

BAM Member Guide to Foundation Wall Support in the 2006 IRC®

Version 1.0

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This document is meant to be used in conjunction with the *2006 International Residential Code®* published by the International Code Council.

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Forward

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Purpose

The 2006 International Residential Code (IRC) includes significant changes to how concrete and masonry foundations are constructed. In response to these changes BAM created this guide for new home construction. This guide describes an alternate method to R404.1 to achieve the new requirements for supporting foundation walls. This document was reviewed by the Minnesota Department of Labor and Industry's Construction Codes and Licensing Division and is deemed to be an acceptable alternative method to R404.1 as long as it is followed in its entirety. Sections R404.1.1, R404.1.2 and R404.1.3 were modified by the State of Minnesota when the 2006 IRC was adopted.

The new requirements in section R404.1 may require residential contractors to increase the structural integrity of concrete or masonry walls, depending on current construction practices. The height of the foundation wall, size of the footing, amount of backfill, soil type and material of the foundation wall all determine what type of anchoring, blocking or reinforcement is required. In some cases engineered designs outside the scope of this guide will still be required. In other cases no additional reinforcement will be required.

Section 1: How to Use This Guide to Build A Code Compliant Foundation Wall

Scope

Foundation walls used in Minnesota are constructed from a number of different materials. This guide only covers foundation walls that are made from poured concrete or masonry (also referred to as CMU's - concrete masonry units or masonry block). Refer directly to the 2006 International Residential Code (IRC) as amended by Minnesota for specific requirements for these other types of foundations:

- Precast concrete foundation walls see R402.3
- Wood foundation walls see R402.1 and R404.2
- Insulating concrete forms foundation walls (ICFs) see R404.4.
- Frost protected shallow foundations see R403.3

Types of Foundation Support Required by the IRC

Section R404.1 Concrete and Masonry Foundation Walls of the 2006 IRC affects two types of concrete and masonry foundation walls: (1) full height foundation walls and (2) foundation walls that include above grade frame walls. R404.1 also covers two types of requirements for foundation walls:

1. Anchoring and Wall Blocking Requirements for Full Height Foundation Walls
See Section 2 and Appendix A
2. Vertical Reinforcement for Full and Partial Height Foundation Walls
See Section 3

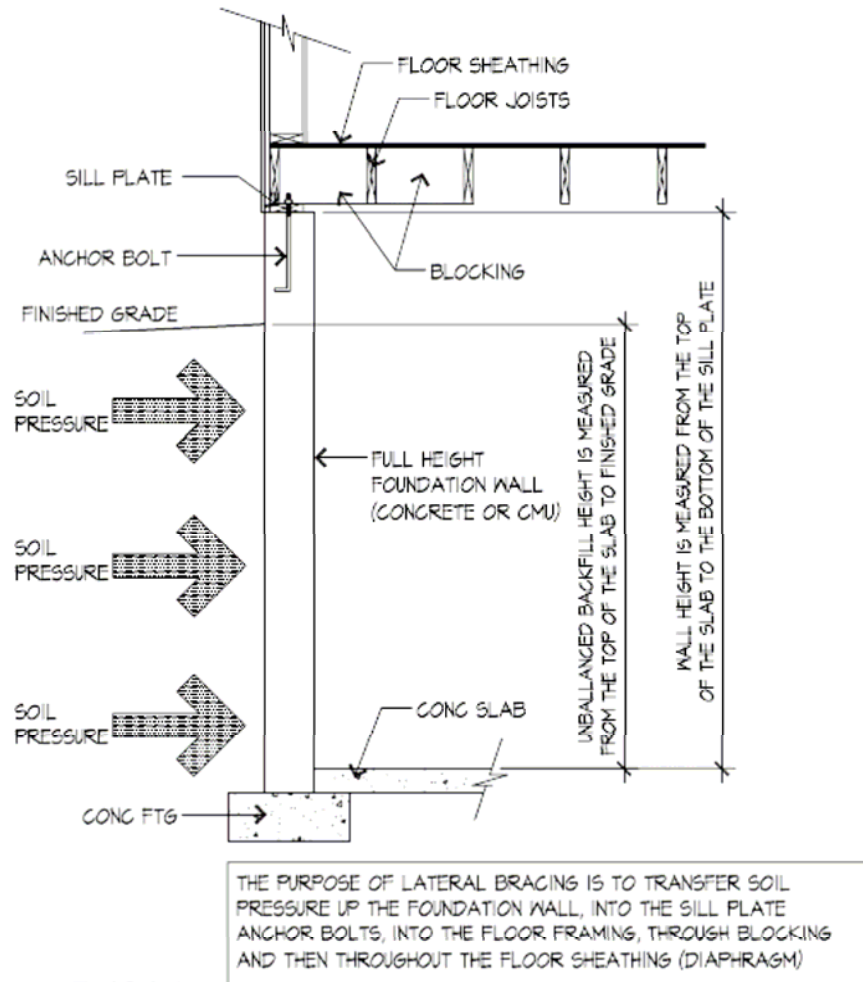
See Section 4 for the code language for these topics.

When Are Designs Required?

There are circumstances where an engineered design will be required if it is outside the bounds or assumptions of Tables within Section R404.1. They will be marked by "DR" or "Design required" or will have a footnote that states, "A design shall be provided."

There are also circumstances where a wall or backfill height falls outside the requirement for these tables and doesn't require any additional support. These circumstances will be marked "N/R" or "none required."

Section 2: Anchoring and Foundation Wall Blocking Requirements for Full Height Foundation Walls



R404.1

CONCRETE AND MASONRY FOUNDATION WALLS

Full-height foundation walls are made from concrete or masonry from the top of the footing to the top of the foundation wall as shown in Figure R404.1. Full height foundation walls transition to a sill plate and rim joist. Section R404.1 of the IRC describes how to transfer the lateral load of the soil pressure on foundation walls to the floor framing and floor sheathing. BAM contracted with Ulteig Engineers to develop an alternate, cost-effective method of complying with the 2006 IRC requirements for these types of walls, called the *MN State Code Compliant Foundation Wall Support Guidelines*.

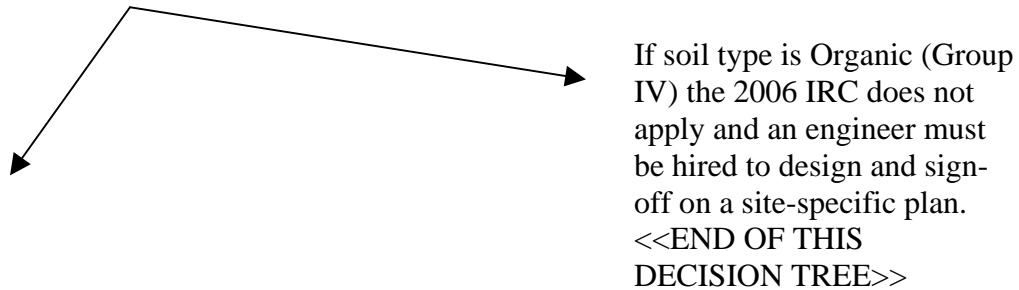
MN State Code Compliant Foundation Wall Support Guidelines is located in Appendix A of this document. To use the *MN State Code Compliant Foundation Wall Support Guidelines* as an alternative method to meet the 2006 IRC, a contractor must get prior approval from a local code official. Use Decision Tree #1 on page ?? to determine what subset of drawings within the *MN State Code Compliant Foundation Wall Support Guidelines* you need to submit to a code official. Check them off on the drawing index (See S-1A on page ?? of Appendix A) and include all checked pages with the plan approval. All the assumptions in S-1B, S1-C, S-2 and any other checked drawing must be followed (See pages ??, ??, and ?? of Appendix A).

Decision Tree #1 for R404.1

Lateral Support for Full Height Concrete or Masonry Foundation Walls (anchoring and wall blocking details)

Question 1: What is the soil type?

