Minimum Vertical Reinforcement Size and Spacing[1,2] for 10-in. Nominal Masonry[3] Foundation Wall Thickness

Maximum Wall Height (ft.)	Maximum Unbalanced Backfill Height[5] (ft.)	Soil Classes[4]		
		GW, GP, SW, and SP	GM, GC, SM, SM-SC, and ML	SC, MH, ML-CL, and Inorganic CL
7	4	#4 @ 56" o.c.	#4 @ 56" o.c.	#4 @ 56" o.c.
	5	#4 @ 56" o.c.	#4 @ 56" o.c.	#4 @ 56" o.c.
	6	#4 @ 56" o.c.	#4 @ 48" o.c.	#4 @ 40" o.c.
	7	#4 @ 56" o.c.	#5 @ 56" o.c.	#5 @ 40" o.c.
8	5	#4 @ 56" o.c.	#4 @ 56" o.c.	#4 @ 48" o.c.
	6	#4 @ 56" o.c.	#4 @ 48" o.c.	#5 @ 56" o.c.
	7	#4 @ 48" o.c.	#4 @ 32" o.c.	#6 @ 56" o.c.
	8	#5 @ 56" o.c.	#5 @ 40" o.c.	#7 @ 56" o.c.
9	5	#4 @ 56" o.c.	#4 @ 56" o.c.	#4 @ 48" o.c.
	6	#4 @ 56" o.c.	#4 @ 40" o.c.	#4 @ 32" o.c.
	7	#4 @ 56" o.c.	#5 @ 48" o.c.	#6 @ 48" o.c.
	8	#4 @ 32" o.c.	#6 @ 48" o.c.	#4 @ 16" o.c.
	9	#5 @ 40" o.c.	#6 @ 40" o.c.	#7 @ 40" o.c.

Notes:
1. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall are permitted provided the spacing of the reinforcement does not exceed 72 in.
2. Vertical reinforcement must be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of the vertical reinforcement must be at least 6.75 in.
3. Mortar shall be Type M or Type S and masonry shall be laid in running bond.
4. Soil classes are in accordance with Unified Soil Classification System.
5. Unbalanced backfill height is the difference in height of the exterior and interior finish ground levels. Where an interior concrete slab is provided, the unbalanced backfill height shall be measured from the exterior finish ground level to the top of the interior concrete slab.

Figure 13-10 Requirements for 10-in.-thick masonry foundation walls. (*From* International Residential Code for One- and Two-Family Dwellings, *2003.*)

13.3.2 Cantilever Walls

Reinforced concrete masonry unit (CMU) cantilever retaining walls are designed to resist overturning and sliding with resultant forces that fall within the middle third of the footing. Many design tables have been developed to simplify selection of wall dimensions and steel reinforcing in CMU retaining walls. The table and drawings in *Fig. 13-17,* from the Portland Cement Association, are typical. Graphic examples of design parameters for 4- to 10-ft-high walls are given in Newman's *Standard Structural Details for Building Construction.*

Figure 13-18 shows three different methods of locating vertical reinforcement in a brick masonry cantilever retaining wall. Each offers certain advantages depending on wall thickness, bar spacing, and unit type. Where 8-in. hollow units are available (B), they can often be less expensive than a double-wythe wall. If only standard units are available, grout pockets may be used (A). A double-wythe grouted cavity wall, however, offers greatest flexibility because bar spacing is not limited by the fixed dimensions of the units (C).

The table in *Fig. 13-19* was developed by the Brick Industry Association (BIA) for preliminary design of brick walls with a maximum height of 6 ft.

Minimum Vertical Reinforcement Size and Spacing[1,2] for 12-in. Nominal Masonry[3] Foundation Wall Thickness

Maximum Wall Height (ft.)	Maximum Unbalanced Backfill Height[5] (ft.)	Soil Classes[4]		
		GW, GP, SW, and SP	GM, GC, SM, SM-SC, and ML	SC, MH, ML-CL, and Inorganic CL
7	4	#4 @ 72" o.c.	#4 @ 72" o.c.	#4 @ 72" o.c.
	5	#4 @ 72" o.c.	#4 @ 72" o.c.	#4 @ 72" o.c.
	6	#4 @ 72" o.c.	#4 @ 64" o.c.	#4 @ 48" o.c.
	7	#4 @ 72" o.c.	#4 @ 48" o.c.	#5 @ 56" o.c.
8	5	#4 @ 72" o.c.	#4 @ 72" o.c.	#4 @ 72" o.c.
	6	#4 @ 72" o.c.	#4 @ 56" o.c.	#5 @ 72" o.c.
	7	#4 @ 64" o.c.	#5 @ 64" o.c.	#4 @ 32" o.c.
	8	#4 @ 48" o.c.	#4 @ 32" o.c.	#5 @ 40" o.c.
9	5	#4 @ 72" o.c.	#4 @ 72" o.c.	#4 @ 72" o.c.
	6	#4 @ 72" o.c.	#4 @ 56" o.c.	#5 @ 64" o.c.
	7	#4 @ 56" o.c.	#4 @ 40" o.c.	#6 @ 64" o.c.
	8	#5 @ 64" o.c.	#6 @ 64" o.c.	#6 @ 48" o.c.
	9	#5 @ 56" o.c.	#7 @ 72" o.c.	#6 @ 40" o.c.

Notes:
1. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall are permitted provided the spacing of the reinforcement does not exceed 72 in.
2. Vertical reinforcement must be Grade 60 minimum. The distance from the face of the soil side of the wall to the center of the vertical reinforcement must be at least 8.75 in.
3. Mortar shall be Type M or Type S and masonry shall be laid in running bond.
4. Soil classes are in accordance with Unified Soil Classification System.
5. Unbalanced backfill height is the difference in height of the exterior and interior finish ground levels. Where an interior concrete slab is provided, the unbalanced backfill height shall be measured from the exterior finish ground level to the top of the interior concrete slab.

Figure 13-11 Requirements for 12-in.-thick masonry foundation walls. (*From* International Residential Code for One- and Two-Family Dwellings, *2003.*)

The bottom of the footing must be below the frost line. Units should be Grade SW, and mortar should be type M. All brick retaining walls should be laid in running bond pattern with masonry headers or metal ties every sixth course.

13.3.3 Footings

Concrete footings for retaining walls should be placed on firm, undisturbed soil. In areas subject to freezing, they should also be placed below the frost line to avoid heave and possible damage to the wall. If the soil under the footing consists of soft or silty clay, it may be necessary to place compacted fill before pouring the concrete.

13.3.4 Drainage and Waterproofing

Failure to drain the backfill area behind retaining walls causes a buildup of hydrostatic pressure which can quickly become critical if rainfall is heavy. In mild climates, weep holes at the base of the wall should be provided at 4- to 8-ft intervals. In areas where precipitation is heavy or where poor drainage