744	744
NO. 124	756	756
NO. 126	768	768
NO. 128	780	780
NO. 130	792	792
NO. 132	804	804
NO. 134	816	816
NO. 136	828	828
NO. 138	840	840
NO. 140	852	852
NO. 142	864	864
NO. 144	876	876
NO. 146	888	888
NO. 148	900	900
NO. 150	912	912
NO. 152	924	924
NO. 154	936	936
NO. 156	948	948
NO. 158	960	960
NO. 160	972	972
NO. 162	984	984
NO. 164	996	996
NO. 166	1008	1008
NO. 168	1020	1020
NO. 170	1032	1032
NO. 172	1044	1044
NO. 174	1056	1056
NO. 176	1068	1068
NO. 178	1080	1080
NO. 180	1092	1092
NO. 182	1104	1104
NO. 184	1116	1116
NO. 186	1128	1128
NO. 188	1140	1140
NO. 190	1152	1152
NO. 192	1164	1164
NO. 194	1176	1176
NO. 196	1188	1188
NO. 198	1200	1200
NO. 200	1212	1212
NO. 202	1224	1224
NO. 204	1236	1236
NO. 206	1248	1248
NO. 208	1260	1260
NO. 210	1272	1272
NO. 212	1284	1284
NO. 214	1296	1296
NO. 216	1308	1308
NO. 218	1320	1320
NO. 220	1332	1332
NO. 222	1344	1344
NO. 224	1356	1356
NO. 226	1368	1368
NO. 228	1380	1380
NO. 230	1392	1392
NO. 232	1404	1404
NO. 234	1416	1416
NO. 236	1428	1428
NO. 238	1440	1440
NO. 240	1452	1452
NO. 242	1464	1464
NO. 244	1476	1476
NO. 246	1488	1488
NO. 248	1500	1500
NO. 250	1512	1512
NO. 252	1524	1524
NO. 254	1536	1536
NO. 256	1548	1548
NO. 258	1560	1560
NO. 260	1572	1572
NO. 262	1584	1584
NO. 264	1596	1596
NO. 266	1608	1608
NO. 268	1620	1620
NO. 270	1632	1632
NO. 272	1644	1644
NO. 274	1656	1656
NO. 276	1668	1668
NO. 278	1680	1680
NO. 280	1692	1692
NO. 282	1704	1704
NO. 284	1716	1716
NO. 286	1728	1728
NO. 288	1740	1740
NO. 290	1752	1752
NO. 292	1764	1764
NO. 294	1776	1776
NO. 296	1788	1788
NO. 298	1800	1800
NO. 300	1812	1812
NO. 302	1824	1824
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NO. 306	1848	1848
NO. 308	1860	1860
NO. 310	1872	1872
NO. 312	1884	1884
NO. 314	1896	1896
NO. 316	1908	1908
NO. 318	1920	1920
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NO. 324	1956	1956
NO. 326	1968	1968
NO. 328	1980	1980
NO. 330	1992	1992
NO. 332	2004	2004
NO. 334	2016	2016
NO. 336	2028	2028
NO. 338	2040	2040
NO. 340	2052	2052
NO. 342	2064	2064
NO. 344	2076	2076
NO. 346	2088	2088
NO. 348	2100	2100
NO. 350	2112	2112
NO. 352	2124	2124
NO. 354	2136	2136
NO. 356	2148	2148
NO. 358	2160	2160
NO. 360	2172	2172
NO. 362	2184	2184
NO. 364	2196	2196
NO. 366	2208	2208
NO. 368	2220	2220
NO. 370	2232	2232
NO. 372	2244	2244
NO. 374	2256	2256
NO. 376	2268	2268
NO. 378	2280	2280
NO. 380	2292	2292
NO. 382	2304	2304
NO. 384	2316	2316
NO. 386	2328	2328
NO. 388	2340	2340
NO. 390	2352	2352
NO. 392	2364	2364
NO. 394	2376	2376
NO. 396	2388	2388
NO. 398	2400	2400
NO. 400	2412	2412
NO. 402	2424	2424
NO. 404	2436	2436
NO. 406	2448	2448