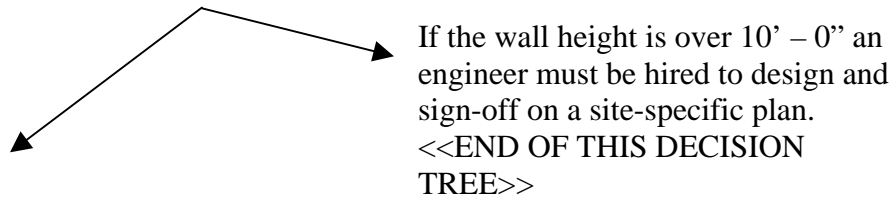
Use Table R405.1 on page ?? to determine whether your soil type is Group I, II, III or IV.



If soil type is Group I, II, or III go to Question 2.

Question 2: What is the height of the wall?

Measure from the top of the slab to the top of the concrete or masonry wall



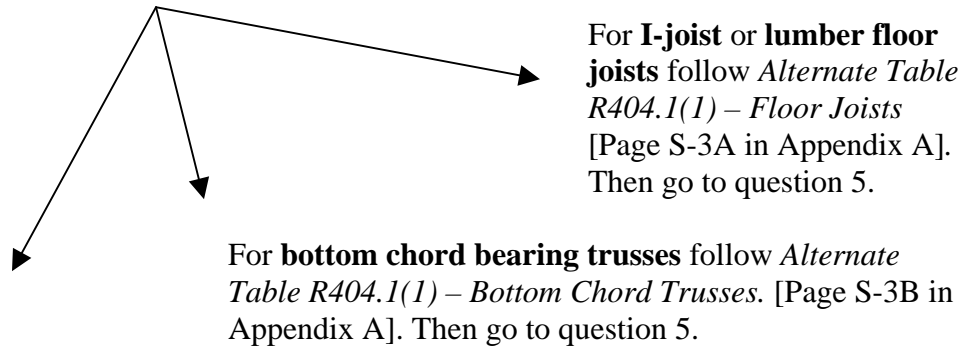
If the wall height is 10' – 0" or under to to Question 3

Question 3: What is the unbalanced backfill height?

Measure from the top of the slab to finished grade. Then Use *Alternate Table R404.1(2)* [Page S-2 in Appendix A] to determine the spacing for 1/2" anchor bolts. Anchor bolts can also be substituted with pre-manufactured metal straps or other approved anchors, provided they are installed according to manufacturer's recommendations. Use the number in parenthesis () to determine what type of connector to use. Ask your manufacturer's representative for assistance. Give the specifications for meeting Alternate Table R404.1(2) to your foundation wall contractor. Go to question 4.

Question 4: What type of floor framing is used?

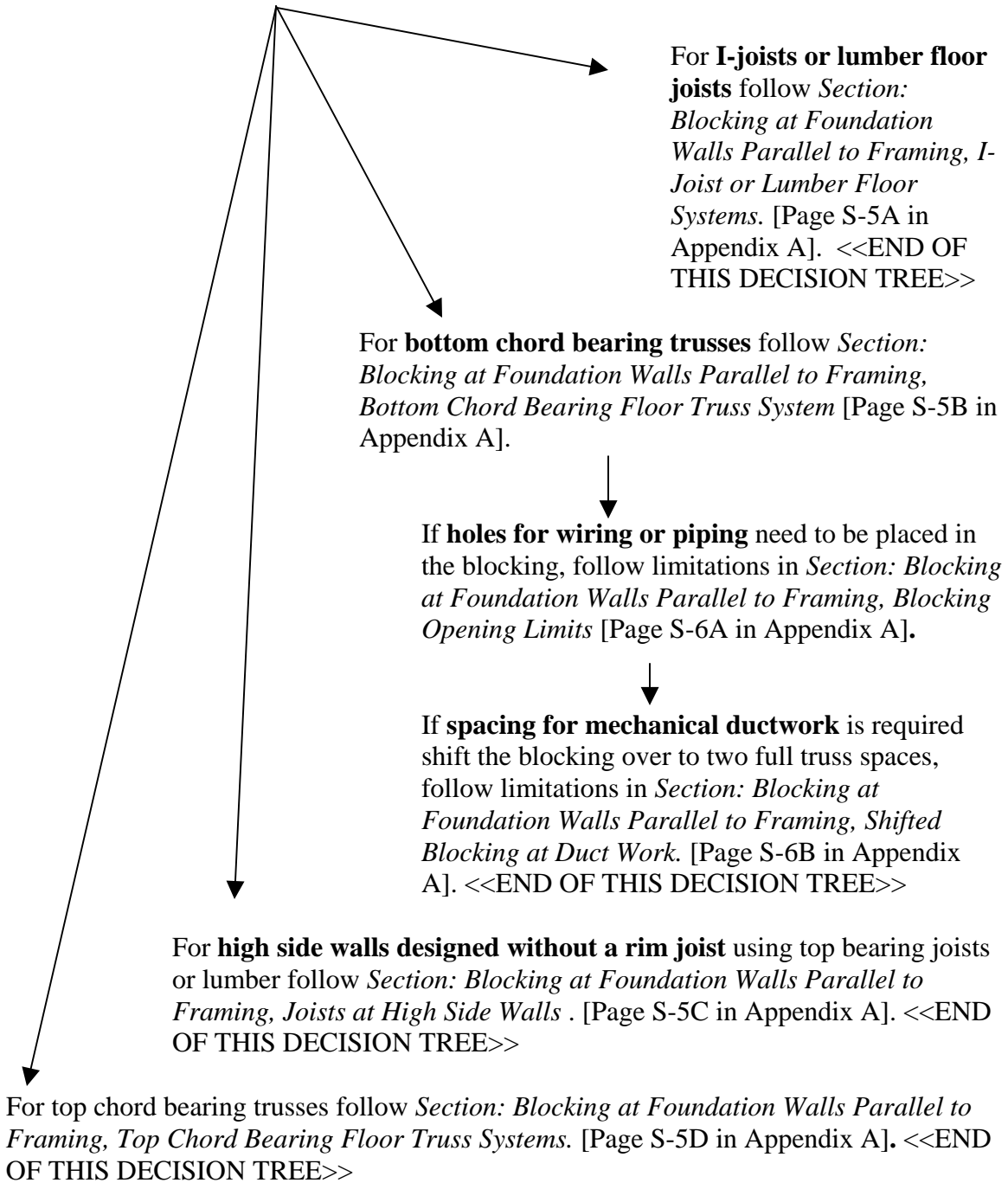
How will floor joists, bottom bearing trusses, or top bearing trusses be connected to the top of the foundation wall?



For **top bearing trusses** follow *Alternate Table R404.1(1) – Top Chord Trusses*. [Page S-3C in Appendix A]. Then go to question 5.

