CHAPTER

3

Foundations

FOUNDATION MATERIALS

The two most common materials for foundation construction in the U.S. and in many jurisdictions around the world are concrete and concrete masonry units (CMUs), the latter often referred to as concrete block or simply masonry. The code does not intend to limit the use of different materials, however. In addition to prescriptive designs for other foundation systems incorporating wood, precast concrete, shallow frost-protected footings, or insulating concrete forms (ICFs), engineered or other alternative designs are permitted by the code. For example, a pier or post foundation offers a cost-effective alternative for a small building such as a tiny house. Manufactured helical piles are gaining popularity in residential construction and provide another satisfactory alternative for tiny house foundations. Foundations for tiny houses, regardless of foundation type, must comply with the code to properly carry other applicable local environmental loads such as earthquake, wind, and flood. [R301 & R402]

The code requires concrete to have a minimum 28-day compressive strength of 2,500 psi (17,237 kPa) for most applications. Higher-strength concrete, often including entrained air, is specified in geographic areas subject to moderate or severe weathering potential when the concrete is exposed to the weather or is used in a garage floor slab. [Table R402.2]

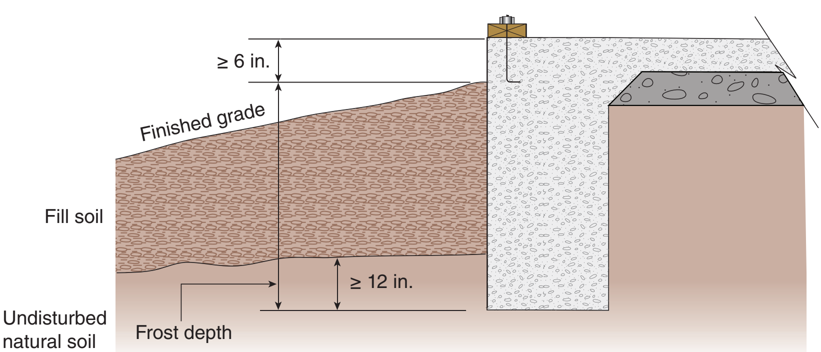
Tiny homes on wheels, in many cases, utilize a steel chassis as both a subfloor and a structure to which wheeled axles and suspension elements may be attached to facilitate transportation of the building.

FOOTING CONDITIONS

In order to properly support the loads of a building, footing design addresses not only the size of the footing, but also factors such as the condition and characteristics of the soil, footing depth, slope, and reinforcing. [R403]

For other than engineered fill soil conditions, footings must bear on undisturbed ground and extend below the frost depth or otherwise be protected from frost to provide a stable foundation. In addition, exterior footings require excavation to at least 12 inches (31 cm) below the undisturbed soil (Figure 3-1). Vegetation, wood, debris, loose or frozen soil and any other detrimental materials are removed prior to placing concrete. [R403.1.4]

For cold climates, placing footings below the frost depth protects foundations from the expansive effects of freezing and thawing soil. Otherwise, frost heave can exert stresses sufficient to cause significant damage to a foundation. The code offers exceptions to the frost depth requirements where damaging effects of frost heave are negligible. Frost-protected shallow foundations utilizing rigid polystyrene insulation are another effective option. [R403.1.5]

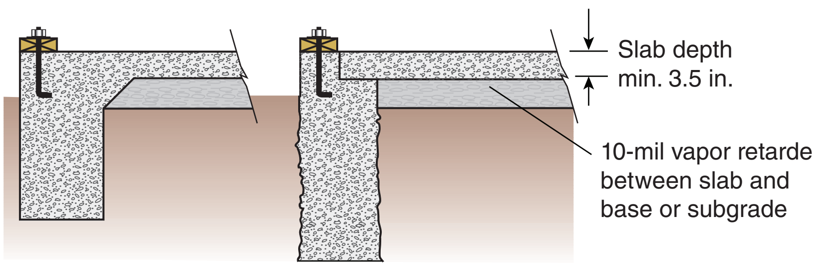


For SI: 1 inch = 25.4 mm.

FIGURE 3-1 Depth of exterior footings

SIZING CONCRETE FOOTINGS

Soil-bearing capacity and the average gravity loads (dead, live and snow) determine footing size. As the load-bearing capacity of the soil decreases, footing size increases to distribute the load to a greater area. The code prescribes the width of continuous footings based on the number of stories supported, the method of construction, the type of foundation (basement, crawl space or slab-on-grade), the ground snow load and the load-bearing value of the soil. In most cases, a 12-inch (31 cm) wide by 6-inch (15 cm) deep continuous spread footing is adequate for supporting foundations of tiny houses. Figures 3-2 and 3-3 illustrate footing types for slab-on-ground and crawl space foundations. [R403.1.1, Tables R403.1(1) through R403.1(3)]