NO. 408	2460	2460
NO. 410	2472	2472
NO. 412	2484	2484
NO. 414	2496	2496
NO. 416	2508	2508
NO. 418	2520	2520
NO. 420	2532	2532
NO. 422	2544	2544
NO. 424	2556	2556
NO. 426	2568	2568
NO. 428	2580	2580
NO. 430	2592	2592
NO. 432	2604	2604
NO. 434	2616	2616
NO. 436	2628	2628
NO. 438	2640	2640
NO. 440	2652	2652
NO. 442	2664	2664
NO. 444	2676	2676
NO. 446	2688	2688
NO. 448	2700	2700
NO. 450	2712	2712
NO. 452	2724	2724
NO. 454	2736	2736
NO. 456	2748	2748
NO. 458	2760	2760
NO. 460	2772	2772
NO. 462	2784	2784
NO. 464	2796	2796
NO. 466	2808	2808
NO. 468	2820	2820
NO. 470	2832	2832
NO. 472	2844	2844
NO. 474	2856	2856
NO. 476	2868	2868
NO. 478	2880	2880
NO. 480	2892	2892
NO. 482	2904	2904
NO. 484	2916	2916
NO. 486	2928	2928
NO. 488	2940	2940
NO. 490	2952	2952
NO. 492	2964	2964
NO. 494	2976	2976
NO. 496	2988	2988
NO. 498	3000	3000
NO. 500	3012	3012
NO. 502	3024	3024
NO. 504	3036	3036
NO. 506	3048	3048
NO. 508	3060	3060
NO. 510	3072	3072
NO. 512	3084	3084
NO. 514	3096	3096
NO. 516	3108	3108
NO. 518	3120	3120
NO. 520	3132	3132
NO. 522	3144	3144
NO. 524	3156	3156
NO. 526	3168	3168
NO. 528	3180	3180
NO. 530	3192	3192
NO. 532	3204	3204
NO. 534	3216	3216
NO. 536	3228	3228
NO. 538	3240	3240
NO. 540	3252	3252
NO. 542	3264	3264
NO. 544	3276	3276
NO. 546	3288	3288
NO. 548	3300	3300
NO. 550	3312	3312
NO. 552	3324	3324
NO. 554	3336	3336
NO. 556	3348	3348
NO. 558	3360	3360
NO. 560	3372	3372
NO. 562	3384	3384
NO. 564	3396	3396
NO. 566	3408	3408
NO. 568	3420	3420
NO. 570	3432	3432
NO. 572	3444	3444
NO. 574	3456	3456
NO. 576	3468	3468
NO. 578	3480	3480
NO. 580	3492	3492
NO. 582	3504	3504
NO. 584	3516	3516
NO. 586	3528	3528
NO. 588	3540	3540
NO. 590	3552	3552
NO. 592	3564	3564
NO. 594	3576	3576
NO. 596	3588	3588
NO. 598	3600	3600
NO. 600	3612	3612
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NO. 606	3648	3648
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NO. 612	3684	3684
NO. 614	3696	3696
NO. 616	3708	3708
NO. 618	3720	3720
NO. 620	3732	3732
NO. 622	3744	3744
NO. 624	3756	3756
NO. 626	3768	3768
NO. 628	3780	3780
NO. 630	3792	3792
NO. 632	3804	3804
NO. 634	3816	3816
NO. 636	3828	3828
NO. 638	3840	3840
NO. 640	3852	3852
NO. 642	3864	3864
NO. 644	3876	3876
NO. 646	3888	3888
NO. 648	3900	3900
NO. 650	3912	3912
NO. 652	3924	3924
NO. 654	3936	3936
NO. 656	3948	3948
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NO. 666	4008	4008
NO. 668	4020	4020
NO. 670	4032	4032
NO. 672	4044	4044
NO. 674	4056	4056
NO. 676	4068	4068
NO. 678	4080	4080
NO. 680	4092	4092
NO. 682	4104	4104
NO. 684	4116	4116
NO. 686	4128	4128
NO. 688	4140	4140
NO. 690	4152	4152
NO. 692	4164	