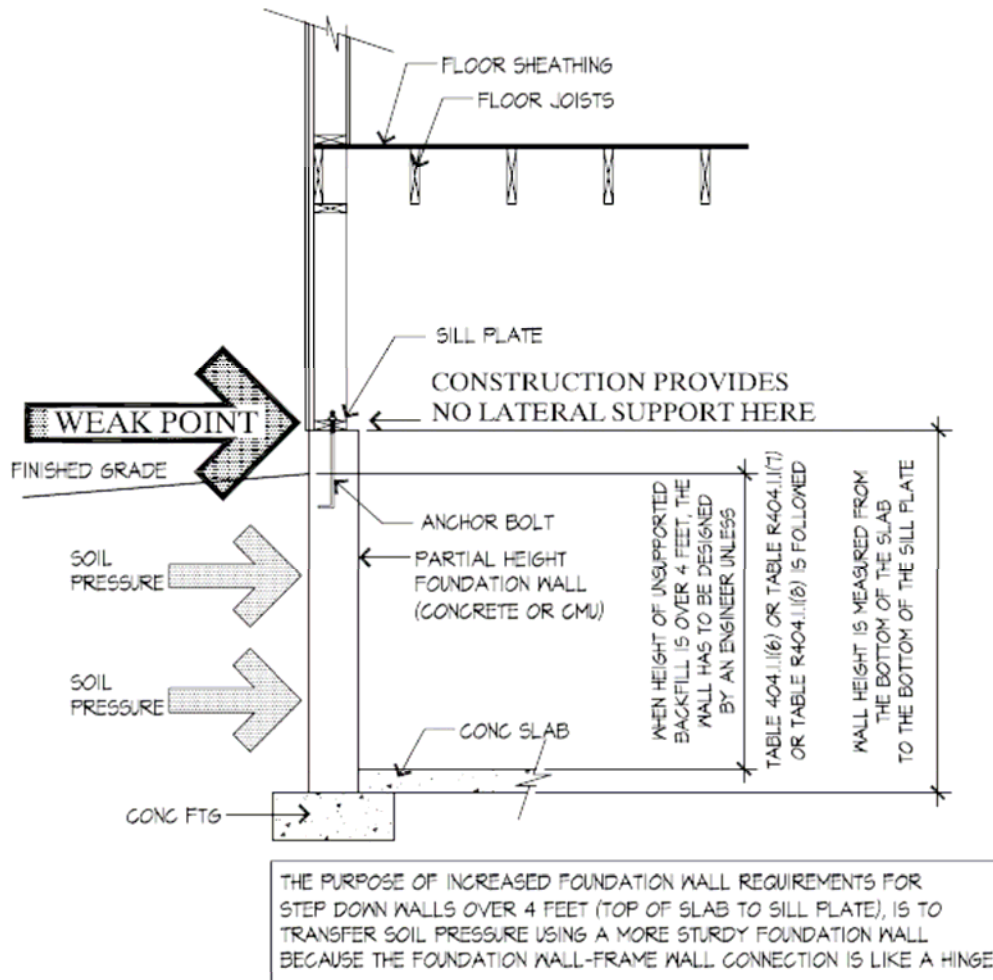
Question 5: How often does blocking need to be installed? See. Use the Table called *Blocking Spacing (inches) for Full Height Foundation Walls* [Page S-4 in Appendix A] to figure out how often blocking needs to be installed at framing that is located parallel to foundation walls. Coordinate blocking with framers, HVAC contractors and other trades, if necessary. Then go to question 6.

Question 6: What blocking strategy will be used?



Section 3: Vertical Reinforcement for Full Height and Partial Height Foundation Walls

Foundation Walls with Above Grade Frame Walls



R404.1.3

PARTIAL HEIGHT FRAMED FOUNDATION WALL (CONCRETE OR MASONRY)

When a concrete or masonry foundation transitions to an above-grade frame wall it is called a "cantilevered" wall in the new code. The above grade wall can't pass the lateral load of the soil pressure onto the floor framing and floor sheathing since there is no rim joist to transfer the load through. Instead, the code allows a method to make the foundation wall more structurally sound at the bottom of the wall. This applies to all above grade partial height foundation walls with unbalanced backfill over 4 ft.

Full height masonry foundation walls may also need vertical reinforcement as required in Tables R404.1.1(1), R404.1.1(2), R404.1.1(3), or R404.1.1(4) depending on the size of

the block used. Full height concrete walls may also need vertical reinforcement when required by Table R404.1.1(5).

The following table shows the types and characteristics of full and partial height foundation walls from Section R404.1. Use Decision Tree #2 is to help determine which of the eight possible tables should be used to construct foundation walls in specific types of soil according to R404.1. The decision tree also shows when a code official can require a site-specific design by an engineer or when there is no additional reinforcement necessary within R404.1.

Types and Characteristics of Foundation Walls in Section R404.1

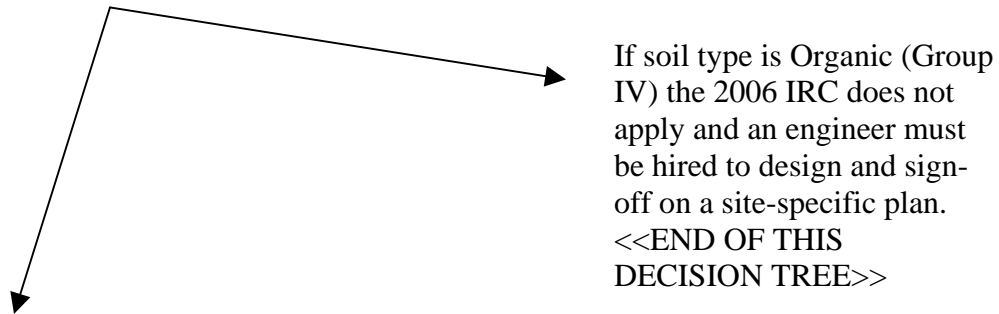
Table Name in 2006 IRC	Height of foundation wall	Type of foundation wall	Maximum wall height that triggers table	Measured from what part of slab?	Maximum unbalanced backfill height that triggers table
R404.1.1(1)	Full Height	Plain Masonry (unreinforced)	5' 0"	Top	4' 0"
R404.1.1(2)	Full Height	8" Masonry (reinforced)	6' 8"	Top	4' 0"
R404.1.1(3)	Full Height	10" Masonry (reinforced)	6' 8"	Top	4' 0"
R404.1.1(4)	Full Height	12" Masonry (reinforced)	6' 8"	Top	4' 0"
R404.1.1(5)	Full Height	Concrete	5' 0"	Top	4' 0"
R404.1.1(6)	Partial Height (cantilevered)	8" Cantilevered Concrete or Masonry	4' 0"	Bottom	3' 0"
R404.1.1(7)	Partial Height (cantilevered)	10" Cantilevered Concrete or Masonry	4' 0"	Bottom	3' 0"
R404.1.1(8)	Partial Height (cantilevered)	12" Cantilevered Concrete or Masonry	4' 0"	Bottom	3' 0"

Decision Tree #2 for R404.1.1, R404.1.2 & R404.1.3 Minimum Vertical Reinforcement for Concrete and Masonry Foundation Walls

Full or Partial Height

Question 1: What is the soil type?

Use Table R405.1 to determine whether your soil type is Group I, II, III or IV.

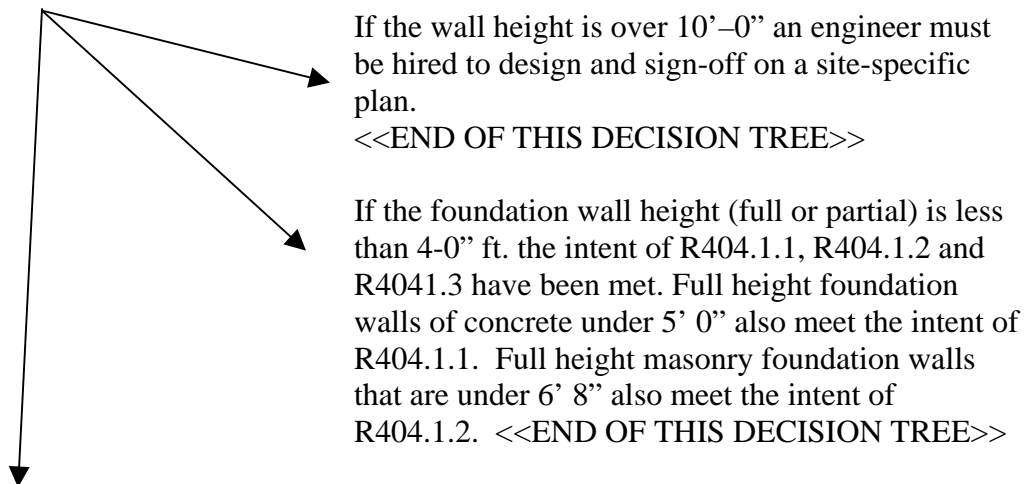


If soil type is Group I, II, or III go to Question 2.

Question 2: What is the height of the wall?

For **Full Height Foundation Walls** - measure from the top of the slab to the top of the concrete or masonry foundation wall. See page ?? for a diagram.

