FOUNDATIONS
RETAINING WALLS

Retaining walls hold back the pressure of earth embankments. Unlike basement walls, they are not braced at the top by a floor system, and must be designed so they will not topple or fail in bending at the bottom.

Forces in a Retaining Wall

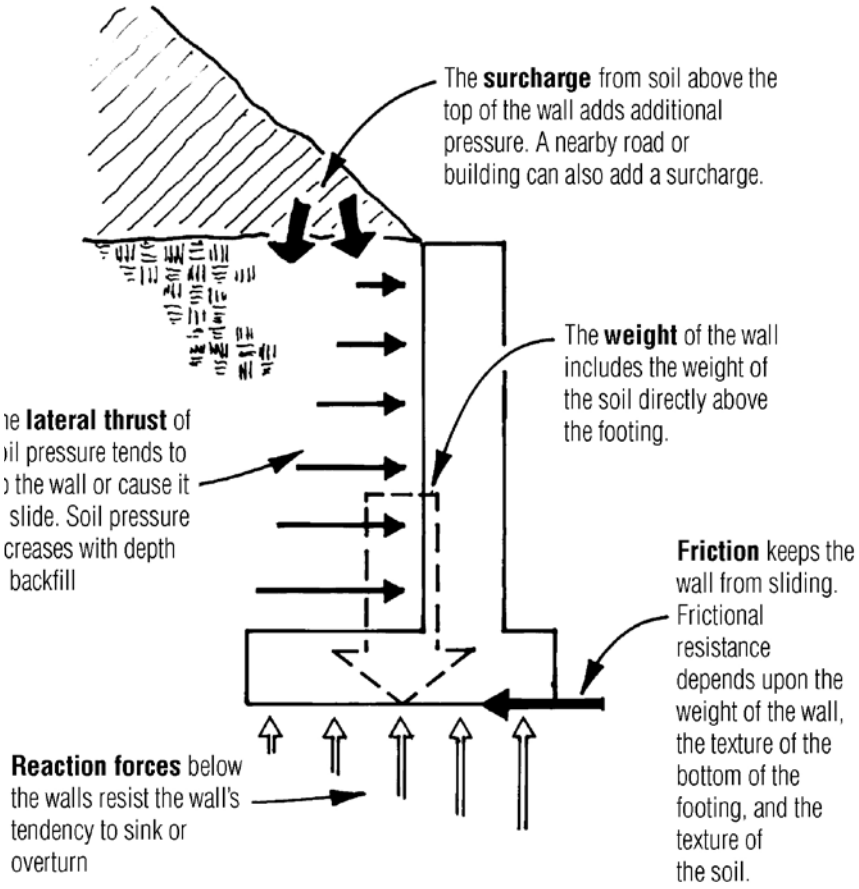
FORCES IN A RETAINING WALL

Soil pressure on a retaining wall increases with increasing depth (**Forces in a Retaining Wall**, below). Walls can fail in bending, by sliding, or by toppling. When engineering a wall, all three failure modes must be analyzed.

Drainage for Retaining Walls

Soil pressures on a retaining wall increase drastically when the soil is saturated (see Soil Types for more on soil types and pressures). At the same time, the chance of soils sliding or overturning increases when soil is wet. Backfilling with poorly draining material, or failing to provide positive drainage, greatly increases the odds of wall failure. Always backfill retaining walls with free-draining granular material (sand or gravel), and provide drains that allow water to escape from behind walls (see Drainage).

FIGURE: FORCES IN A RETAINING WALL



The greater the depth of the wall, the greater the total lateral force of the soil. This exerts an overturning force that is -resisted by the weight of the soil over the footing and the weight of the wall itself. Friction at the base of the footing keeps the wall from sliding.

