4
CEMENTITIOUS MASONRY UNITS

Cementitious masonry units are hardened by chemical reactions rather than by ceramic fusion. This group includes concrete brick and block as well as sand-lime brick and cast stone. The majority of these units are classified as solid, having less than 25% core area in relation to the gross cross section in the bearing plane. Concrete block, however, typically has 40 to 50% coring and is thus defined as hollow.

4.1 CONCRETE BRICK

Concrete brick is produced from a controlled mixture of portland cement and aggregates in sizes, colors, and proportions similar to clay brick (*see Fig. 4-1*). It is governed by the requirements of ASTM C55, *Standard Specification for Concrete Building Brick,* and can be loadbearing or non-loadbearing. Aggregates include gravel, crushed stone, cinders, burned clay, and blast-furnace slag, producing both normal-weight and lightweight units. Coring or "frogging" may be used to reduce weight and improve mechanical bond.

Grading is based on strength and resistance to weathering. Grade N provides high strength and maximum resistance to moisture penetration and frost action. Grade S has only moderate strength and resistance to frost action and moisture penetration.

Concrete mixes may be altered to produce a slight roll or slump when forms are removed, creating a unit similar in appearance to adobe brick. Color is achieved by adding natural or synthetic iron oxides, chromium oxides, or other pigments to the mix, just as in colored mortar (refer to Chapter 2). ASTM standards do not include color, texture, weight classification, or other special features. These properties must be covered separately in the project specifications.

4.2 SAND-LIME BRICK

Calcium silicate brick, or sand-lime brick, is made with sand or other siliceous material and 5 to 10% hydrated lime, then steam-cured in high-pressure

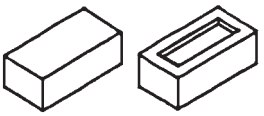

Figure 4-1 Concrete and calcium silicate (sand-lime) brick.

autoclaves at 400°F for up to 8 hours. In the autoclave, the lime reacts chemically with the silica to form hydrated calcium silicate, a strong and durable cementing agent that binds the sand particles together.

Calcium silicate brick is widely used in industrial countries where suitable siliceous sands are more readily available than clay. In the United States, calcium silicate brick has been produced since the early 1900s. The units have a natural near-white color with a slight yellow, gray, or pink tint, depending on the color of the sand used. With the addition of natural or synthetic pigments, dark earth tones, reds, blacks, and light pastel colors can be produced, including blues and greens. Two colors can be blended for a swirled mixture, or units can be dipped in acid after hardening to intensify their color. Unit surfaces are smooth and uniform—the finer the sand particles, the smoother the surface. Texture is produced by sandblasting, mechanical brushing, or adding flint aggregates to the mix. Splitting hardened units produces a natural rockface finish.

Sand-lime brick is used extensively in Europe, Russia, Australia, the Middle East, Mexico, and the United Kingdom. Most U.S. building codes permit its use in the same manner as clay brick for both loadbearing and nonloadbearing applications. ASTM C73, *Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick),* includes grading standards identical to those for clay face brick for severe weathering (Grade SW) and moderate weathering (Grade MW). Compressive strength minimums are 4500 and 2500 psi, respectively, and absorption rates are 10 and 13%, respectively. Strength and hardness are increased as carbon dioxide in the air slowly converts the calcium silicate to calcium carbonate.

Alternate wetting and drying, and repeated freeze-thaw cycles, have little effect on calcium silicate brick, and efflorescence is not a problem because the raw materials do not ordinarily contain soluble sulfates or other salts. Sand-lime brick is also resistant to attack when in contact with soils containing high levels of sulfates. As with all limestone-based products, the sulfur dioxide in heavily polluted air affects the brick after 20 to 30 years. And like cement-based products, calcium silicate brick is not resistant to acids or repeated exposure to saturated saltwater solutions.

At 100 to 300 lb/cu ft, density is similar to that of a medium-density clay brick. Using expanded aggregates reduces density to about 80 lb/cu ft, and coring or perforations can reduce overall weight. Both sound transmission and fire resistance are similar to clay brick, but ordinary calcium silicate units can also be used in flues, chimney stacks, and other locations requiring moderate refractories.

Calcium silicate units are produced in modular brick sizes as well as larger blocks measuring from 8 × 8 × 16 in. to face sizes of 12 × 24 or 24 × 36 in. with a bed thickness of 4 to 12 in. The larger block units are widely used in some European countries to increase labor production. Single- or multiwythe walls can be erected by using small, transportable electric cranes and mechanical grippers. The units are self-aligning, either by tongue-and-groove slots or by mechanical plugs, and vertical reinforcing steel can be incorporated through core holes and end grooves.