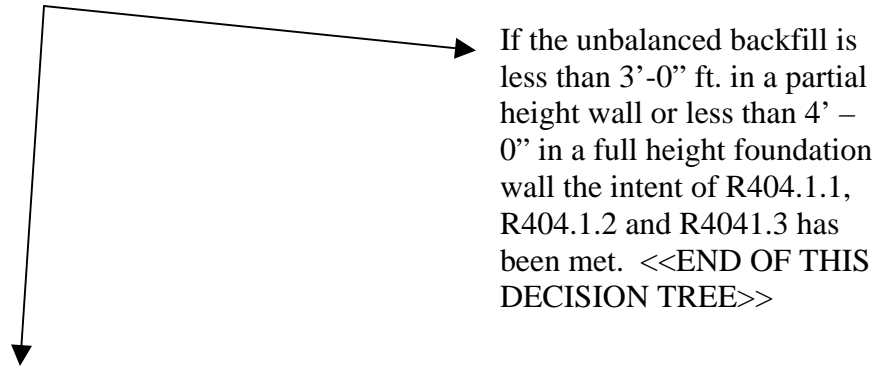
For **Partial Height Framed Foundation Walls** - measure from the bottom of the slab to the top of the concrete or masonry wall. See page ?? for a diagram.



If wall height is within the bounds of the Table requirements in R404.1 go to Question 3.

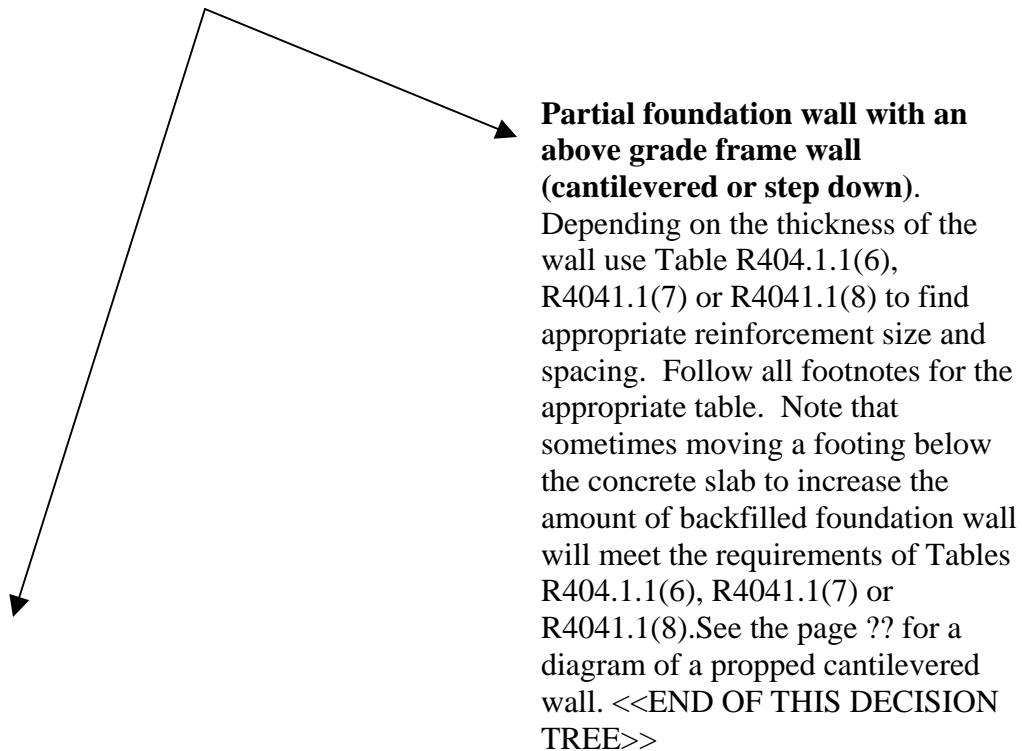
Question 3: What is the unbalanced backfill height?

Measure from the top of the slab to the finished grade



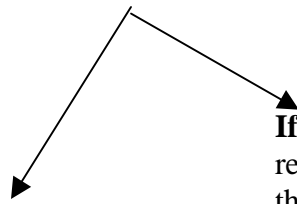
If the unbalanced backfill is at least 3'-0" ft. or more go to Question 4.

Question 4: Is the concrete or masonry foundation wall full height or does the partial foundation wall transition to an above grade frame wall (also called a step down or cantilevered wall)?



For full height walls go to Question 5.

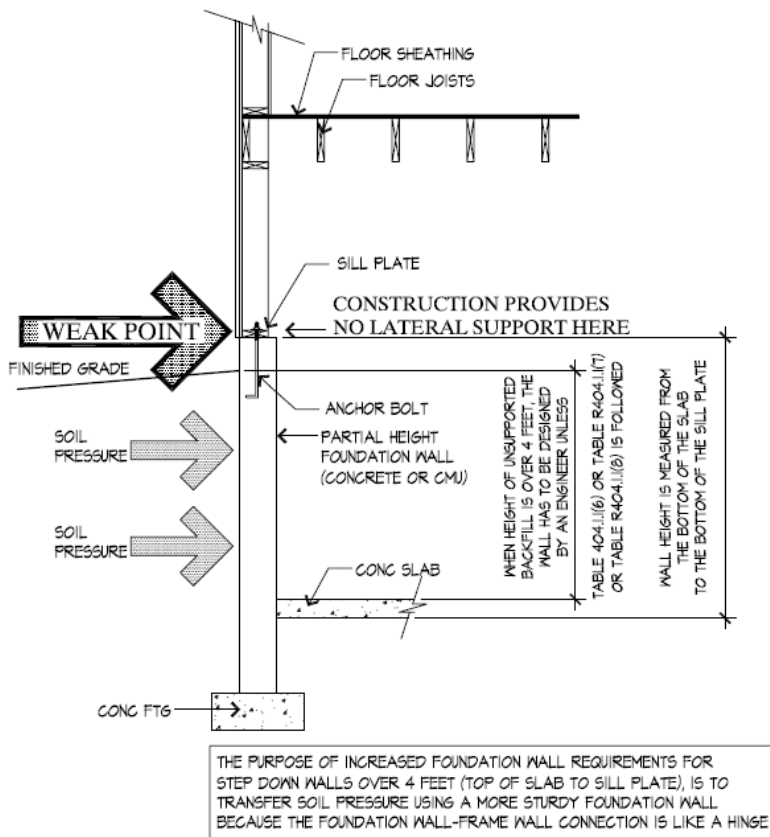
Question 5 is full height wall constructed out of concrete or masonry?



If concrete, use Table R404.1.1(5) to find appropriate reinforcement size and spacing. Follow all footnotes for the table. <<END OF THIS DECISION TREE>>

If masonry, use Table R404.1.1(1) for plain masonry walls, Table R404.1.1(2) for 8” masonry walls with reinforcing, Table R404.1.1(3) for 10” masonry walls with reinforcing, or Table R404.1.1(4) for 12” masonry walls with reinforcing. Follow all footnotes for the appropriate table. <<END OF THIS DECISION TREE>>

Note that a propped cantilevered wall can also be used to reduce the vertical reinforcement requirements for some cantilevered partial height foundation walls



R404.1.3 PROP

PARTIAL HEIGHT FRAMED FOUNDATION WALL (CONCRETE OR MASONRY)

Section 4: Code Language for Section R404.1 of the 2006 IRC

According to BAM's *MN State Code Compliant Foundation Wall Support Guidelines*

The code language in this document corresponds to the alternate code language proposed by the Builders Association of Minnesota. The *BAM MN State Code Compliant Foundation Wall Support Guidelines* is a package of engineered, code-compliant alternative method for foundation wall support. The Guidelines include alternatives for Table R404.1(1) and Table R404.1(2) and associated requirements for these sections. All other language in this document matches the new 2006 IRC language proposed by the State of Minnesota, including the complete deletion of Table R404.(3).

- Underlined text indicates 2006 IRC code language was amended by the State of Minnesota.
- Double underlined text indicates code language that was changed because of the provisions of the *MN State Code Compliant Foundation Wall Support Guidelines*.
- *Italicized text* indicates editorial comments

SECTION R404 FOUNDATION AND RETAINING WALLS (including changes from the *BAM MN State Code Compliant Foundation Wall Support Guidelines*)

R404.1 Concrete and masonry foundation walls. Concrete and masonry foundation walls shall be selected and constructed in accordance with the provisions of Section R404 or in accordance with ACI 318, ACI 332, NCMA TR68–A or ACI 530/ASCE 5/TMS 402 or other approved structural standards. When ACI 318, ACI 332 or ACI 530/ASCE 5/TMS 402 or the provisions of Section R404 are used to design concrete or 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.