Reinforcing Retaining Walls

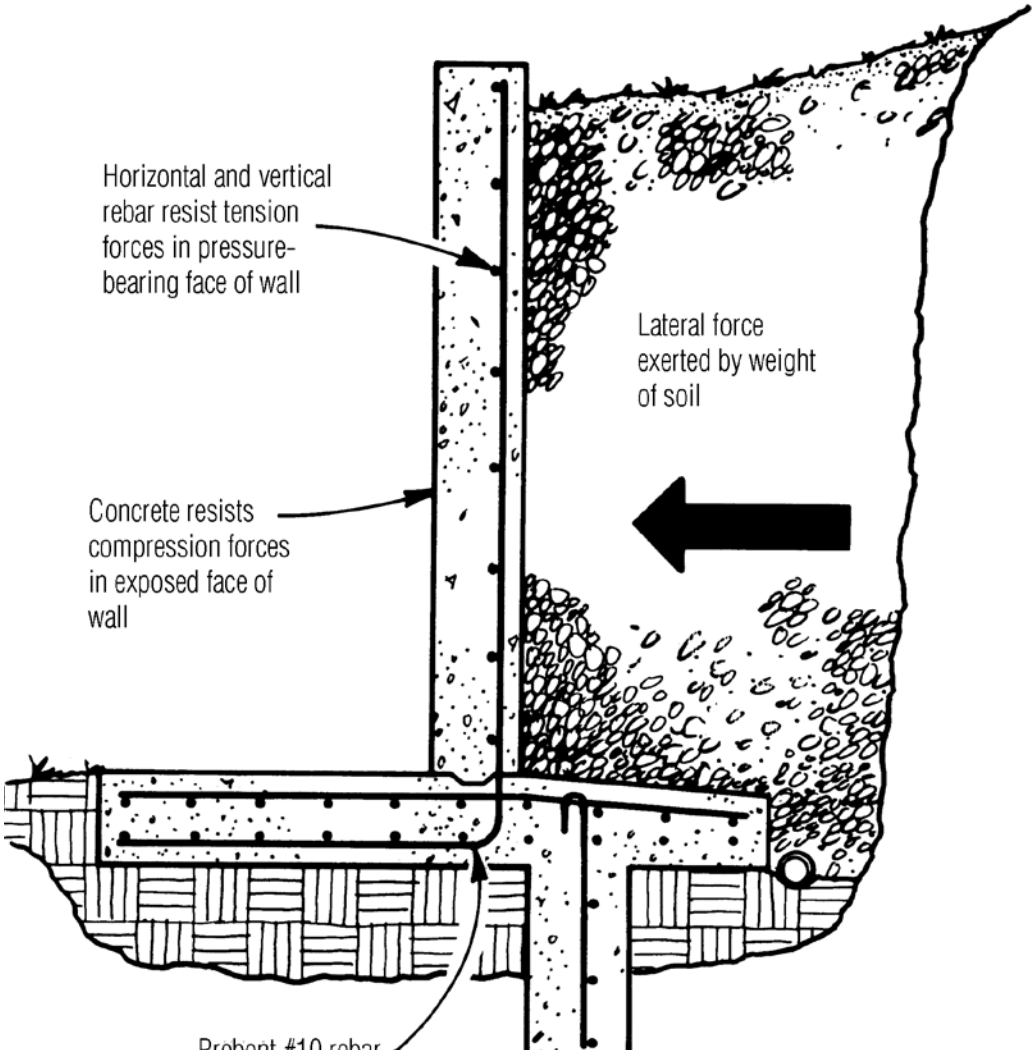
Poured Concrete and Masonry Retaining Walls

REINFORCING RETAINING WALLS

Follow general guidelines for reinforcing foundations (see **Rebar**).

In a retaining wall, which is not braced at the top like a foundation wall, steel goes on the side of the wall close to the soil load, where tensile stresses occur (**below**).