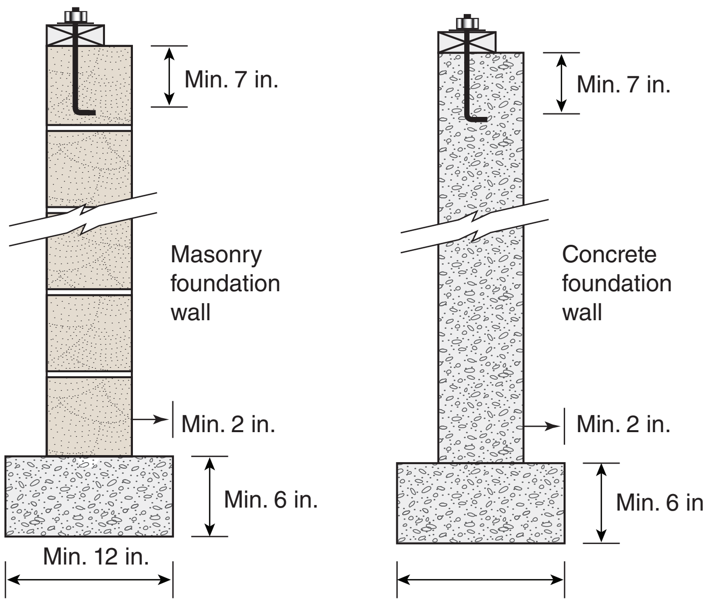


For SI: 1 inch = 25.4 mm.

FIGURE 3-2 Slab-on-ground footings

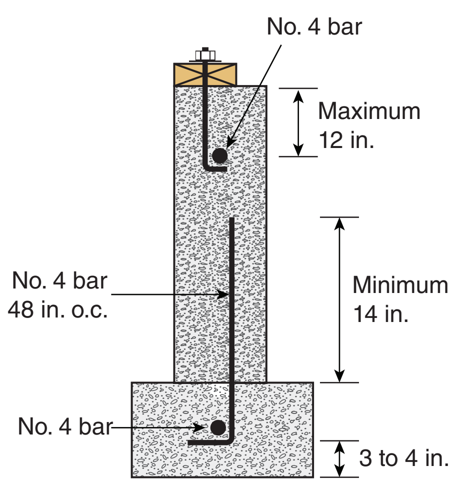
REINFORCING

For the most part, the IRC permits footings without reinforcement in Seismic Design Categories (SDCs) A, B and C. The code does require reinforcing of continuous footings and stem walls when the building is located in SDC D_0, D_1 or D_2. See Figures 3-4 and 3-5 for the reinforcing requirements in these higher seismic regions. Information on SDCs is available at the building department. [R403.1.3]



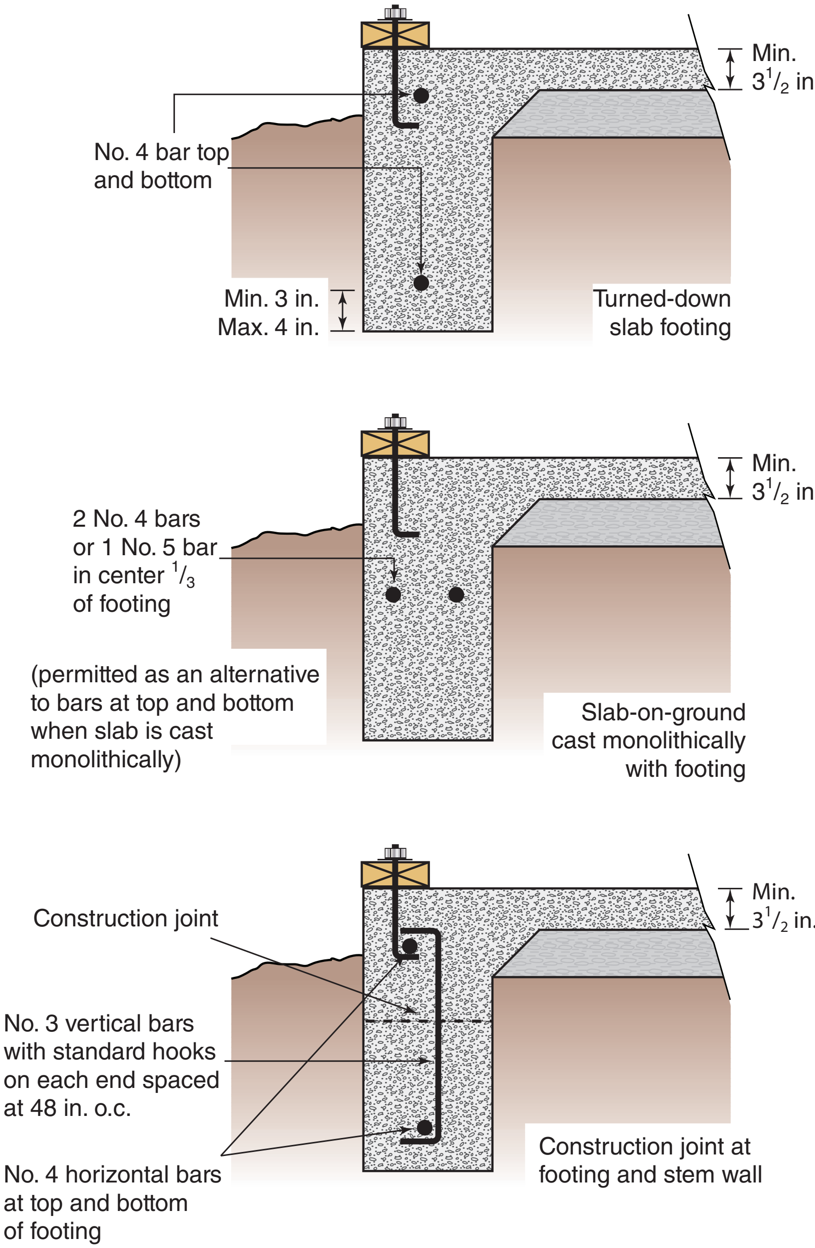
For SI: 1 inch = 25.4 mm.

