

Clay is well suited to the manufacture of masonry products. It is plastic when mixed with water, and easily molded or formed into the desired shapes; it has sufficient tensile strength to maintain those shapes after the dies or molds are removed; and its particles are ceramically fused at high temperatures.

### 2.1.3 Material Preparation

Brick plants commonly mine from several clay pits at a time. Since the raw clay is not always uniform in quality and composition, two or more clays from different pits or from remote locations within the same pit are blended to minimize much of the natural variation in chemical composition and physical properties. Blending produces a higher degree of product uniformity, helps control the color of the units, and permits some latitude in providing raw material suitable for specific types of brick or special product requirements. The clay is first washed to remove stones, soil, or excessive sand, then crushed into smaller pieces, and finally ground to a powdered mix. Particle size is carefully controlled so that only the finer material is taken to storage bins or directly to the forming machine or pug mill for tempering and molding.

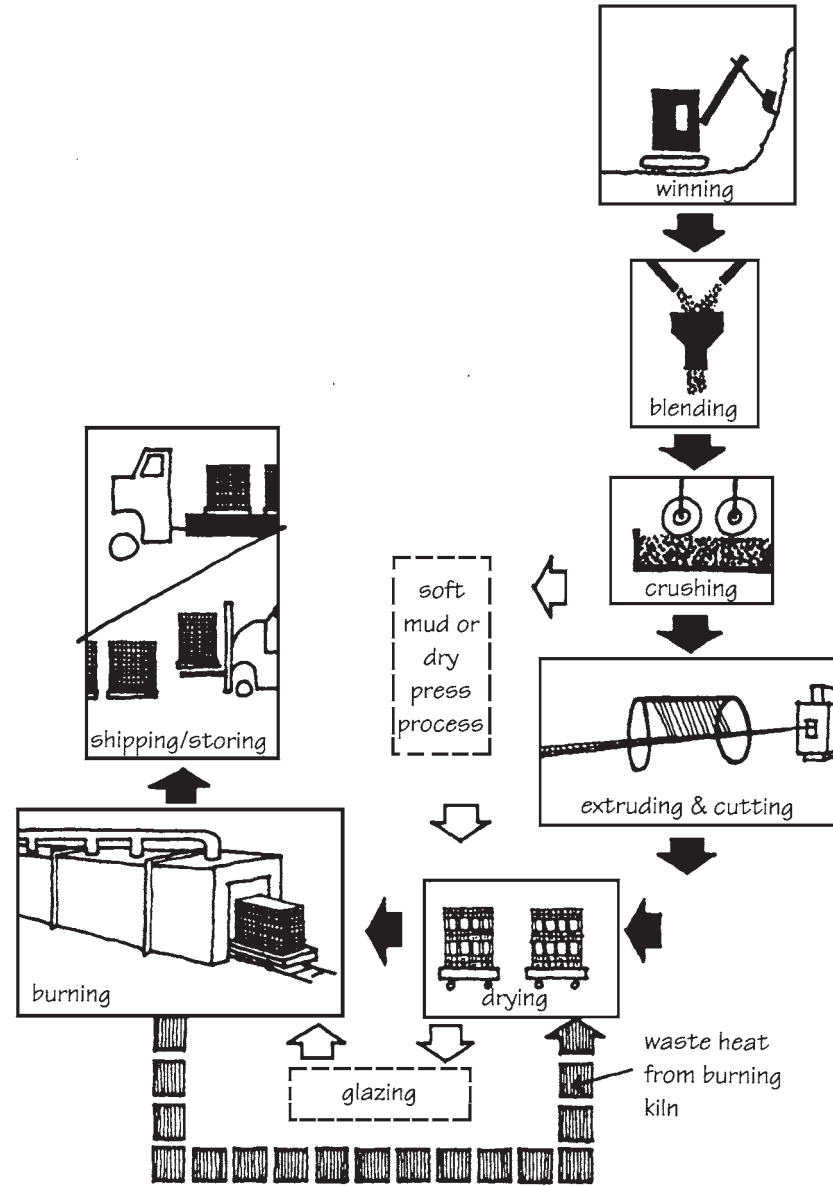
### 2.1.4 Manufacturing

After preparation of the raw clay, the manufacture of fired brick is completed in four additional stages: *forming, drying, burning, and drawing and storage* (see Fig. 2-1). The basic process is always the same, and differences occur only in the molding techniques. In ancient as well as more recent history, brick was exclusively hand-made. Since brick-making machines were invented in the late nineteenth century, however, most of the structural clay products manufactured in the United States are machine-made by one of three forming methods: *stiff-mud, soft-mud, or dry-press*.

### 2.1.5 Forming

The first step in each forming method is tempering, where the clay is thoroughly mixed with a measured amount of water. The amount of water and the desired plasticity vary according to the forming method to be used.

The *stiff-mud extrusion method* is used for more than 80% of the brick manufactured in the United States. A minimum amount of water, generally 12 to 15% moisture by weight, is mixed with the dry clay to make it plastic. After thorough mixing in a pug mill, the tempered clay goes through a de-airing process which increases the workability and plasticity of the clay and produces units with greater strength. The clay is then forced through a steel die in a continuous extrusion of the desired size and shape, and at the same time, is cored to reduce weight and to facilitate drying and burning. Automatic cutting machines using thin wires attached to a circular steel frame cut the extruded clay into pieces (see Fig. 2-2). Since the clay will shrink as it is dried and burned, die sizes and cutter wire spacing must be carefully calculated to compensate. Texturing attachments may be affixed to roughen, score, scratch, or otherwise alter the smooth skin of the brick column as it emerges from the die (see Fig. 2-3). After cutting, a clay slurry of contrasting color or texture may also be applied to the brick surface to produce different aesthetic effects.



**Figure 2-1** Brick manufacturing process.

A conveyor belt moves the “green” or wet brick past inspectors, who remove imperfect units and return them to the pug mill. Satisfactory units are moved from the conveyor to dryer cars and stacked in a prescribed pattern to allow free flow of air and kiln gases for burning. The stiff-mud process produces the hardest and most dense of the machine-made bricks, and also delivers the highest volume of production.

The *soft-mud method* of production is the oldest, and was used exclusively up until the nineteenth century (see Fig. 2-4). All hand-made brick is formed by this process even today. Only a few manufacturers still produce genuine hand-made brick, but demand is increasing as more historic restoration projects are undertaken.