FIGURE: REBAR IN CONCRETE RETAINING WALLS



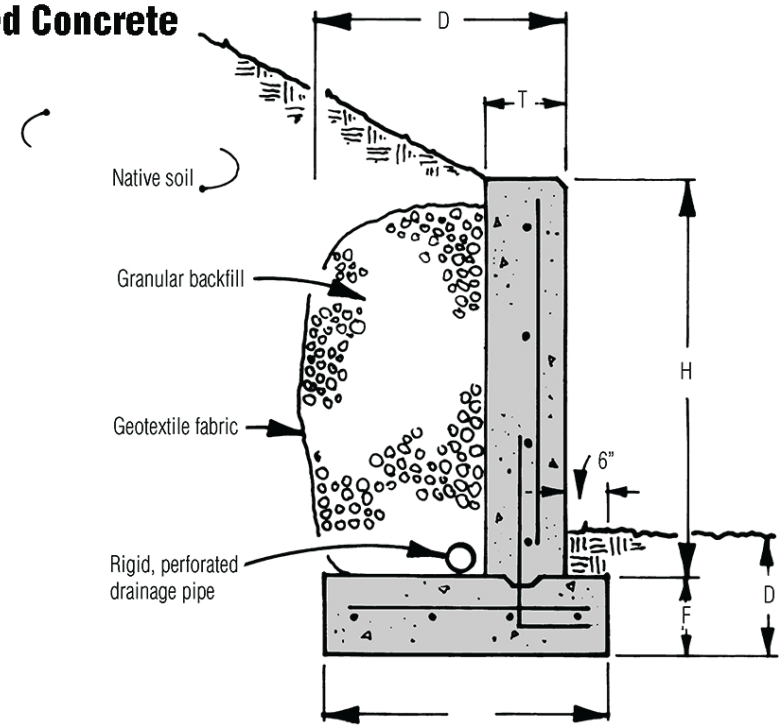
The compressive strength of concrete and the tensile strength of steel work together to resist lateral pressures placed on a retaining wall.

POURED CONCRETE AND MASONRY RETAINING WALLS

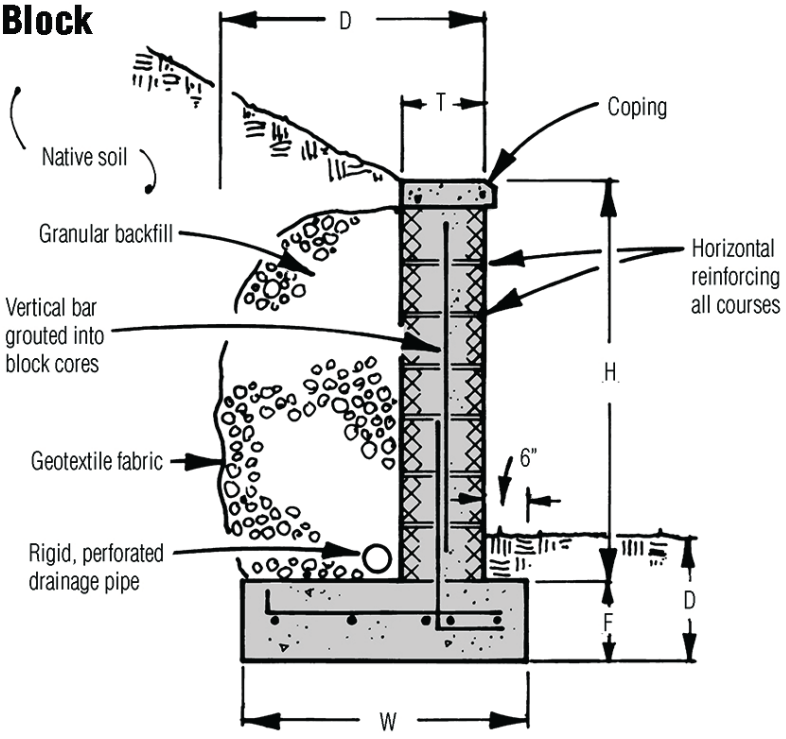
For concrete and masonry retaining walls less than 5-ft.-tall, follow guidelines for steel placement and dimensions as shown **below**. Taller walls should be designed by a qualified engineer.