Construction joint reinforcement R404.1.3.3.7.8

- Construction joints in foundation walls shall be made and located to not impair the strength of the wall.
- Construction joints in plain concrete walls, including walls required to have not less than No. 4 bars at 48 inches on center by Sections R404.1.3.2 and R404.1.4.2, shall be located at points of lateral support, and a minimum of one No. 4 bar shall extend across the construction joint at a spacing not to exceed 24 inches on center.



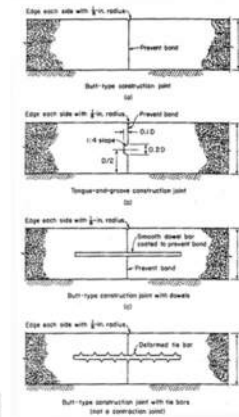
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Construction joint reinforcement R404.1.3.3.7.8

- Construction joint reinforcement shall have a minimum of 12 inches embedment on both sides of the joint.
- Construction joints in reinforced concrete walls shall be located in the middle third of the span between lateral supports, or located and constructed as required for joints in plain concrete walls.



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Construction joint reinforcement R404.1.3.3.7.8

- Exception:
- Use of vertical wall reinforcement required by this code is permitted in lieu of construction joint reinforcement provided the spacing does not exceed 24 inches, or the combination of wall reinforcement and No.4 bars described above does not exceed 24 inches.



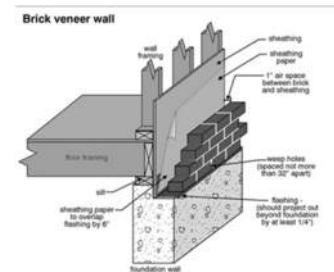
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Exterior wall coverings R404.1.3.3.8

- Requirements for installation of masonry veneer, stucco and other wall coverings on the exterior of concrete walls and other construction details not covered in this section shall comply with the requirements of this code.



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Requirements for Seismic Design Category C R404.1.3.4

- Concrete foundation walls supporting above-grade concrete walls in townhouses assigned to Seismic Design Category C shall comply with ACI 318, ACI 332 or PCA 100 (see Section R404.1.3).



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Seismic Design Categories D0, D1 and D2 R404.1.4.1 Masonry

- In buildings assigned to Seismic Design Category D0, D1 or D2, as established in Table R301.2(1), masonry foundation walls shall comply with this section.
- In addition to the requirements of Table R404.1.1(1), plain masonry foundation walls shall comply with the following:

- Wall height shall not exceed 8 feet.
- Unbalanced backfill height shall not exceed 4 feet.
- Minimum nominal thickness for plain masonry foundation walls shall be 8 inches.
- Masonry stem walls shall have a minimum vertical reinforcement of one No. 3 bar located a maximum of 4 feet on center in grouted cells. Vertical reinforcement shall be tied to the horizontal reinforcement in the footings.



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Seismic Design Categories D0, D1 and D2 R404.1.4.1 Masonry

- Foundation walls, supporting more than 4 feet of unbalanced backfill or exceeding 8 feet in height shall be constructed in accordance with Table R404.1.1(2), R404.1.1(3) or R404.1.1(4).
- Masonry foundation walls shall have two No. 4 horizontal bars located in the upper 12 inches of the wall.



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Concrete foundation walls R404.1.4.2

- In buildings assigned to Seismic Design Category D0, D1 or D2, as established in Table R301.2(1), concrete foundation walls that support light-frame walls shall comply with this section, and concrete foundation walls that support above-grade concrete walls shall comply with ACI 318, ACI 332 or PCA 100 (see Section R404.1.3).
- In addition to the horizontal reinforcement required by Table R404.1.2(1), plain concrete walls supporting light-frame walls shall comply with the following:

- Wall height shall not exceed 8 feet.
- Unbalanced backfill height shall not exceed 4 feet.
- Minimum thickness for plain concrete foundation walls shall be 7.5 inches except that 6 inches is permitted where the maximum wall height is 4 feet, 6 inches.



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Concrete foundation walls R404.1.4.2

- Foundation walls less than 7.5 inches in thickness, supporting more than 4 feet of unbalanced backfill or exceeding 8 feet in height shall be provided with horizontal reinforcement in accordance with Table R404.1.2(1), and vertical reinforcement in accordance with Table R404.1.2(2), R404.1.2(3), R404.1.2(4), R404.1.2(5), R404.1.2(6), R404.1.2(7) or R404.1.2(8). Where Tables R404.1.2(2) through R404.1.2(8) permit plain concrete walls, not less than No. 4 vertical bars at a spacing not exceeding 48 inches shall be provided.



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Foundation wall thickness based on walls supported - R404.1.5

- The thickness of masonry or concrete foundation walls shall not be less than that required by Section R404.1.5.1 (Masonry) or R404.1.5.2 (Concrete), respectively.



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R404.1.5.1 Masonry wall thickness



Masonry foundation walls shall be not be less than the thickness of the wall supported, except that masonry foundation walls of at least 8-inch nominal thickness shall be permitted under brick veneered frame walls and under 10-inch-wide cavity walls where the total height of the wall supported, including gables, is not more than 20 feet, provided the requirements of Section R404.1.1 are met.



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R404.1.5.2 Concrete wall thickness

- The thickness of concrete foundation walls shall be equal to or greater than the thickness of the wall in the story above.
- Concrete foundation walls with corbels, brackets or other projections built into the wall for support of masonry veneer or other purposes are not within the scope of the tables in this section.



