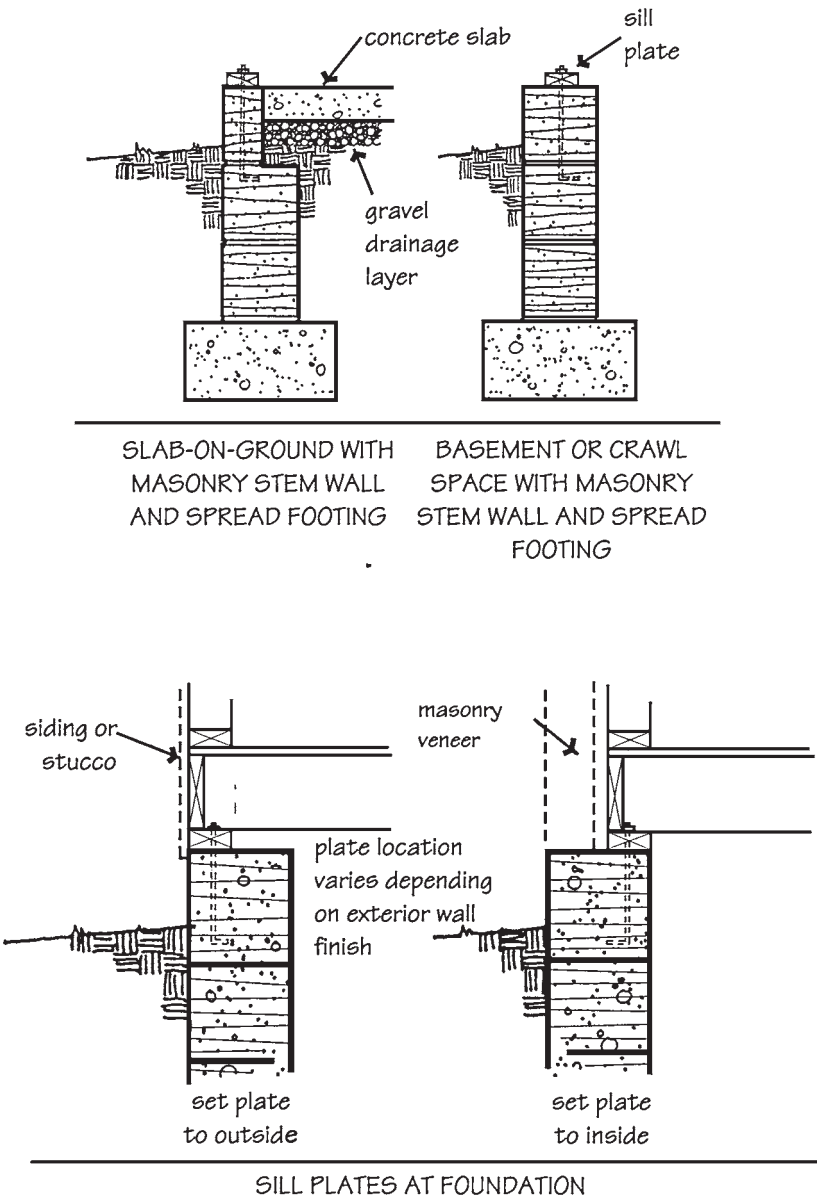

Figure 13-4 Concrete masonry foundation types and sill plate details.

areas. *Figure 13-4* shows basic concrete masonry foundation types. Footings are set below the frost line in undisturbed soil. The masonry walls provide low thermal conductivity and may easily be waterproofed against moisture infiltration and dampness. Below-grade masonry walls also offer excellent enclosures for underground or earth-sheltered buildings. Analytically designed reinforced masonry permits the construction of deep basement walls, walls supporting heavy vertical loads, and walls where unsupported height or length exceeds lateral support requirements for empirically designed, unreinforced masonry.

13.2.1 Design and Construction

Concrete masonry is much more widely used in below-grade construction than brick, and much research has been done to test its capability and performance. General design considerations must include (1) maximum lateral load from soil pressure, (2) vertical loads from building superstructure, (3) minimum wall thickness required by code, and (4) length or height of wall between lateral supports. Basement walls supporting bearing wall construction must usually support relatively heavy compressive loads in addition to earth pressure or other lateral loads. In skeleton frame construction, columns may extend down to separate footings and carry most of the dead and live loads of the superstructure. In such cases, the basement walls may be subject to appreciable lateral load, but little vertical load. If the columns are closely spaced, or if pilasters are added, the wall may be designed to transmit these lateral loads horizontally and vertically as two-way slabs. If the vertical supports are widely spaced, and the first-floor construction cannot be considered as providing lateral support, a design cantilever action will be required (i.e., retaining wall design).

It is normally assumed that the stresses created in basement walls by soil pressure against the exterior face are resisted by bending of the walls in the vertical span. This means that the wall behaves like a simple beam supported at top and bottom. Support at the top is provided by the first-floor construction, and bottom support by the footing and basement floor slab. If the first floor is to contribute lateral support, backfilling should be delayed until this construction is in place.

A portion of the lateral earth load is carried by the wall acting as a beam in the horizontal span. The distribution of the total lateral load horizontally and vertically will depend on wall height and length as well as stiffness in both directions. If the length of the wall between supports is no greater than its height, the load is generally divided equally between vertical and horizontal spans.

The overall stability of a below-grade wall may be enhanced by increasing the stiffness in either direction, or by reducing the length of the horizontal span. *Horizontal stiffness* can be increased by incorporating bond beams into the design, or by placing prefabricated joint reinforcement in the mortar joints at vertical intervals of not more than 16 in. Bond beams are most advantageously located at or near the top of the wall, and built to extend continuously around the perimeter of the building. When used in this manner, they will also serve to distribute concentrated vertical loads. The increase in flexural strength achieved with horizontal joint reinforcement is limited by the practical amount of steel that can be embedded in the joints, and by the amount of bond strength developed between mortar, reinforcement, and masonry units.

Vertical stiffness may be increased in one of two ways: (1) steel reinforcement may be grouted into hollow cells, or (2) pilasters may be added (*see Fig. 13-5*). Pilasters should project from the wall a distance equal to approximately one-twelfth of the wall height. Pilaster width should be equal to approximately one-tenth of the horizontal span between supports. The distance between pilasters or between end walls or cross walls and pilasters should not exceed 18 ft for unreinforced walls 10 in. thick, or 15 ft for walls 8 in. thick.

In relying on floors and footings for lateral bracing, proper anchorage of members must be provided to assure transfer of loads. Steel dowels should connect walls securely to the footing. Pilasters, cross walls, and end walls must be bonded with interlocking masonry units or with metal ties. Sill plates should be anchored to the wall at 6-ft maximum intervals (*see Fig. 13-6*).