Foundation walls that meet all of the following shall be considered laterally supported:

1. Full basement floor shall be 3.5 inches (89 mm) thick concrete slab poured tight against the bottom of the foundation wall. *Interior insulation cannot be installed between the slab and the foundation wall.*
2. Floor joists and blocking shall be connected to the sill plate at the top of wall by the prescriptive method called out in Alternative to Table R404.1(1), or; shall be connected with an approved connector with listed capacity meeting Alternative to Table R404.1(1).
3. Bolt spacing for the sill plate shall be no greater than per Alternative to Table R404.1(2).
4. Floor shall be blocked perpendicular to the floor joists. Blocking shall be full depth within two joist spaces of the foundation. Or extended to two full spaces per MN State Code Compliant Foundation Wall Support Guidelines

5. Where foundation walls support unbalanced load on opposite sides of the building, such as a daylight basement, the rim board shall be attached to the sill with a 20 gage metal angle clip at 24 inches on center, with five 8d nails per leg, or an approved connector supplying 230 pounds per linear foot capacity.

The original Table R404.1(1) Top Reactions and Prescriptive Support for Foundation Walls was deleted. This table was replaced by three others in the BAM Foundation Wall Support Guide. Only one table is needed depending on whether a floor joist, bottom bearing floor truss or top bearing floor truss is used (See pages ??, ?? and ?? for these tables:

- a. S-3A Joist Bearing Anchorage Detail
- b. S-3B Bottom Chord Bearing Truss Anchorage Detail
- c. S-3C Top Chord Bearing Truss Anchorage Detail

The original Table R404.1(2) Maximum Anchor Bolt Spacing for Supported Foundation Wall from the 2006 IRC was deleted, reformatted and replaced by Minnesota Amendment. An alternative table was developed for BAM that refined the options available to contractors for anchor bolt spacing. Concrete contractors will need to know the requirements for the particular basement they are constructing.

Alternative to Table R404.1(2)

This entire table has been rewritten and reorganized

½" DIAMETER ANCHOR BOLT SPACING (INCHES) FOR FULL HEIGHT FOUNDATION WALL

Foundation Height (top of basement slab to top of wall)	Backfill Height (above top of basement slab)	Group I Soil (Sand): GW, GP, SW & SP (30 PSF)	Group II Soil (Sandy Clay): GM, GC, SM-SC, & ML (45 PSF)	Group III Soil (Clay): SC, MH, ML-CL & I-CL (60 PSF)
8'- 0"	6' – 0" or Less	72 (140)	72 (200)	72 (270)
	7' - 0"	72 (210)	72 (320)	64 (430)
	7' - 4"	72 (250)	72 (370)	48 (490)
	7' - 6"	72 (260)	72 (400)	48 (530)
9'- 0"	7' – 0" or Less	72 (190)	72 (290)	72 (380)
	8' - 0"	72 (280)	64 (430)	40 (570)
	8' - 4"	73 (320)	56 (480)	40 (640)
	8' - 6"	72 (340)	48 (510)	32 (680)
10'- 0"	7' – 0" or Less	72 (170)	72 (260)	72 (340)
	8' - 0"	72 (260)	72 (380)	48 (510)
	9' - 0"	72 (370)	48 (550)	32 (730)
	9' - 4"	64 (410)	40 (610)	DR
	9' - 6"	56 (430)	32 (640)	DR

Number shown in () is the top of wall load in pounds per foot for use in the design of pre-manufactured metal strap or other approved anchors in lieu of anchor bolts

DR means a design is required for this condition.

IRC Table R404.1(3) was deleted in its entirety by the State of Minnesota.

The following three code sections (R404.1.1, R404.1.2, and R404.1.3) are not part of the MN State Code Compliant Foundation Wall Support Guidelines. {??Author's note: The associated tables will be modified when alternate values are confirmed by Dept. of Labor and Industry.} ~~Additional reinforcement sizes and spacing options are shown in Tables R404.1.1(6), R404.1.1(7), and R404.1.1(8) of this guide on pages ??, ?? and ??. The alternate values of rebar size and spacing are shown in parentheses on these tables. Ask for prior approval by a code official if a one of these values will be used.~~

R404.1.1 Masonry foundation walls. 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 the provisions of Section R404 and the applicable provisions of Sections R606, R607, and R608. Rubble stone masonry foundation walls shall be constructed in accordance with Sections R404.1.8 and R607.2.2. Cantilevered masonry foundation walls shall be constructed as set forth in Table R404.1.1(6), R404.1.1(7), or R404.1.1(8). Cantilevered means: foundation walls that do not have permanent lateral support at the top.

R404.1.2 Concrete foundation walls. Concrete foundation walls shall be constructed as set forth in Table R404.1.1(5) and shall also comply with the provisions of Section R404 and the applicable provisions of Section R404.2. Cantilevered concrete foundation walls shall be constructed as set forth in Table R404.1.1(6), R404.1.1(7), or R404.1.1(8). Cantilevered means: foundation walls that do not have permanent lateral support at the top.

R404.1.3 Design required. Concrete or masonry foundation walls shall be designed in accordance with accepted engineering practice when either of the following conditions exists:

1. Walls are subject to hydrostatic pressure from groundwater.
2. Walls supporting more than 48 inches (1219 mm) of unbalanced backfill that do not have permanent lateral support at the top or bottom.

Exception: Cantilevered concrete and masonry foundation walls constructed in accordance with Table R404.1.1(6), R404.1.1(7), or R404.1.1(8).

~~R404.1.4 Seismic Design Categories D0, D1 and D2.~~ *[language isn't applicable to MN, only deals with earthquake prone areas.]*

R404.1.5 Foundation wall thickness based on walls supported. The thickness of concrete and masonry foundation walls shall not be less than the thickness of the wall supported, except that foundation walls of at least 8-inch (203 mm) nominal thickness shall be permitted under brick veneered frame walls and under 10-inch-wide (254 mm) cavity walls where the total height of the wall supported, including gables, is not more than 20 feet (6096 mm), provided the requirements of Sections R404.1.1 and R404.1.2 are met.

R404.1.5.1 Pier and curtain wall foundations. *[This section was omitted because this is not a construction technique used in Minnesota].*

R404.1.6 Height above finished grade. Concrete and masonry foundation walls shall extend above the finished grade adjacent to the foundation at all points a minimum of 4 inches (102 mm) where masonry veneer is used and a minimum of 6 inches (152 mm) elsewhere.

R404.1.7 Backfill placement. 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.

Exception: Bracing is not required for walls supporting less than 4 feet (1219 mm) of unbalanced backfill.

R404.1.8 Rubble stone masonry. *[the section on rubble stone masonry foundations was omitted from this summary of concrete and masonry foundations]. No Minnesota-specific amendments were made to this section, see 2006 IRC for complete text.*

R404.2 Wood foundation walls. *[the section on wood foundations was omitted from this summary of concrete and masonry foundations]. No Minnesota-specific amendments were made to this section, see 2006 IRC for complete text.*

R404.3 Wood sill plates. Wood sill plates shall be a minimum of 2-inch by 4-inch (51 mm by 102 mm) nominal lumber. Sill plate anchorage shall be in accordance with Sections R403.1.6 and R602.11.

R404.4 Insulating concrete form foundation walls. *[this section was omitted from this summary of concrete and masonry foundations]. No Minnesota-specific amendments were made to this section, see 2006 IRC for complete text. For full wall height ICF foundation walls contractors may use the alternate requirements for anchoring and wall blocking details described in Decision Tree #1 on page ?? as an alternative method.*

Note that this table is normally not used for most construction situations in Minnesota.