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R404.1.5.2 Concrete wall thickness

- Where a concrete foundation wall is reduced in thickness to provide a shelf for the support of masonry veneer, the reduced thickness shall be equal to or greater than the thickness of the wall in the story above.
- Vertical reinforcement for the foundation wall shall be based on Table R404.1.2(8) and located in the wall as required by Section R404.1.3.3.7.2 where that table is used. Vertical reinforcement shall be based on the thickness of the thinner portion of the wall.



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R404.1.5.2 Concrete wall thickness

Exception:

Where the height of the reduced thickness portion measured to the underside of the floor assembly or sill plate above is less than or equal to 24 inches and the reduction in thickness does not exceed 4 inches, the vertical reinforcement is permitted to be based on the thicker portion of the wall.



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Height Above Finished Grade R404.1.6



- 4 inches for masonry veneer
- 6 inches elsewhere



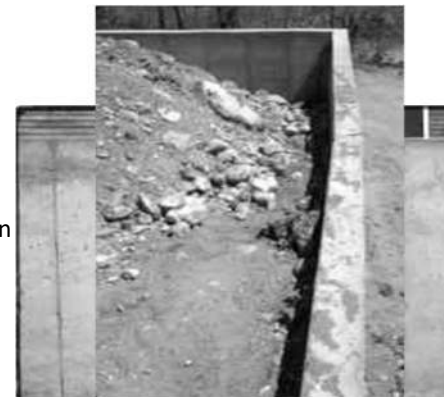
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Backfill Placement R404.1.7

- Backfill shall not be placed against the wall until the wall has sufficient strength and has been anchored to the floor above, or has been sufficiently braced to prevent damage by the backfill.
- Except walls supporting less than 4' of unbalance backfill



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R404.1.8 Rubble stone masonry

- Rubble stone masonry foundation walls shall have a minimum thickness of 16 inches, shall not support an unbalanced backfill exceeding 8 feet in height, shall not support a soil pressure greater than 30 pounds per square foot per foot, and shall not be constructed in Seismic Design Categories D0, D1, D2 or townhouses in Seismic Design Category C.



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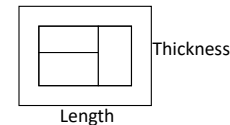
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R404.1.9 Isolated Masonry Piers



- 8" minimum nominal thickness
- Length not to exceed 3x the nominal thickness (provided)
- Height not to exceed 4x nominal thickness (provided)



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R404.1.9 Isolated Masonry Piers



Except...

- Filled solid with grout, the height may be 10x the nominal thickness

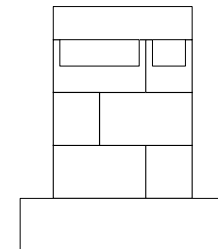


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R404.1.9.1 Pier Cap



- Hollow masonry shall be provided with a minimum of 4" solid masonry or concrete cap (or grouted full down at least 4").
- If required, termite protection required at the cap.



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R404.1.9.2 Supporting floor girders



- Interior bearing walls
 - 12" minimum thickness
 - 10' maximum height
- Exterior bearing walls
 - 12" minimum thickness
 - 4' maximum height
- Height is measured from the bottom of the footing.
- Thickness applies to the pier, not the masonry unit



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R404.1.9 Isolated Masonry Piers



- If supporting braced wall panels, the pier must be designed using accepted engineering practice
- SDC D and Townhouse SDC C requires design by accepted engineering practice.
- Flood areas required design per R322



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Wood Foundation Walls R404.2



- Wood Grade
 - Grade mark DOC PS20
- Stud Size
 - 2X6 minimum
- Height of Backfill for foundations not designed per AF&PA Report #7
 - maximum 4 feet
 - Table R404.2.3



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Wood Foundation Walls R404.2



- Backfilling
 - not until first floor has been constructed or walls braced
- Drainage & Dampproofing
 - R405 & R406
- Sheathing Fastening
 - Stainless steel
 - Table R602.3(1)



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Wood sill plates R404.3

- Wood sill plates shall be a minimum of 2-inch by 4-inch nominal lumber.
- Anchorage shall be in accordance with Sections R403.1.6 and R602.11.



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Retaining Walls R404.4

- Retaining walls that are not laterally supported at the top and that retain in excess of 24 inches of unbalanced fill shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift.



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Retaining Walls R404.4

Retaining walls shall be designed for a safety factor of 1.5 against lateral sliding and overturning. This section shall not apply to foundation walls supporting buildings.



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Precast concrete foundation walls R404.5

- Precast concrete foundation walls shall be designed in accordance with accepted engineering practice. The design and manufacture of precast concrete foundation wall panels shall comply with the materials requirements of Section R402.3 or ACI 318.
- The panel design drawings shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed in accordance with Section R106.1.



