Solid units are made in thicknesses ranging from $2^1/_2$ to 6 in. The thicker units are used for heavy service loads, and the thinner ones for light-duty residential areas. Individual solid paving units are small in size to facilitate manual installation. The irregular shapes prevent accurate description by linear measure, but units typically will range in size from 15 sq in. to a maximum of about 64 sq in. Some manufacturers are now casting from 6 to 12 units together in clusters that are designed to be laid at the job site by machine or by a team of two workers. After the units are in place, the individual pavers break apart along preformed cleavage lines. This method increases production and can result in a reduced labor costs.

Concrete paver shapes come in full-size units for field areas, but most designs also include edge units and half-length units to reduce the amount of job-site cutting required. Units are generally produced in a number of colors, but both color and shape will depend on local availability. Before planning the size and layout of a paved area, check with local manufacturers to verify design-related information.

Concrete grid pavers are popular for applications where soil stabilization is required but a natural grass covering is also desirable. ASTM C1319, *Standard Specification for Concrete Grid Paving Units,* requires an average compressive strength of 5000 psi and a maximum average water absorption of 10%. Physically, the units are permitted a maximum 50% void area, and must have a minimum $1^1/_4$-in. web thickness. Durability standards are based solely on proven field performance in maintaining the required compressive strength and water absorption characteristics after three years in service. Minimum nominal thickness is $3^1/_8$ in., and maximum dimensions are 24 × 24 in. Features such as weight classification, surface texture, color, and finish are not covered in the standard and must be specified separately. Availability of specific unit patterns, shapes, and colors will vary locally.

Clay brick paving units also come in a number of shapes, sizes, thicknesses, colors, and textures. Coarser-textured, slip-resistant units are recommended for outdoor installations exposed to rain, snow, and ice. This type of exposure also calls for units that are highly resistant to damage from freezing in the presence of moisture. For residential and light commercial applications such as patios, walkways, floors, plazas, and driveways, brick pavers should meet or exceed the requirements of ASTM C902, *Standard Specification for Pedestrian and Light Traffic Paving Brick.* Three weathering classifications are given, Classes SX, MX, and NX, roughly corresponding to the three grades of face brick for severe weathering, moderate weathering, and no weathering exposure. Traffic Type I, II, or III may be specified for exposure to extensive abrasion, intermediate traffic, or low traffic, respectively.

For paving in areas with a high volume of heavy vehicular traffic such as streets, commercial driveways, and aircraft taxiways, brick pavers should meet or exceed the requirements of ASTM C1272, *Standard Specification for Heavy Vehicular Paving Brick.* The standard covers two types of pavers. Type R (rigid paving) is intended to be set in a mortar setting bed supported by an adequate concrete base or an asphalt setting bed supported by an adequate asphalt or concrete base. Type F (flexible paving) is intended to be set in a sand bed with sand joints. Three different applications are also covered, PS, PX, and PA, roughly corresponding to appearance types FBS, FBX, and FBA for clay facing brick. Because they are intended to be installed over a flexible base, Type F pavers must have the highest compressive strength at 10,000 psi. Type R pavers that will be supported on an asphalt or concrete base must have a minimum average compressive strength of only 8000 psi.

Heavy vehicular paving brick is obviously intended to be more rugged and durable in commercial, municipal, and industrial applications than pedestrian and light traffic pavers.

The Brick Industry Association (BIA) does not recommend the use of salvaged or used brick in paving installations. Older manufacturing processes did not assure uniformity in the quality of materials or performance, and units may spall, flake, pit, and crack when exposed to outdoor freeze-thaw cycles. Although used brick may be adequate for small residential jobs, and may provide a pleasing rustic effect, materials of unknown origin and composition should not be used for larger installations unless performance criteria can be tested and verified.

14.1.7 Paving Patterns

Many different effects can be achieved with standard rectangular pavers by varying the bond pattern in which the units are laid (*see Fig. 14-8*). It is important to specify the proper size of unit required for a particular pattern. Any of the patterns shown can be achieved with 4 × 8-in. *actual dimension* units laid dry and tight, or with nominal 4 × 8-in. units ($3^5/_8 \times 7^5/_8$-in. actual size) laid with $^3/_8$-in. mortar or sand joints. Patterns that require the width of the unit to be exactly one-half the length may not be laid dry and tight using nominal dimension units designed for mortar joints, and vice versa. The interlocking and herringbone patterns provide greater stability and lateral stress transfer. Designs that result in continuous joints (especially longitudinal joints in the direction of traffic flow) are more subject to shoving, displacement, and the formation of ruts.

14.1.8 Brick Steps

For rigid brick paving systems, sharp changes in grade can be accommodated by constructing brick steps. Unit size affects riser height. There are four different ways of creating risers using different paver thickness, either laying the bricks flat (*see Fig. 14-9*) or setting them on edge (*see Fig. 14-10*), and varying the mortar joint thickness from $^3/_8$ to $^1/_2$ in. This gives some flexibility in achieving the exact riser height needed. The exposed length of the pavers as shown produces a tread width of 12 in. Overall width should be a multiple of 8 in. to accommodate the use of $2^1/_4$-in.-thick pavers that are either laid on edge or laid flat. A 4-in.-thick stepped concrete base reinforced with welded wire fabric or reinforcing bars should be used to support the brick steps (*see Fig. 14-11*). Either slope the surface of the treads on the concrete base for drainage, or pour the concrete flat and slope the brick treads by varying the mortar bed thickness.

14.2 FIREPLACES

Residential fireplace design has evolved over the centuries toward standardization of the functional elements that assure successful operation. A fireplace must have proper fuel combustion, good chimney draw, and maximum heat radiation. Design should also provide simplicity of construction and fire safety, particularly when adjacent building elements are of combustible materials.

The proper functioning of a fireplace is related to the shape and relative dimensions of the combustion chamber or fire box, the proper location of the fireplace throat in relation to the smoke shelf, and the ratio of the flue area to the area of the fireplace opening (*see Fig. 14-12*). The shape of the combustion