Figure 3-31 Under-burned bricks are easily scratched or scored with a coin, cut with a knife, or broken by hand. (*Photos courtesy Brick Institute of Texas.*)

expansion is restrained, particularly by concrete elements which have an opposing potential for shrinkage. Jointing details must provide flexible anchorage to accommodate such differential movement. (Refer to Chapter 9.)

3.4.6 Fire and Thermal Resistance

Masonry fire resistance and thermal performance are both determined by mass. The characteristics of the individual units are not considered, but ratings are established for finished wall assemblies. Detailed analysis of these properties is covered in Chapter 8.

3.4.7 Acoustical Characteristics

The density of clay masonry determines its acoustical characteristics. Although sound absorption is almost negligible, the heavy mass provides excellent resistance to the transmission of sound through walls. This suggests best use as partitions or sound barriers between areas of different occupancy. Where higher absorption is required in addition to sound isolation, special acoustical units are used. Acoustical tile was developed to offer 60 to 65% absorption. The unit is a structural facing tile with a perforated face shell. The adjacent cell(s) are factory-filled with a fibrous glass pad. The perforations may be round or slotted and arranged in random or uniform patterns. The tile itself is of loadbearing quality, may be glazed or unglazed, and otherwise exhibits the same properties and characteristics of structural clay facing tile manufactured in accordance with ASTM C212 or C126. (Refer to Chapter 8.)

3.4.8 Colors and Textures

Brick and tile are available in an almost unlimited variety of colors and textures. They may be standard items or custom units produced for unique project requirements. Natural clay colors can be altered or augmented by the introduction of various minerals in the mix, and further enhanced by application of a clear, lustrous glaze. Ceramic glazed finishes range from the bright primary colors through the more subtle earth tones in solid, mottled, or

blended shades. Glossy, matte, and satin finishes, as well as applied textures, add other aesthetic options (*see Fig. 2-3*).

3.5 ADOBE MASONRY

Adobe masonry is constructed of large, sun-dried bricks made from clay, sand, silt, and water with additives sometimes used as stabilizers. There are no industry standards for reliable soil selection. The National Parks Service performed testing on a number of historic and contemporary adobe structures and found a wide range of soil types, clay contents, and particle sizes. The Uniform Building Code (UBC) Standard 21-9, *Unburned Clay Masonry Units and Standard Methods of Sampling and Testing Unburned Clay Masonry Units,* requires soil with not less than 25% nor more than 45% of material passing a No. 200 mesh sieve, and containing sufficient clay to bind the particles together. Soil can be tested for approximate composition. Place a soil sample in a jar and then fill the jar with water. Shake the mixture and allow it to settle until the water at the top is clear. The resulting bands of coarser aggregates at the bottom of the jar, and sand, silt, and clay on top will indicate the approximate proportions of the constituent materials. Another field test for clay content and plasticity is the rope test. Mix a sample of soil with a small amount of water to make a stiff lump of mud. Roll the mud by hand into a rope-like shape. The rope should bend easily without breaking if the soil composition is suitable for making adobes.

Soils more often contain too much rather than too little clay, and can be modified by adding sand, straw, hay, or other vegetable fibers. This tempering process helps minimize the shrinkage cracking which can be caused by using soils with too much clay. Any sand that is added should be sharp, angular manufactured sand rather than natural rounded bank run particles. The proper proportions are usually determined by trial and error and tested by making sample bricks. There is generally a broad tolerance range on sand/clay proportions which produce good-quality adobe bricks.

Adobe mixtures are seldom specified. Most often, test bricks are made, dried, and checked. A good mix of clay, sand, silt, and water should be easy to hand-mix by shovel or hoe, should not fall apart when turned into a small mound, should slip free of forms, and should not warp, curl, or crack as the brick dries. The dried brick should not chip or break off at corners when moved, and should be able to withstand 10 to 15 minutes of light to moderate rain with little or no erosion or washing. When broken in half, a unit should exhibit uniform color throughout. Expansive clays such as montmorillinite should be avoided because of their shrink/swell potential, although it can be minimized by adding straw to the mix. Kaolin clays are non-expansive.

Traditional additives or stabilizers for adobe have ranged from straw to horsehair, grass, and pine needles. These materials were used primarily as tensile reinforcement to resist shrinkage cracking. More recently, other chemical materials have been used to increase moisture resistance. Emulsified asphalt is most commonly used, mixed with the adobe at a rate of 5 to 8% by weight. The asphalt emulsion coats the clay particles to reduce natural moisture absorption. Portland cement is also sometimes added to adobe soils. This will increase the compressive strength of the bricks, but will not improve moisture resistance. Lime should not be used as a soil additive.

3.5.1 Manufacturing Adobe

Adobe bricks are usually rectangular in shape with a length that is twice the width. Sizes range from 4 in. high × 9 × 18 in. to 6 in. high × 12 × 24 in., but the latter units are very heavy. In New Mexico, a majority of adobe