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Identification R404.5.3



- Precast concrete foundation wall panels shall be identified by a certificate of inspection label issued by an approved third party inspection agency.

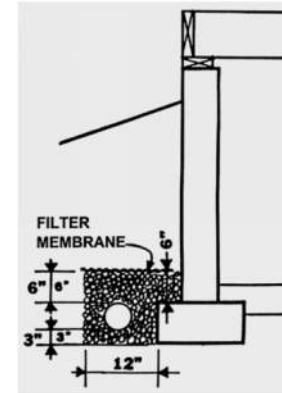


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Foundation Drainage R405.1



- Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade.



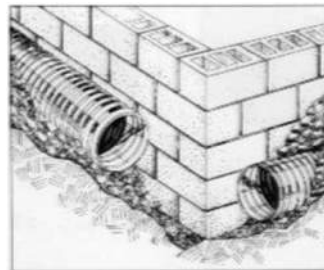
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Foundation Drainage R405.1

- Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the top of the footing or below the bottom of the slab and shall discharge by gravity or mechanical means into an approved drainage system.



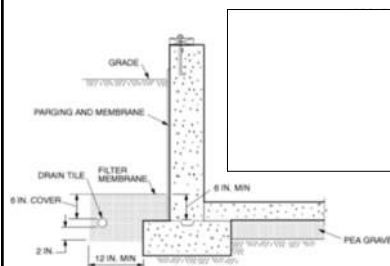
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Foundation Drainage R405.1

- Gravel or crushed stone drains shall extend at least 1 foot beyond the outside edge of the footing and 6 inches above the top of the footing and be covered with an approved filter membrane material.



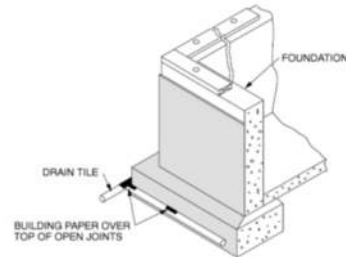
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Foundation Drainage R405.1

- The top of open joints of drain tiles shall be protected with strips of building paper, and the drainage tiles or perforated pipe shall be placed on a minimum of 2 inches of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than 6 inches of the same material.



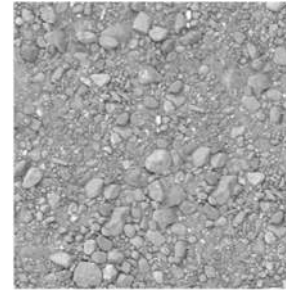
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Foundation Drainage R405.1, Exception

- A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils, as detailed in Table R405.1.



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TABLE R405.1
PROPERTIES OF SOILS CLASSIFIED ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL GROUP	UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOL	SOIL DESCRIPTION	DRAINAGE CHARACTERISTICS ^a	FROST HEAVE POTENTIAL	VOLUME CHANGE POTENTIAL EXPANSION ^b
Group I	GW	Well-graded gravels, gravel sand mixtures, little or no fines	Good	Low	Low
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low
	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low
	GM	Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low
Group II	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low
	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Medium	High	Low
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium to Low
Group III	CH	Inorganic clays of high plasticity, fat clays	Poor	Medium	High
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High
Group IV	OL	Organic silts and organic silty clays of low plasticity	Poor	Medium	Medium
	OH	Organic clays of medium to high plasticity, organic silts	Unsatisfactory	Medium	High
	Pt	Peat and other highly organic soils	Unsatisfactory	Medium	High

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Precast concrete foundation R405.1.1

- Precast concrete walls that retain earth and enclose habitable or useable space located below-grade that rest on crushed stone footings shall have a perforated drainage pipe installed below the base of the wall on either the interior or exterior side of the wall, at least one foot beyond the edge of the wall.
- If the exterior drainage pipe is used, an approved filter membrane material shall cover the pipe.
- The drainage system shall discharge into an approved sewer system or to daylight.



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Wood Foundation Drainage

405.2

- Wood foundations enclosing habitable or usable spaces located below grade shall be adequately drained in accordance with Sections R405.2.1 through R405.2.3.

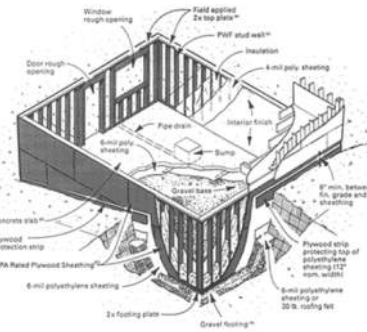


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Base
R405.2.1

- A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of 4 inches under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.