FIGURE: MASONRY RETAINING WALLS

Poured Concrete



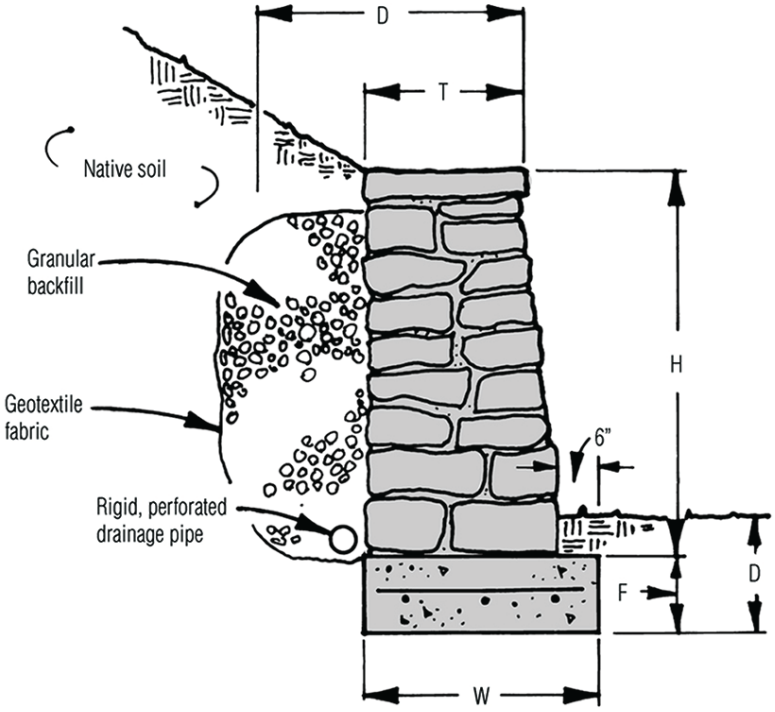
Concrete Block



Poured Concrete and Masonry Retaining Walls

Timber Retaining Walls

Mortared or Dry-Laid Stone



Recommended Dimensions for Low Masonry Retaining Walls[1]						
H	**W**	**Steel Rebar**	**Bar Spacing**	**F**	**T**	**D**
