



Inspections Division
7700 Market Boulevard, P.O. Box 147
Chanhassen, MN 55317
Phone: 952-227-1180/Fax: 952-227-1190

RESIDENTIAL FOUNDATION REINFORCEMENT

In accordance with the 2007 Minnesota State Building Code and the 2006 IRC as adopted and amended.

R403.1.1 Footings. Minimum footing sizes for concrete and masonry foundations shall be as set forth in IRC Table 403.1. The minimum footing depth is 42 inches.

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 applicable provisions of Sections R606, R607, and R608. 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). Cantilever 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 applicable provisions of Section R404. 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).

Foundations must be constructed in accordance with the attached IRC tables or designed by a structural engineer.

1. Mortar shall be Type M or S and masonry shall be laid in running bond. IRC Tables R404.1.1(1), R404.1.1(2), 404.1.1(3), 404.1.1(4), or 404.1.1(6) footnote a.
2. 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 comply with masonry foundation Tables R404.1.1(2), R404.1.1(3), 404.1.1(4), or 404.1.1(6) footnote c and concrete foundation Table R404.1.1(5) footnote d.
3. **The foundation anchor bolts shall be installed to align with vertical reinforcing.** Anchor bolts shall be spaced a maximum of 6 feet on center. See attached MSRC Table R404.1(2) for anchor bolt spacing. There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches from the ends of each plate section. Bolts shall be at least ½ inch diameter and shall extend a minimum of 7 inches into masonry or concrete. All anchor bolts installed in masonry shall be grouted in place with at least 1 inch of grout between the bolt and the masonry. MSRC R403.1.6.
4. If foundation walls are parallel to floor framing, solid blocking or diagonal bracing must be installed at the anchor bolt locations in the first three joist or truss spaces. MSRC R404.1.1

R404.1.3 Design required. A design in accordance with accepted engineering practice shall be provided for concrete or masonry foundation walls when either of the following conditions exist:

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 and bottom. Exception: Cantilevered walls.

INSPECTIONS REQUIRED

1. **FOOTINGS**- prior to pouring concrete. Need to verify setbacks, elevation, form sizes, soil and reinforcing steel.
2. **FOUNDATION WALL REINFORCEMENT**- is inspected after foundation reinforcing is secured in place, and before concrete or grout is placed. If the foundation wall is engineered, a copy of the engineering design must be on site.
3. **FOUNDATION PRE-BACKFILL INSPECTION**- prior to backfilling. This inspection shall be done after the walls have been waterproofed, foundation insulation is in place and exterior drainage system is installed.

FOUNDATION DRAINAGE

IRC R405.1 Concrete or masonry foundations. Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least 1 foot (305 mm) beyond the outside edge of the footing and 6 inches (152 mm) above the top of the footing and be covered with an approved filter membrane material. 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 (51 mm) 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 (152 mm) of the same material.

MSRC R406.2 Concrete and masonry foundation waterproofing.

In all soils groups other than Group 1 soils in accordance with Table R405.1, exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed at a minimum from the top of the footing to the finished grade. Walls shall be waterproofed in accordance with one of the following:

- 1) 2-ply hot-mopped felts.
- 2) 55 pound (25 kg) roll roofing.
- 3) 6-mil (0.15 mm) polyvinyl chloride.
- 4) 6-mil (0.15 mm) polyethylene.
- 5) 40-mil (1 mm) polymer-modified asphalt.
- 6) 60-mil (1.5 mm) flexible polymer cement.
- 7) 1/8-inch cement based, fiber reinforced, waterproof coating.
- 8) 60-mil (1.5 mm) solvent free liquid applied synthetic rubber.

The joints in the membrane shall be lapped and sealed with an adhesive compatible with the waterproofing membrane.

Tables R404.1(2), R404.1.1(6), R404.1.1(7) and R404.1.1(8) are provided here (see accompanying "Foundation Reinforcement Tables"). IRC table R404.1(3) is deleted in its entirety. Other tables referred to in this document are found in the *2006 International Residential Code* (Copyrighted).

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Table R404.1(2)

Maximum Anchor Bolt Spacing for Supported Foundation Wall

Max. Wall Height	Max. Unbalanced Backfill Height	Soil Classes	Soil Load (pcf / ft)	Top of Wall Reaction (plf) ^b	1/2" diameter Anchor Bolt Spacing (inches) ^a
8' - 0"	7' - 4"	GW, GP, SW, & SP	30	250	72
		GM, GC, SM-SC, & ML	45	370	72
		SC, MH, ML-CL & I-CL	60	490	48
9' - 0"	8' - 4"	GW, GP, SW, & SP	30	320	72
		GM, GC, SM-SC, & ML	45	480	48
		SC, MH, ML-CL, & I-CL	60	640	40

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

^a Sill plate shall be 2 x 6 minimum. Anchor bolt shall be minimum 0.5" diameter cast in place with 7" embed. Anchor bolt shall have a 2" diameter by 0.125" thick washer tightened and countersunk 0.25" into the top of the sill plate.

^b Minimum load to be used for sizing of accepted anchors or fasteners if bolts are not used.

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, & SP	GM, GC, SM, SM-CS, & 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 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 floor 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 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, & SP	GM, GC, SM, SM-SC, & 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

- 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 Section R403.1.6.

Subp. 8. **Table R404.1.1(8)**. IRC Section R404 is amended by adding a new table as follows:

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,i,k}		
		Soil Classes ^d		
		GW, GP, SW, & SP	GM, GC, SM, SM-SC, & 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 Section R403.1.6.