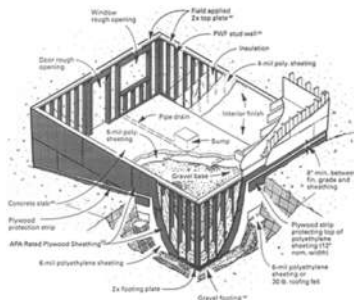
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Vapor Barrier

R405.2.2

- A 6-mil-thick polyethylene vapor retarder shall be applied over the porous layer with the basement floor constructed over the polyethylene.



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Drainage Dystem

R405.2.3

- In other than Group I soils, a sump shall be provided to drain the porous layer and footings.
- The sump shall be at least 24 inches in diameter or 20 inches square, shall extend at least 24 inches below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water.
- The drainage system shall discharge into an approved sewer system or to daylight.



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Foundation Dampproofing R406

- Except where required to be waterproofed by R406.2, foundation walls that retain earth and enclose habitable or usable spaces located below grade shall be dampproofed from the top of the footing to the finished grade.



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Foundation Dampproofing R406

- Masonry walls shall have not less than 3/8 inch portland cement parging applied to the exterior of the wall. The parging shall be dampproofed in accordance with one of the following:
 1. Bituminous coating.
 2. 3 pounds per square yard of acrylic modified cement.
 3. 1/8-inch coat of surface-bonding cement complying with ASTM C 887.
 4. Any material permitted for waterproofing in Section R406.2.
 5. Other approved methods or materials.

Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry.



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Foundation Dampproofing R406



- Concrete walls shall be dampproofed by applying any one of the above listed dampproofing materials or any one of the waterproofing materials listed in Section R406.2 to the exterior of the wall.



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Concrete And Masonry Foundation Waterproofing - R406.2

- In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the top of the footing to the finished grade. Walls shall be waterproofed in accordance with one of the following:



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Concrete And Masonry Foundation Waterproofing - R406.2

1. 2-ply hot-mopped felts.
2. 55 pound roll roofing.
3. 6-mil polyvinyl chloride.
4. 6-mil polyethylene.
5. 40-mil polymer-modified asphalt.
6. 60-mil flexible polymer cement.
7. 1/8 inch cement-based, fiber-reinforced, waterproof coating.
8. 60-mil solvent-free liquid-applied synthetic rubber.



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Concrete And Masonry Foundation Waterproofing - R406.2, Exception

- Organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones and esters shall not be used for ICF walls with expanded polystyrene form material.
- Use of plastic roofing cements, acrylic coatings, latex coatings, mortars and pargings to seal ICF walls is permitted. Cold-setting asphalt or hot asphalt shall conform to type C of ASTM D 449.
- Hot asphalt shall be applied at a temperature of less than 200°F.



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Dampproofing For Wood Foundations - R406.3

- Wood foundations enclosing habitable or usable spaces located below grade shall be dampproofed in accordance with Sections R406.3.1 through R406.3.4.



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Panel Joint Sealed R406.3.1

- Plywood panel joints in the foundation walls shall be sealed full length with a caulking compound capable of producing a moisture-proof seal under the conditions of temperature and moisture content at which it will be applied and used.



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Porous Fill R406.3.3

- The space between the excavation and the foundation wall shall be backfilled with the same material used for footings, up to a height of 1 foot above the footing for well-drained sites, or one-half the total back-fill height for poorly drained sites. The porous fill shall be covered with strips of 30-pound asphalt paper or 6-mil polyethylene to permit water seepage while avoiding infiltration of fine soils.



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Backfill R406.3.4

- The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation.



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Precast concrete foundation system dampproofing - R406.4



- Except where required by Section R406.2 to be waterproofed, precast concrete foundation walls enclosing habitable or useable spaces located below grade shall be dampproofed in accordance with Section R406.1.



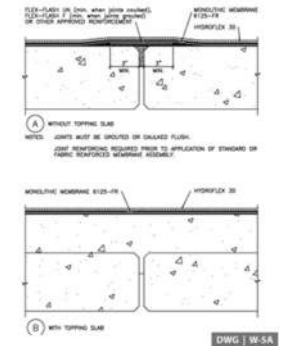
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Panel joints sealed R406.4.1

- Precast concrete foundation panel joints shall be sealed full height with a sealant meeting ASTM C 920, Type S or M, Grade NS, Class 25, Use NT, M or A. Joint sealant shall be installed in accordance with the manufacturer's installation instructions.



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Wood Column Protection R407.1



- Wood columns shall be protected against decay as set forth in Section R317



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Wood Columns R317.1.4



- Wood columns shall be approved wood of natural decay resistance or approved pressure-preservative-treated wood.
- Except...



