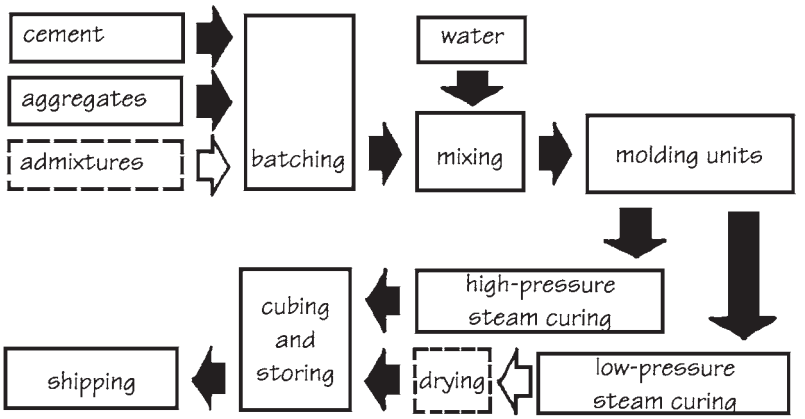

Figure 2-6 Concrete masonry manufacturing process.

tion properties. Ingredients must be carefully regulated so that consistency in texture, color, dimensional tolerances, strength, and other physical properties is strictly maintained. Batching by weight is more common than volume proportioning.

The mixes normally have a low water-cement ratio, and are classified as zero-slump concrete. Special high-strength units are made with more cement and water, but still have no slump. In the production of some slump block units, the batching is changed so that the mix will slump within controlled limits when the unit is removed from its mold. The soft roll in texture is intended to produce the appearance of a handmade adobe.

2.2.6 Forming

Early block production consisted of hand-tamping the concrete mix into wooden molds. A two-man team could turn out about 80 blocks a day. By the mid-1920s, automatic machines could produce as many as 3000 blocks a day. Today, units are molded with a combination of mechanical vibration and hydraulic pressure, and production is typically in the neighborhood of 1000 units per hour.

2.2.7 Curing

Freshly molded blocks are lightly brushed to remove loose aggregate particles, then moved to a kiln or autoclave for accelerated curing.

A normal 28-day concrete curing cycle is not conducive to the mass production of unit masonry. Experiments in accelerated steam curing were conducted as early as 1908. In addition to hastening the hydration process, steam curing also increases compressive strength, helps control shrinkage, and aids in uniformity of performance and appearance. Both high-pressure and low-pressure curing are used in the industry.

Most of the block manufactured in the United States is produced by *low-pressure steam curing*. The first phase is the holding or preset period of 1 to 3 hours. The units are allowed to attain initial hardening at normal temperatures of 70 to 100°F before they are exposed to steam. During the heating

period, saturated steam is injected to raise the temperature to a maximum of 190°F. The exact time duration and temperature span recommended by the American Concrete Institute (ACI) depend on the composition of the cementitious materials and the type of aggregate used. Once maximum temperature is reached, the steam is shut off and a soaking period begins. Blocks are held in the residual heat and moisture for 12 to 18 hours or until the required compressive strengths are developed. An accelerated drying period may also be used, with the temperature in the kiln raised to evaporate moisture.

The entire cycle is generally accomplished within 24 hours. Compressive strengths of 2- to 4-day-old units cured by low-pressure steam are approximately 90% of ultimate strength compared with only 40% for blocks of the same age cured by 28-day moist sprinkling. Steam-cured units are also characterized by a generally lighter color.

A variation of the low-pressure steam method adds a carbonation phase in which carbon dioxide is introduced into the drying atmosphere to cause irreversible shrinkage. Preshrinking decreases volume changes caused by atmospheric moisture conditions and reduces shrinkage cracking in the wall. Carbonation also increases tensile and compressive strength, hardness, and density of the block.

High-pressure steam curing improves the quality and uniformity of concrete masonry, speeds production, and lowers manufacturing costs. Curing takes place in an autoclave kiln 6 to 10 feet wide and as much as 100 feet long (*see Fig. 2-7*).

A typical high-pressure curing cycle consists of four phases: preset, temperature rise, constant temperature and pressure, and rapid pressure release. The low-heat preset period hardens the masonry sufficiently to withstand the high-pressure steam. The temperature rise period slowly brings both

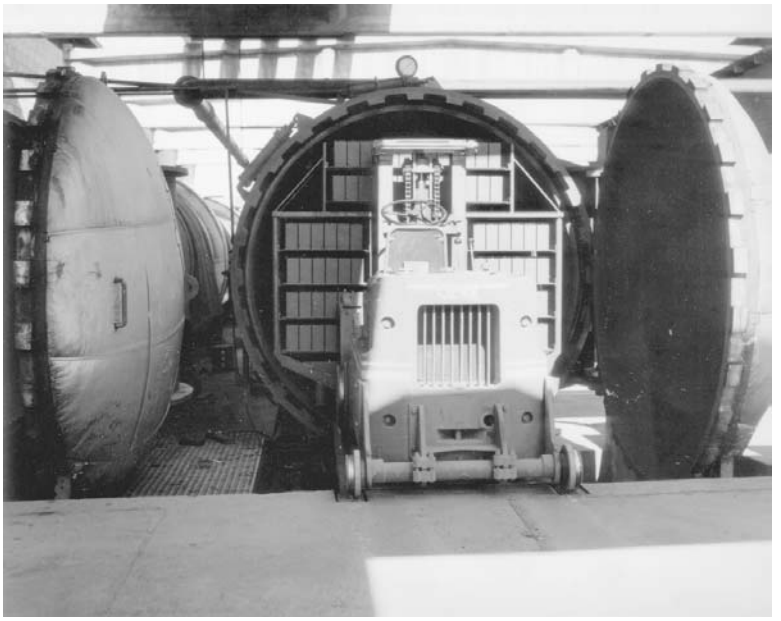

Figure 2-7 Loading racks of fresh units into an autoclave for high-pressure steam curing. (*Photo courtesy PCA.*)