R404.1.1(1) Plain Masonry Foundation Walls

MAXIMUM WALL HEIGHT (feet) [Top of basement slab to top of masonry wall]	MAXIMUM UNBALANCED BACKFILL HEIGHT (feet)	Plain Masonry Minimum Nominal Wall Thickness (inches)		
		Soil Classes		
		GW, GP, SW and GP	GM, GC, SM, SM-SC and ML	SC, MH, ML-CL and Inorganic CL
5	4	6 solid or 8	6 solid or 8	6 solid or 8
	5	6 solid or 8	8	10
6	4	6 solid or 8	6 solid or 8	6 solid or 8
	5	6 solid or 8	8	10
	6	8	10	12
7	4	6 solid or 8	8	8
	5	s solid or 8	10	10
	6	10	12	10 solid
	7	12	10 solid	12 solid
8	4	6 solid or 8	6 solid or 8	8
	5	6 solid or 8	10	12
	6	10	12	12 Solid
	7	12	12 solid	Footnote e
	8	10 solid	12 solid	Footnote e
9	4	6 solid or 8	6 solid or 8	8
	5	8	10	12
	6	10	12	12 Solid
	7	12	12 solid	Footnote e
	8	12 solid	Footnote e	Footnote e
	9	Footnote e	Footnote e	Footnote e

For SI: 1 inch= 25.4mm, 1 foot= 304.8 mm, 1 pound per square inch = 6.895 Pa.

- a. Mortar shall be Type M or S and masonry shall be laid in running bond. UngROUTED hollow masonry units are permitted except where otherwise indicated.
- b. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table R405.1
- c. Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with the interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.
- d. Solid grouted hollow units or solid masonry units.
- e. Wall construction shall be in accordance with Table R404.1.1(2),(3),(4) or a design shall be provided.

Table R404.1.1(2)
8" Masonry Foundation Walls With Reinforcing

Where d > 5 inches (a)

Alternate vertical reinforcement values as shown in () were extrapolated as equivalents by the Minnesota Concrete Masonry Association

Wall Height [Top of basement slab to top of masonry wall]	Height of Unbalanced Backfill (e)	Minimum Vertical Reinforcement (b, c)		
		Soil Classes and lateral load (d) (psf per foot below grade)		
		GW, GP, SW and SP Soils	GM, GC, SM, SM-SC and ML Soils	SC, ML-CL and Inorganic CL Soils
6 ft. 8 in.	4 ft. or less	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	6 ft. 8 in.	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
7 ft. 4 in.	4 ft. (or less)	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	6 feet	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")
	7 ft. 4 in.	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
8 feet	4 ft. (or less)	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	6 feet	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")
	7 feet	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	8 feet	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")
8 ft. 8 in.	4 ft. (or less)	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	6 feet	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")
	7 feet	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	8 ft. 8 in.	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")	#6 @ 24" (#5 @ 16") (#7 @ 32")

9 ft. 4 in.	4 ft. (or less)	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")
	6 feet	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
	7 feet	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	8 feet	#6 @ 48" (#4 @ 16") \ (#5 @ 32") (#7 @ 64")	#6 @ 40" (#5 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 40" (#5 @ 16") (#5 @ 24") (#7 @ 48")
	9 ft. 4 in.	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 24" (#5 @ 16") (#7 @ 32")	#6 @ 16"
10 feet	4 ft. (or less)	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")
	5 feet	#4 @ 48" (#5 @ 72")	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")
	6 feet	#4 @ 48" (#5 @ 72")	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
	7 feet	#5 @ 48" (#4 @ 24") (#6 @ 64") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")
	8 feet	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")	#6 @ 24" (#5 @ 16") (#7 @ 32")
	9 feet	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 24" (#5 @ 16") (#7 @ 32")	#6 @ 16"
	10 feet	#6 @ 32" (#5 @ 16") (#7 @ 40")	#6 @ 16"	#6 @ 16"

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. The first reinforcing bar size and spacing is as prescribed in the IRC tables and is followed by alternative bar sizes and spacing having an equivalent cross-sectional area of reinforcement per lineal foot of wall as permitted, providing the spacing of the reinforcement does not exceed 72 inches.

c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be at least 5 inches.

d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. Refer to Table 1.

e. Unbalanced backfill height is the difference in height of the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.

Table R404.1.1(3)
10" Masonry Foundation Walls With Reinforcing

Where d > 6.75 inches (a)

Alternate vertical reinforcement values as shown in () were extrapolated as equivalents by the Minnesota Concrete Masonry Association

Wall Height [Top of basement slab to top of masonry wall]	Height of Unbalanced Backfill (e)	Minimum Vertical Reinforcement (b, c)		
		Soil Classes and lateral load (d) (psf per foot below grade)		
		GW, GP, SW and SP Soils	GM, GC, SM, SM-SC and ML Soils	SC, ML-CL and Inorganic CL Soils
6 ft. 8 in.	4 ft. or less	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 ft. 8 in.	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#5 @ 56" (#4 @ 32") (#6 @ 72')
7 ft. 4 in.	4 ft. (or less)	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')
	7 ft. 4 in.	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")
8 feet	4 ft. (or less)	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')
	7 feet	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")
	8 feet	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
8 ft. 8 in.	4 ft. (or less)	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')
	7 feet	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")
	8 ft. 8 in.	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")

9 ft. 4 in.	4 ft. (or less)	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 feet	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#5 @ 56" (#4 @ 32") (#6 @ 72')
	7 feet	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")
	8 feet	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72')	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	9 ft. 4 in.	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 24" (#5 @ 16") (#7 @ 32)
10 feet	4 ft. (or less)	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	5 feet	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")	#4 @ 56" (#5 @ 72")
	6 feet	#4 @ 56" (#5 @ 72")	#5 @ 56" (#4 @ 32") (#6 @ 72')	#5 @ 56" (#4 @ 32") (#6 @ 72')
	7 feet	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
	8 feet	#5 @ 56" (#4 @ 32") (#6 @ 72')	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	9 feet	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 24" (#5 @ 16") (#7 @ 32)
	10 feet	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 32" (#5 @ 16") (#7 @ 40")	#6 @ 24" (#5 @ 16") (#7 @ 32)

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. The first reinforcing bar size and spacing is as prescribed in the IRC tables and is followed by alternative bar sizes and spacing having an equivalent cross-sectional area of reinforcement per lineal foot of wall as permitted, providing the spacing of the reinforcement does not exceed 72 inches.

c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be at least 6.75 inches.

d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. See Table R405.1.

e. Unbalanced backfill height is the difference in height of the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.

Table 3

Table R404.1.1(4)
12" Masonry Foundation Walls With Reinforcing

Where d > 8.75 inches (a)

Alternate vertical reinforcement values as shown in () were extrapolated as equivalents by the Minnesota Concrete Masonry Association

Wall Height [Top of basement slab to top of masonry wall]	Height of Unbalanced Backfill (e)	Minimum Vertical Reinforcement (b, c)		
		Soil Classes and lateral load (d) (psf per foot below grade)		
		GW, GP, SW and SP Soils	GM, GC, SM, SM-SC and ML Soils	SC, ML-CL and Inorganic CL Soils
6 ft. 8 in.	4 ft. or less	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 ft. 8 in.	#4 @ 72"	#4 @ 72"	#5 @ 72" (#4 @ 40")
7 ft. 4 in.	4 ft. (or less)	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 feet	#4 @ 72"	#4 @ 72"	#5 @ 72" (#4 @ 40")
	7 ft. 4 in.	#4 @ 72"	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")
8 feet	4 ft. (or less)	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 feet	#4 @ 72"	#4 @ 72"	#5 @ 72" (#4 @ 40")
	7 feet	#4 @ 72"	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")
	8 feet	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 64" (#4 @ 24") (#5 @ 40") (#7 @ 72")
8 ft. 8 in.	4 ft. (or less)	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 feet	#4 @ 72"	#4 @ 72"	#5 @ 72" (#4 @ 40")
	7 feet	#4 @ 72"	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")
	8 ft. 8 in.	#5 @ 72" (#4 @ 40")	#7 @ 72" (#4 @ 24") (#5 @ 32") (#6 @ 48")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
9 ft. 4 in.	4 ft. (or less)	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 feet	#4 @ 72"	#5 @ 72" (#4 @ 40")	#5 @ 72" (#4 @ 40")
	7 feet	#4 @ 72"	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")
	8 feet	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
	9 ft. 4 in.	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")