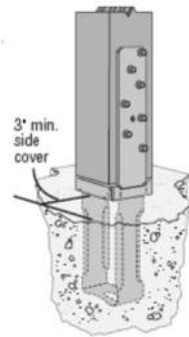
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Wood Columns R317.1.4, Exceptions

1. Columns exposed to the weather or in basements when supported by concrete piers or metal pedestals projecting 1 inch above a concrete floor or 6 inches above exposed earth and the earth is covered by an approved impervious moisture barrier.



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Wood Columns R317.1.4, Exceptions

2. Columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building when supported by a concrete pier or metal pedestal at a height more than 8 inches from exposed earth and the earth is covered by an impervious moisture barrier.



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Wood Columns R317.1.4, Exceptions



3. Deck posts supported by concrete piers or metal pedestals projecting not less than 1 inch above a concrete floor or 6 inches above exposed earth.



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Steel Column Protection R407.2



All surfaces (inside and outside) of steel columns shall be given a shop coat of rust-inhibitive paint, except for corrosion-resistant steel and steel treated with coatings to provide corrosion resistance.



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Structural Requirements R407.3

- The columns shall be restrained to prevent lateral displacement at the bottom end.
- Wood columns shall not be less in nominal size than 4 inches by 4 inches.
- Steel columns shall not be less than 3-inch-diameter Schedule 40 pipe manufactured in accordance with ASTM A 53 Grade B or approved equivalent.



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Structural Requirements R407.3

Exception:

In Seismic Design Categories A, B and C, columns no more than 48 inches in height on a pier or footing are exempt from the bottom end lateral displacement requirement within under-floor areas enclosed by a continuous foundation.



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Under floor Ventilation R408

- 1/150 square feet
- 1/1500 with Class I vapor retarder
- One ventilating opening shall be within 3 feet of each corner of the building.



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Under floor Ventilation R408

- Ventilation openings shall be covered for their height and width with any of the following materials provided that the least dimension of the covering shall not exceed $\frac{1}{4}$ inch:

1. Perforated sheet metal plates not less than 0.070 inch thick.
2. Expanded sheet metal plates not less than 0.047 inch thick.
3. Cast-iron grill or grating.
4. Extruded load-bearing brick vents.
5. Hardware cloth of 0.035 inch wire or heavier.
6. Corrosion-resistant wire mesh, with the least dimension being $\frac{1}{8}$ inch.



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Under floor Ventilation R408

Exception:

The total area of ventilation openings shall be permitted to be reduced to 1/1,500 of the under-floor area where the ground surface is covered with an approved Class I vapor retarder material and the required openings are placed to provide cross ventilation of the space. The installation of operable louvers shall not be prohibited.



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Unvented Crawl Space R408.3

Ventilation openings in under-floor spaces specified in Sections R408.1 and R408.2 shall not be required where:

1. Exposed earth is covered with a continuous Class I vapor retarder. Joints overlap by 6 inches and shall be sealed or taped. The edges extend at least 6 inches up the stem wall and shall be attached and sealed to the stem wall; and



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Unvented Crawl Space R408.3

2. One of the following is provided for the under-floor space:

2.1. Continuously operated mechanical exhaust ventilation at a rate equal to 1 cfm for each 50 ft² of crawlspace floor area, including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.8;



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Unvented Crawl Space R408.3

2.2. Conditioned air supply sized to deliver at a rate equal to 1 cfm for each 50 ft² of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.8;



Crawl Space



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Unvented Crawl Space R408.3



2.3 Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.



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Unvented Crawl Space R408.3

2.4. Dehumidification sized to provide 70 pints of moisture removal per day for every 1,000 square feet of crawl space floor area.



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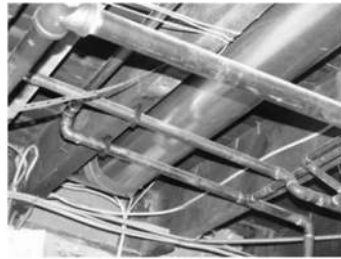
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Under-Floor Plenums M1601.5

Under-floor plenums shall be prohibited in new structures.

Modification or repairs to under-floor plenums in existing structures shall conform to the requirements of this section.



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General M1601.5.1

The space shall be cleaned of loose combustible materials and scrap, and shall be tightly enclosed.

The ground surface of the space shall be covered with a moisture barrier having a minimum thickness of 4 mils

Plumbing waste cleanouts shall not be located within the space.