2'	20"	#3 (3/8")	2'-0" o.c.	9"	8"	Local frost depth or 12" to 18"
3'	25"	#4 (/2")	2'-0" o.c.	10"	8"	
4'	32"	#5 (5/8")	2'-0" o.c.	11"	10"	
5'	42"	#5 (5/8")	1'-6" o.c.	12"	12"	

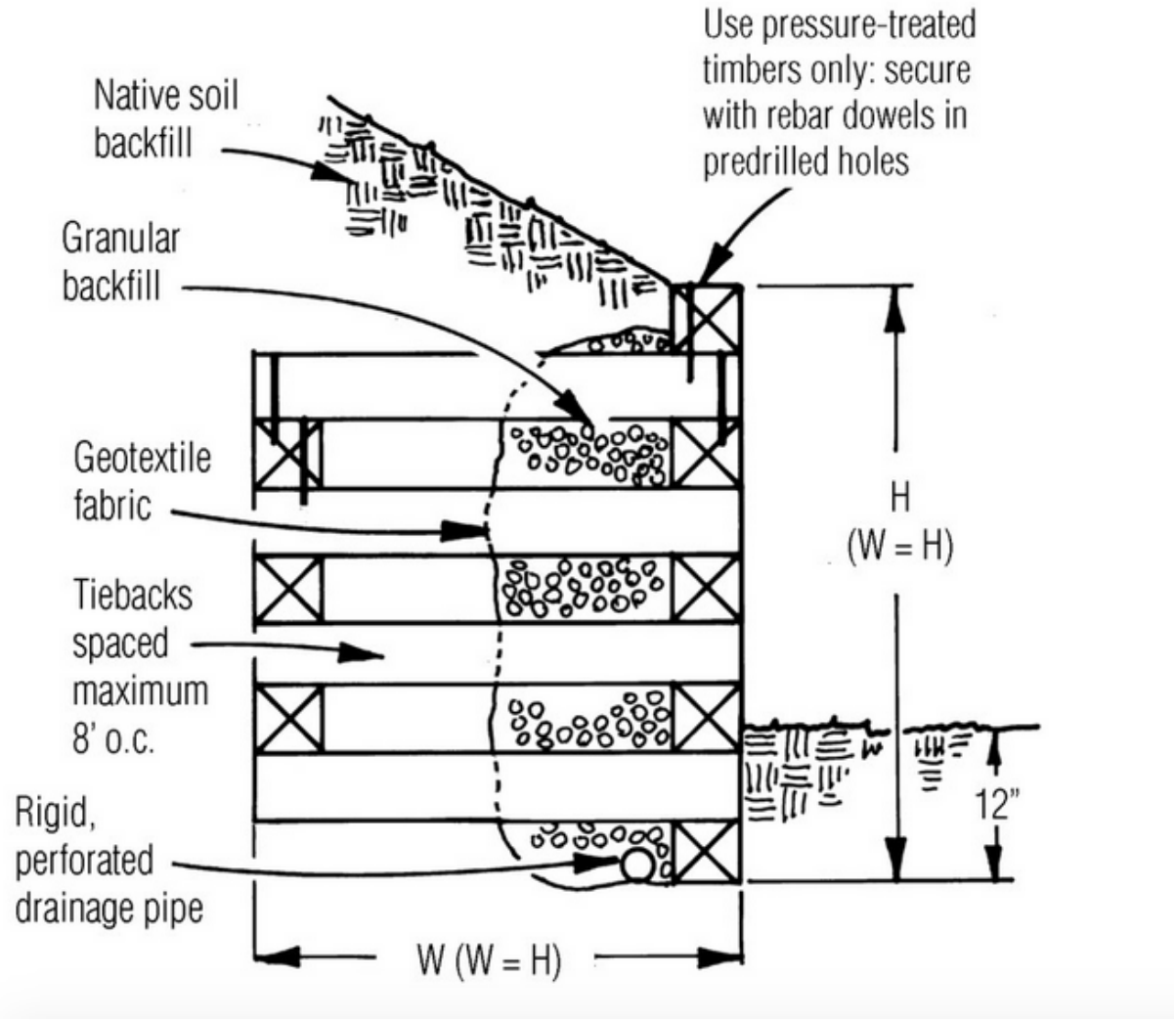
Note: 1: Suggested details for walls no higher than 5 ft. where dense, coarse-grain soil exists below footings. Not for loose or soft sand, peat, or clay.