10 feet	4 ft. (or less)	#4 @ 72"	#4 @ 72"	#4 @ 72"
	5 feet	#4 @ 72"	#4 @ 72"	#4 @ 72"
	6 feet	#4 @ 72"	#5 @ 72" (#4 @ 40")	#5 @ 72" (#4 @ 40")
	7 feet	#4 @ 72"	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 72" (#4 @ 32") (#5 @ 48")
	8 feet	#5 @ 72" (#4 @ 40")	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 48" (#4 @ 16") (#5 @ 32") (#7 @ 64")
	9 feet	#6 @ 72" (#4 @ 32") (#5 @ 48")	#6 @ 56" (#4 @ 24") (#5 @ 32") (#7 @ 72")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")
	10 feet	#6 @ 64" (#4 @ 24") (#5 @ 40") (#7 @ 72")	#6 @ 40" (#4 @ 16") (#5 @ 24") (#7 @ 48")	#6 @ 32" (#5 @ 16") (#7 @ 40")

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. The first reinforcing bar size and spacing is as prescribed in the IRC tables and is followed by alternative bar sizes and spacing having an equivalent cross-sectional area of reinforcement per lineal foot of wall as permitted, providing the spacing of the reinforcement does not exceed 72 inches.

c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be at least 8.75 inches.

d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. See Table R405.1.

e. Unbalanced backfill height is the difference in height of the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.

Table R404.1.1(5)
Concrete Foundation Walls^{h,i,j,k}

Maximum Wall Height (feet) [top of basement slab to top of concrete wall]	Maximum Unbala-nced Backfill Height ^b (feet)	Minimum Vertical Reinforcement Size and Spacing ^{c,d,e,f,l}											
		Soil classes ^a and design lateral soil (PSF per foot of depth)											
		GW, GP, SW and SP 30				GM, GC, SM, SM-SC and ML 45				SC, ML-CL and inorganic CL 60			
		Minimum wall thickness (inches)											
		5.5	7.5	9.5	11.5	5.5	7.5	9.5	11.5	5.5	7.5	9.5	11.5
5	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
6	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	PC	PCg	PC	PC	#4 @ 35"	PCg	PC	PC
7	6	PC	PC	PC	PC	#5 @ 48"	PC	PC	PC	#5 @ 36"	PC	PC	PC
	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	PC	PC	PC	PC	#5 @ 47"	PC	PC	PC
	6	PC	PC	PC	PC	#5 @ 42"	PC	PC	PC	#6 @ 43"	#5 @ 48"	PCg	PC
8	7	#5 @ 46"	PC	PC	PC	#6 @ 42"	#5 @ 46"	PCg	PC	#6 @ 34"	#6 @ 48"	PC	PC
	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	#4 @ 38"	PCg	PC	PC	#5 @ 43"	PC	PC	PC
	6	#4 @ 37"	PCg	PC	PC	#5 @ 37"	PC	PC	PC	#6 @ 37"	#5 @ 43"	PCg	PC
	7	#5 @ 40"	PC	PC	PC	#6 @ 37"	#5 @ 41"	PC	PC	#6 @ 34"	#6 @ 43"	PC	PC
9	8	#6 @ 43"	#5 @ 47"	PC	PC	#6 @ 34"	#6 @ 43"	PC	PC	#6 @ 27"	#6 @ 32"	#6 @ 44"	PC
	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	#4 @ 35"	PCg	PC	PC	#5 @ 40"	PC	PCe	PC
	6	#4 @ 34"	PCg	PC	PC	#6 @ 48"	PC	PC	PC	#6 @ 36"	#5 @ 39"	PCg	PC
	7	#5 @ 36"	PC	PC	PC	#6 @ 34"	#5 @ 37"	PC	PC	#6 @ 33"	#6 @ 38"	#5 @ 37"	PCg
	8	#6 @ 38"	#5 @ 41"	PCg	PC	#6 @ 33"	#6 @ 38"	#5 @ 37"	PC	#6 @ 24"	#7 @ 39"	#6 @ 39"	#4 @ 48" h
10	9	#6 @ 34"	#6 @ 46"	PC	PC	#6 @ 26"	#7 @ 41"	#6 @ 41"	PC	#6 @ 19"	#7 @ 31"	#7 @ 41"	#6 @ 39"
	4	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
	5	PC	PC	PC	PC	#4 @ 33"	PCg	PC	PC	#5 @ 38"	PC	PC	PC
	6	#5 @ 48"	PCg	PC	PC	#6 @ 45"	PC	PC	PC	#6 @ 34"	#5 @ 37"	PC	PC
	7	#6 @ 47"	PC	PC	PC	#6 @ 34"	#6 @ 48"	PC	PC	#6 @ 30"	#6 @ 35"	#6 @ 48"	PCg
	8	#6 @ 34"	#5 @ 38"	PC	PC	#6 @ 30"	#7 @ 47"	#6 @ 47"	PCg	#6 @ 22"	#7 @ 35"	#7 @ 48"	#6 @ 45" h
10	9	#6 @ 34"	#6 @ 41"	#4 @ 48"	PCg	#6 @ 23"	#7 @ 37"	#7 @ 48"	#4 @ 48" h	DR	#6 @ 22"	#7 @ 37"	#7 @ 47"
	10	#6 @ 28"	#7 @ 45"	#6 @ 45"	PC	DR	#7 @ 31"	#7 @ 40"	#6 @ 38"	DR	#6 @ 22"	#7 @ 30"	#7 @ 38"

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa; 1 pound per square foot = 0.157 kPa/mm.

a. Soil classes are in accordance with the United Soil Classification System. Refer to Table R405.1

b. Unbalanced backfill height is the difference in height of the exterior and interior finish ground levels. Where there is an interior concrete slab, the unbalanced backfill height shall be measured from the exterior finish ground level to the top of the interior concrete slab.

c. The size and spacing of the vertical reinforcement shown in the table is based on the use of reinforcement with a minimum yield strength of 60,000 psi. Vertical reinforcement with a minimum yield strength of 40,000 psi or 50,000 psi is permitted, provided that the same size bar is used and the spacing shown in the table is reduced by multiplying the spacing by 0.67 or 0.83 respectively.

d. Vertical reinforcement, when required, shall be placed nearest the inside face of the wall at a distance d from the outside face (soil side) of the wall. The distance d is equal to the wall thickness, t, minus 1.25 inches plus one-half the bar diameter, db (d = t - (1.25 + db/2)). The reinforcement shall be placed within a tolerance of + or - 3/8 inch where d is less than or equal to 8 inches, or + or - 1/2 inch where d is greater than 8 inches.

- e. In lieu of the reinforcement shown, smaller reinforcing bar sizes and closer spacings resulting in an equivalent cross-sectional area of reinforcement per linear foot of wall are permitted.
- f. Concrete cover for reinforcement measured from the inside face of the wall shall not be less than 3/4 inch. Concrete cover for reinforcement measured from the outside face of the wall shall not be less than 1 1/2 inches for No. 5 bars and smaller, and not less than 2 inches for larger bars.
- g. The minimum thickness is permitted to be reduced 2 inches, provided the minimum specified compressive strength of concrete f_c , is 4,000 psi.