FIGURE 3-3 Continuous spread footing and stem wall for crawl space



For SI: 1 inch = 25.4 mm.

FIGURE 3-4 Concrete footing and stem wall reinforcing in SDCs D_0, D_1 and D_2

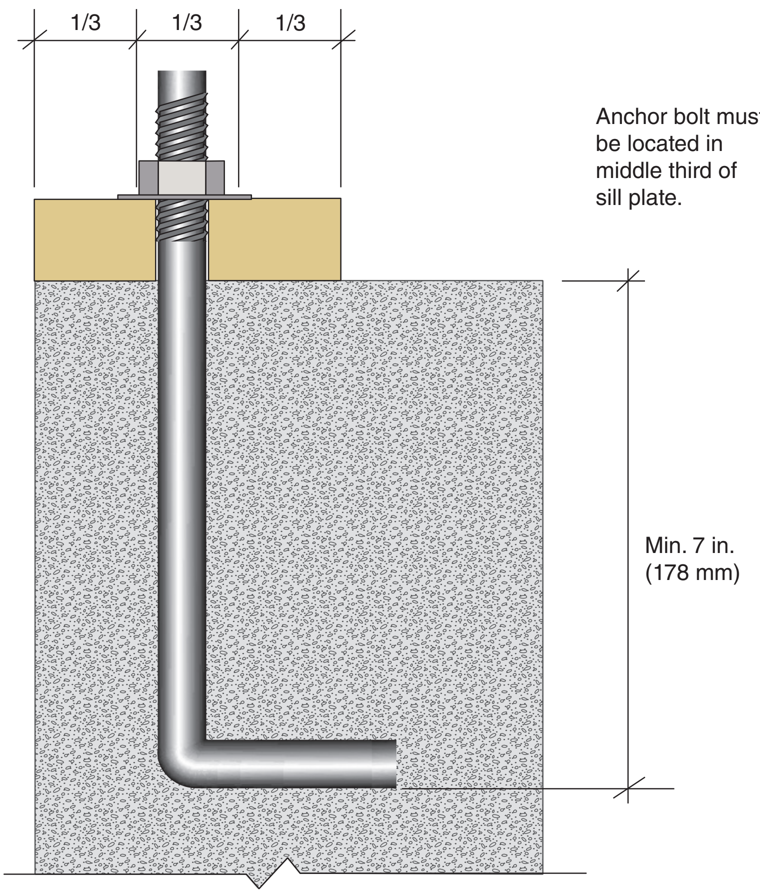


For SI: 1 inch = 25.4 mm.

FIGURE 3-5 Reinforcing for turned-down slab footings in SDCs D_0, D_1 and D_2

FOUNDATION ANCHORAGE

The code prescribes anchor bolt criteria for connecting the sill plate to the foundation. Other methods, such as foundation straps, may be used if installed according to the manufacturer's instructions and in a way to provide equivalent anchorage. Location, spacing and embedment requirements for anchor bolts are illustrated in Figures 3-6 and 3-7. To resist the increased forces of earthquake ground motion, anchor bolts for buildings located in SDC D_0, D_1 or D_2 require 3-inch by 3-inch (8 cm by 8 cm) plate washers approximately $^1/_4$ inch (7 mm) thick to increase the bearing area of the washer against the sill plate or bottom plate (Figure 3-8). [R403.1.6.1 & R602.11.1]



For SI: 1 inch = 25.4 mm.

FIGURE 3-6 Anchor bolt placement in center third of sill plate

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