TIMBER RETAINING WALLS

Crib walls built out of landscaping ties function like a gravity wall. The mass of earth in the crib structure holds back the pressure of the soil behind it. Wood must be treated against rot. Timbers can be joined with 10- or 11-in.-long, hot-dipped, galvanized spikes or with rebar dowels in pre-drilled holes.

Crib walls can be as high as 30 ft., but a qualified engineer should design walls higher than 5 ft. For walls 5 ft. or shorter, follow the guidelines shown **below**.

FIGURE: TIMBER RETAINING WALLS



Recommended Dimensions for Low Timber Crib Walls[1]

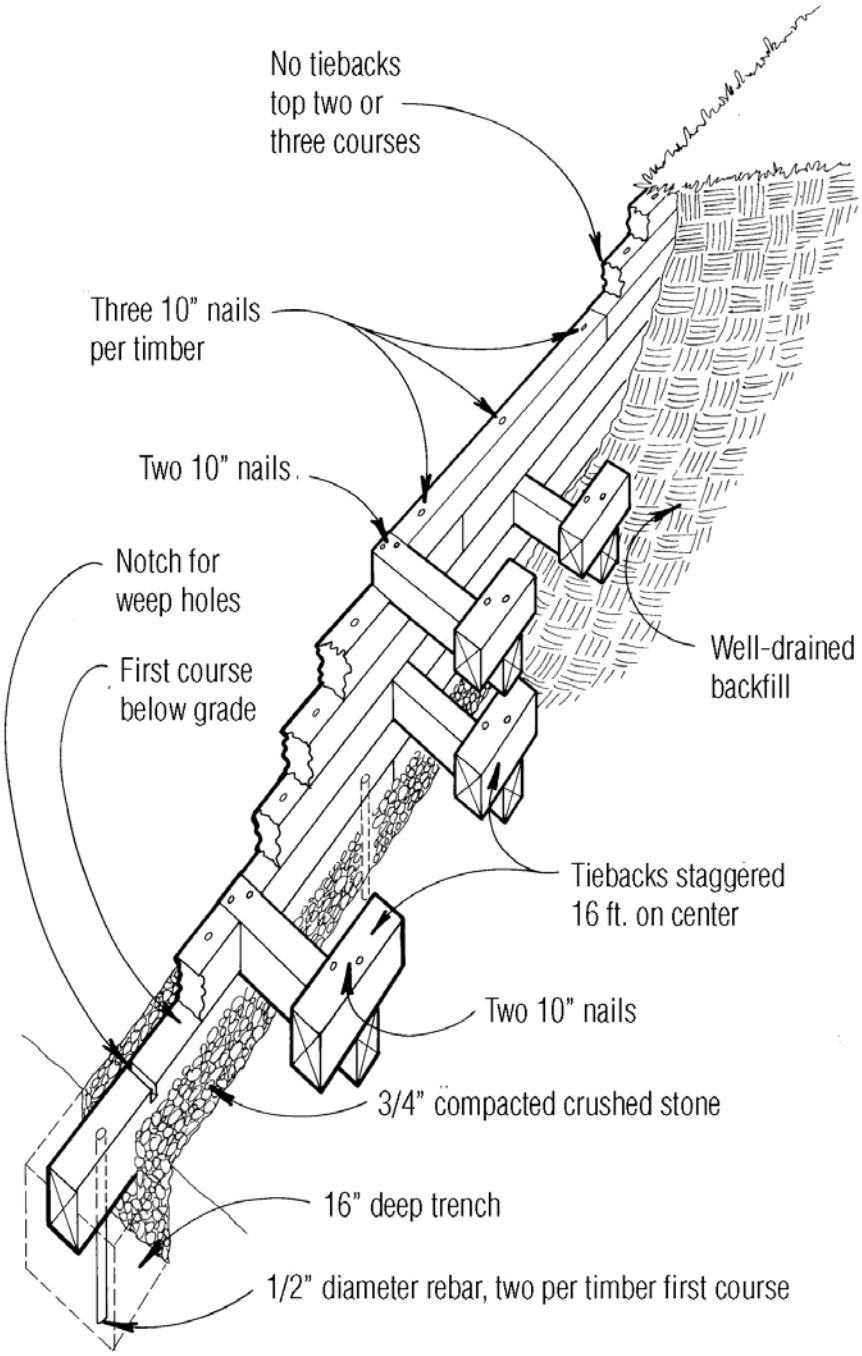
Timber Size	Dowel Size	Spacing of Tiebacks
6x6	1/2" (#4 bar)[2]	6'-0" (max.)
8x8	3/4" (#6 bar)[3]	8'-0" (max.)

Notes: 1: Details apply to walls no higher than 5 ft., **2:** In acidic soils, increase by 1/4 in. or use hot-dipped galvanized., **3:** In acidic soils, increase by 1/4 in. or use hot-dipped galvanized.

Tiebacks for Low Walls

For very low timber retaining walls in granular soil, you may be able to use tiebacks instead of an actual crib design (see **below**). Tiebacks spaced 16 ft. o.c., staggered on alternate courses, are typical. (For greater holding power, space tiebacks closer.) Tiebacks should extend into soil a distance equal to the wall height.

FIGURE: TIEBACKS FOR LOW RETAINING WALLS



T-shaped timber tiebacks every 16 ft. on each course help to stabilize very low timber walls. In heavy soils, backfill with sand or crushed stone. With new, surfaced timbers that fit snugly together, weep holes or perforated drain pipe is needed to relieve hydrostatic pressure.