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Materials M1601.5.2

The under-floor space, including the sidewall insulation, shall be formed by materials having flame-spread ratings not greater than 200 when tested in accordance with ASTM E 84.



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Furnace Connections M1601.5.3

A duct shall extend from the furnace supply outlet to not less than 6 inches below the combustible framing. This duct shall comply with the provisions of Section M1601.1.

A noncombustible receptacle shall be installed below any floor opening into the plenum in accordance with the following requirements:

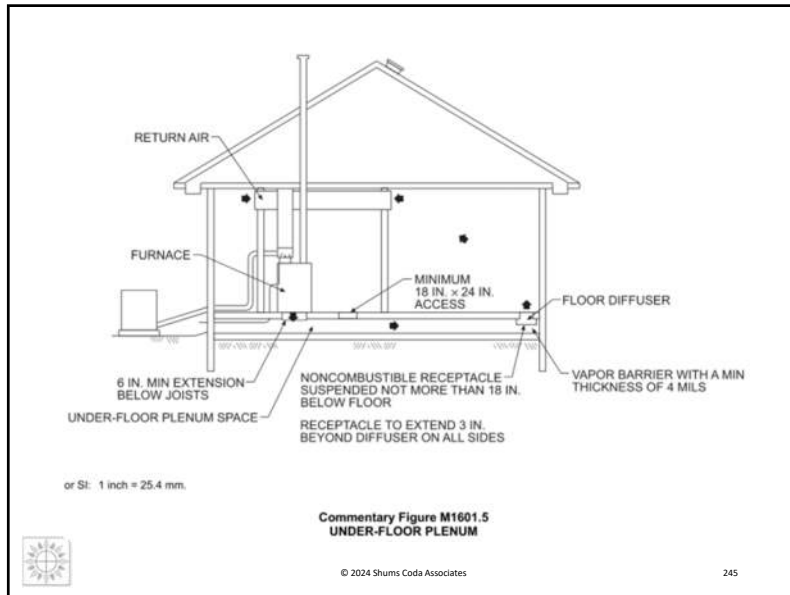
1. The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches below the floor opening.
2. The area of the receptacle shall extend 3 inches beyond the opening on all sides.
3. The perimeter of the receptacle shall have a vertical lip at least 1 inch high at the open sides.



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Access M1601.5.4



- Access to an under-floor plenum shall be provided through an opening in the floor with minimum dimensions of 18 inches by 24 inches.



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Furnace Controls M1601.5.5

- The furnace shall be equipped with an automatic control that will start the air-circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150°F.
- The furnace shall additionally be equipped with an approved automatic control that limits the outlet air temperature to 200°F.



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Crawlspace Access R408.4



- Minimum opening
 - 18" X 24" in floor
 - 16" X 24" in perimeter wall
 - 16" X 24" areaway required in access is below grade
- Mechanical equipment access



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Removal Of Debris R408.5

- The under-floor grade shall be cleaned of all vegetation and organic material. All wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose.
- All construction materials shall be removed before a building is occupied or used for any purpose.

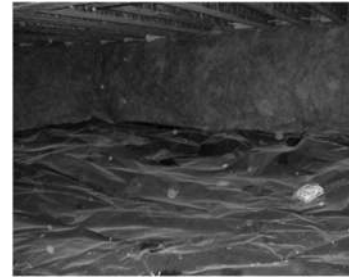


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Finished Grade R408.6



- May be located at bottom of footings
 - If ground water can rise to within 6" of finished floor at building perimeter or surface water doesn't drain, grade shall be as high as outside finished grade or approved drainage system is provided



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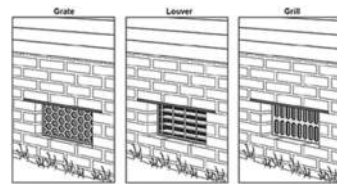
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Flood Resistance R408.7

- For buildings located in areas prone to flooding:
 - Walls enclosing the underfloor space shall be provided with flood openings in accordance with Section R323.2.2.
 - The finished ground level of the underfloor space shall be equal to or higher than the outside finished ground level on at least one side.

Exception:

- Underfloor spaces that meet the requirements of FEMA/FIA TB 11-1.



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R408.8 Under-floor vapor retarder.

- In Climate Zones 1A, 2A and 3A below the warm-humid line, a continuous Class I or II vapor retarder shall be provided on the exposed face of air-permeable insulation installed between the floor joists and exposed to the grade in the under-floor space. The vapor retarder shall have a maximum water vapor permeance of 1.5 perms when tested in accordance with Procedure B of ASTM E96.
- Exception: The vapor retarder shall not be required in unvented crawl spaces constructed in accordance with Section R408.3.



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