**TABLE R404.1.1(6)
CANTILEVERED CONCRETE AND MASONRY FOUNDATION WALLS**

MAXIMUM WALL HEIGHT ^j (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^e (feet)	MINIMUM VERTICAL REINFORCEMENT SIZE AND SPACING FOR 8-INCH NOMINAL WALL THICKNESS ^{a, b, c, e, f, i, k}		
		Soil Classes ^d		
		GW, GP, SW, and SP	GM, GC, SM, SM-SC, and ML	SC, MH, ML-CL, and inorganic CL
4	3	None required	None required	None required
	4	None required	None required	No. 4 @ 72 in. o.c.
5	3	None required	None required	None required
	4	No. 4 @72 in. o.c.	No. 4 @56 in. o.c. ^h	No. 4 @40 in. o.c. ^g
	5	No. 4 @72 in. o.c.	No. 4 @56 in. o.c. ^h	No. 4 @40 in. o.c. ^g

a. Mortar shall be Type M or S and masonry shall be laid in running bond. Minimum unit compressive strength is 1900 psi.

b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches.

c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be no greater than 2.5 inches.

d. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table R405.1.

e. Interior concrete floor slab shall be placed tight to the wall. The exterior grade level shall be 6 inches minimum below the top of wall. Maximum height from top of slab to bottom of floor joists is 10 feet, 0 inches. Unbalanced backfill height is the difference in height of the exterior finish ground levels and the top of the interior concrete slab-on-grade.

f. Minimum footing size of 20 inches by 8 inches shall be placed on soil with a bearing capacity of 2000 psf. Minimum concrete compressive strength of footing shall be 3000 psi.

g. Provide propped cantilever wall: top of footing shall be 16 inches below the bottom of the concrete floor slab minimum.

h. Provide #5 Grade 60 dowels, 1 foot 6 inches long, to connect footing to wall. Embed dowel 5 inches into footing. Place dowels in center of wall thickness spaced at 32 inches o.c. maximum. No dowels are required where length of the foundation wall between perpendicular walls is two times the foundation wall height or less.

i. This table is applicable where the length of the foundation wall between perpendicular walls is 35 feet or less, or where the length of the foundation laterally supported on only one end by a perpendicular wall is 17 feet or less.

j. Maximum wall height is measured from top of the foundation wall to the bottom of the interior concrete slab-on-grade.

k. Install foundation anchorage per Section R403.1.6.

**TABLE R404.1.1(7)
CANTILEVERED CONCRETE AND MASONRY FOUNDATION WALLS**

MAXIMUM WALL HEIGHT ^j (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^e (feet)	MINIMUM VERTICAL REINFORCEMENT SIZE AND SPACING FOR 10-INCH NOMINAL WALL THICKNESS ^{a, b, c, e, f, i, k}		
		Soil Classes ^d		
		GW, GP, SW, and SP	GM, GC, SM, SM-SC, and ML	SC, MH, ML-CL, and inorganic CL
4	3	None required	None required	None required
	4	None required	None required	None required
5	3	None required	None required	None required
	4	None required	No. 4 @ 72 in. o.c.	No. 4 @ 64 in. o.c. ^g
	5	No. 4 @ 72 in. o.c.	No. 4 @ 72 in. o.c.	No. 4 @ 56 in. o.c. ^g
6	3	None required	No. 4 @ 72 in. o.c.	No. 4 @ 72 in. o.c.
	4	No. 4 @ 72 in. o.c.	No. 4 @ 72 in. o.c.	No. 4 @ 64 in. o.c. ^h
	5	No. 4 @ 64 in. o.c. ^h	No. 4 @ 40 in. o.c. ^{g, h}	No. 5 @ 48 in. o.c. ^{g, h}
	6	No. 4 @ 64 in. o.c. ^h	No. 4 @ 40 in. o.c. ^{g, h}	No. 5 @ 48 in. o.c. ^{g, h}

- a. Mortar shall be Type M or S and masonry shall be laid in running bond. Minimum unit compressive strength is 1,900 psi.
- b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches.
- c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be no greater than 2.5 inches.
- d. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table R405.1.
- e. Interior concrete slab-on-grade shall be placed tight to the wall. The exterior grade level shall be 6 inches minimum below the top of wall. Maximum height from top of slab-on-grade to bottom of floor joists is 10 inches, 0 inches. Unbalanced backfill height is the difference in height of the exterior finish ground levels and the top of the interior concrete slab-on-grade.
- f. Minimum footing size of 20 inches by 8 inches shall be placed on soil with a bearing capacity of 2,000 psf. Minimum concrete compressive strength of footing shall be 3,000 psi.
- g. Provide propped cantilever wall: top of footing shall be 16 inches below the bottom of the concrete floor slab minimum.
- h. Provide #5 Grade 60 dowels, 1 foot 6 inches long, to connect footing to wall. Embed dowel 5 inches into footing. Place dowels in center of wall thickness spaced at 32 inches o.c. maximum. No dowels are required where length of the foundation wall between perpendicular walls is two times the foundation wall height or less.
- i. This table is applicable where the length of the foundation wall between perpendicular walls is 35 feet or less, or where the length of the foundation laterally supported on only one end by a perpendicular wall is 17 feet or less.
- j. Maximum wall height is measured from top of the foundation wall to the bottom of the interior concrete slab-on-grade.
- k. Install foundation anchorage per R403.1.6.

**TABLE R404.1.1(8)
CANTILEVERED CONCRETE AND MASONRY FOUNDATION WALLS**

MAXIMUM WALL HEIGHT ^j (feet)	MAXIMUM UNBALANCED BACKFILL HEIGHT ^e (feet)	MINIMUM VERTICAL REINFORCEMENT SIZE AND SPACING FOR 12-INCH NOMINAL WALL THICKNESS ^{a, b, c, e, f, l, k}		
		Soil Classes ^d		
		GW, GP, SW, and SP	GM, GC, SM, SM-SC, and ML	SC, MH, ML-CL, and inorganic CL
4	3	None required	None required	None required
	4	None required	None required	None required
5	3	None required	None required	None required
	4	None required	None required	No. 4 @72 in. o.c.
	5	No. 4 @72 in. o.c.	No. 4 @72 in. o.c.	No. 4 @72 in. o.c.
6	3	None required	None required	None required
	4	None required	None required	No. 4 @72 in. o.c.
	5	No. 4 @72 in. o.c.	No. 4 @56 in. o.c. ^h	No. 4 @40 in. o.c. ^g
	6	No. 4 @72 in. o.c.	No. 4 @56 in. o.c. ^g	No. 4 @32 in. o.c. ^{g, h}
7	3	None required	None required	None required
	4	None required	No. 4 @72 in. o.c.	No. 4 @72 in. o.c.
	5	No. 4 @72 in. o.c.	No. 4 @56 in. o.c. ^h	No. 4 @40 in. o.c. ^g
	6	No. 4 @48 in. o.c. ^h	No. 5 @48 in. o.c. ^{g, h}	No. 6 @48 in. o.c. ^{g, h}
	7	No. 4 @48 in. o.c. ^h	No. 5 @40 in. o.c. ^{g, h}	No. 6 @48 in. o.c. ^{g, h}

- a. Mortar shall be Type M or S and masonry shall be laid in running bond. Minimum unit compressive strength is 1,900 psi.
- b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches.
- c. Vertical reinforcement shall be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of vertical reinforcement shall be no greater than 3 inches.
- d. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table R405.1.
- e. Interior concrete slab-on-grade shall be placed tight to the wall. The exterior grade level shall be 6 inches minimum below the top of wall. Maximum height from top of slab-on-grade to bottom of floor joists is 10 feet, 0 inches. Unbalanced backfill height is the difference in height of the exterior finish ground levels and the top of the interior concrete slab-on-grade.
- f. Minimum footing size of 20 inches by 8 inches shall be placed on soil with a bearing capacity of 2,000 psf. Minimum concrete compressive strength of footing shall be 3,000 psi.
- g. Provide propped cantilever wall: top of footing shall be 16 inches below the bottom of the concrete floor slab minimum.
- h. Provide #5 Grade 60 dowels, 1 foot, 6 inches long, to connect footing to wall. Embed dowel 5 inches into footing. Place dowels in center of wall thickness spaced at 32 inches o.c. maximum. No dowels are required where length of the foundation wall between perpendicular walls is two times the foundation wall height or less.
- i. This table is applicable where the length of the foundation wall between perpendicular walls is 35 feet or less, or where the length of the foundation laterally supported on only one end by a perpendicular wall is 17 feet or less.
- j. Maximum wall height is measured from top of the foundation wall to the bottom of the interior concrete slab-on-grade.
- k. Install foundation anchorage per R403.1.6.

**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 mixtures	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

For SI: 1 Inch=25.4 mm.

- a. The percolation rate for good drainage is over 4 inches per hour, medium drainage is 2 inches to 4 inches per hour, and poor is less than 2 inches per hour.
- b. Soils with a low potential expansion typically have a plasticity index (PI) of 0 to 15, soils with a medium potential expansion have a PI of 10 to 35 and soils with a high potential expansion have a PI greater than 20.