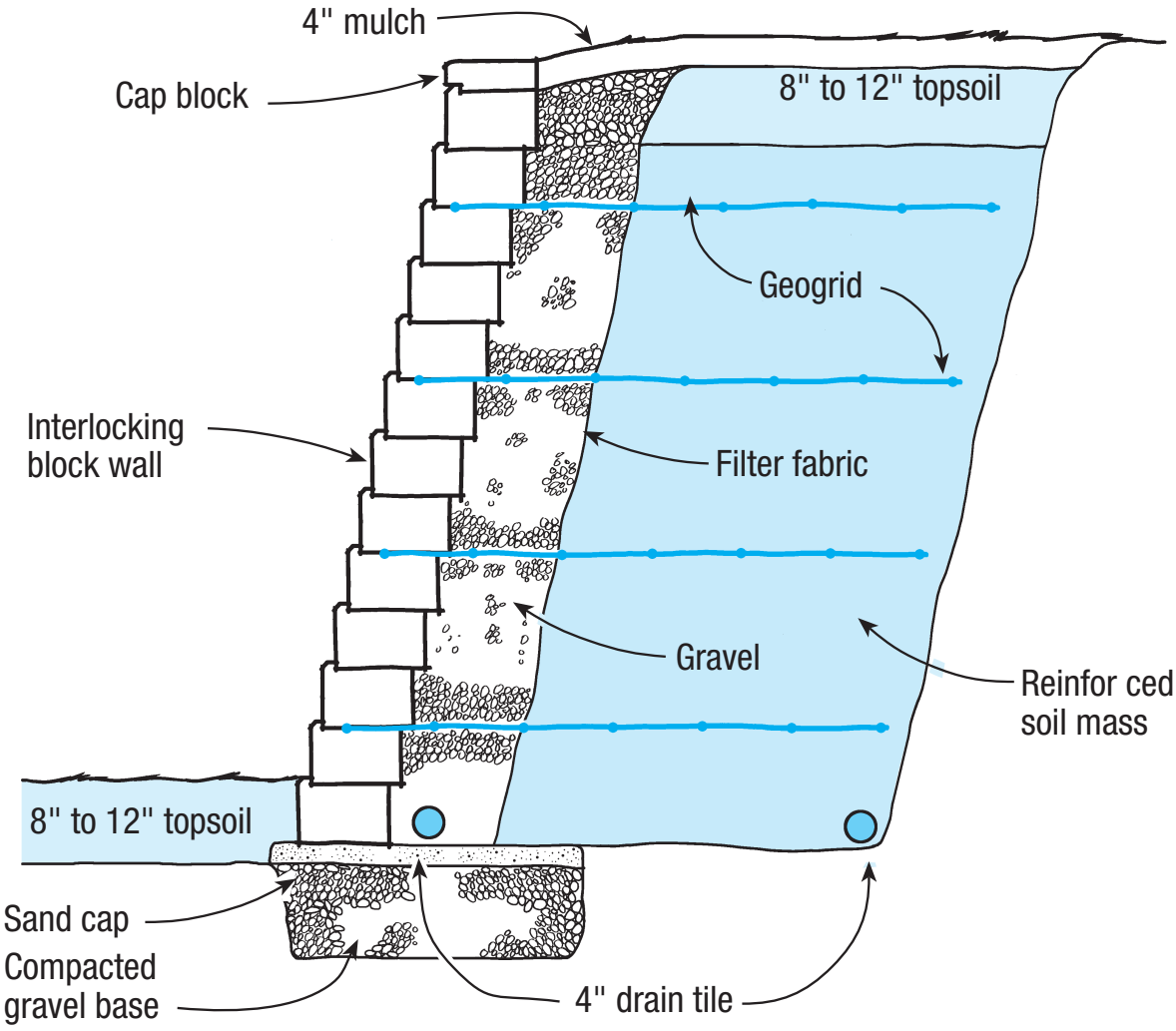
INTERLOCKING BLOCK RETAINING WALLS

Geogrid is a plastic grid material used to reinforce soil banks. In combination with interlocking block systems, it can be used to create a block-faced earth retaining wall that functions similarly to a concrete gravity retaining wall (**Interlocking Block Retaining Walls**, below).

Engineered Tall Walls

A qualified engineer should design block walls higher than 5 ft. Usually, the vertical spacing of the geogrid is about twice the depth of the masonry units, and the geogrid extends into the soil horizontally a distance equal to 60% to 80% the total wall height, depending on the surcharge above the wall.

FIGURE: INTERLOCKING BLOCK RETAINING WALLS



In an interlocking block wall, geogrid is typically placed on soil layers at 1- to 2-ft. intervals, and the soil is compacted in lifts. Block without geogrid may be sufficient for walls up to 4 ft. in height; with geogrid, walls can be as high as 16 ft. or more.