Marble often has compressive strengths as high as 20,000 psi, and when used in dry climates or in areas protected from precipitation, the stone is quite durable. Some varieties, however, are decomposed by weathering or exposure to industrial fumes, and are suitable only for interior work. ASTM C503, *Standard Specification for Marble Dimension Stone (Exterior),* covers four marble classifications, each with a minimum required compressive strength of 7500 psi: I, calcite; II, dolomite; III, serpentine; and IV, travertine. Over 200 imported and domestic marbles are available in the United States. Each has properties and characteristics that make it suitable for different types of construction.

Marbles are classified as A, B, C, or D on the basis of working qualities, uniformity, flaws, and imperfections. For exterior applications, only group A, highest-quality materials should be used. The other groups are less durable, and will require maintenance and protection. Group B marbles have less favorable working properties than Group A, and will have occasional natural faults requiring limited repair. Group C marbles have uncertain variations in working qualities; contain flaws, voids, veins, and lines of separation; and will always require some repair (known as sticking, waxing, filling, and reinforcing). Group D marbles have an even higher proportion of natural structural variations requiring repair, and have great variation in working qualities.

Marble is available as rough or finished dimension stone and as thin veneer slabs for wall and column facings, flooring, partitions, and other decorative surface work. Veneer slabs may be cut in thicknesses from ¾ to 2 in. Light transmission and translucence diminish as thickness increases. Fabrication tolerances for marble are shown in *Fig. 5-10.*

5.4.4 Slate

Slate is also a metamorphic rock, formed from argillaceous sedimentary deposits of clay and shale. Slates containing large quantities of mica are stronger and more elastic than clay slates. The texture of slate is fine and compact with very minute crystallization. It is characterized by distinct cleavage planes permitting easy splitting of the stone mass into slabs ¼ in. or more in thickness. Used in this form, slate provides an extremely durable material for flooring, roofing, sills, stair treads, and facings. ASTM C629, *Standard Specification for Slate Dimension Stone,* requires that Type I exterior slate have a minimum modulus of rupture of 9000 psi across the grain and 7200 psi along the grain.

Allowable Tolerances for Marble Building Stone

Thickness	Panel Finished on Both Faces (in.)	Panel Finished on One Face (in.)
Thin stock (3/4" to 2")	+0, -1/16	+1/8, -1/16
Cubic stock (over 2")	±1/16	+3/16, -1/8
Marble tile	—	±1/32
Sizes and Squareness		
Thin stock	±1/16	±1/16
Cubic stock	—	±1/16

Figure 5-10 Fabrication tolerances for marble building stone. (*From* Dimension Stone, Vol. III, *Marble Institute of America.*)

Small quantities of other mineral ingredients give color to the various slates. Carbonaceous materials or iron sulfides produce dark colors such as black, blue, and gray; iron oxide produces red and purple; and chlorite produces green tints. "Select" slate is uniform in color and more costly than "ribbon" slate, which contains stripes of darker colors.

5.4.5 Sandstone

Sandstone is a sedimentary rock formed of sand or quartz grains. Its hardness and durability depend primarily on the type of cementing agent present. If cemented with silica and hardened under pressure, the stone is light in color, strong, and durable. If the cementing medium is largely iron oxide, the stone is red or brown, and is softer and more easily cut. Lime and clay are less durable binders, subject to disintegration by natural weathering. Sandstone can be categorized by grain size and cementing media. Siliceous sandstone is cemented together with silica. It is resistant to sulfurous pollutants. Many siliceous sandstones contain iron, which is oxidized by acidic pollutants (or acidic cleaners), and turns the stone brown. Ferruginous sandstone is cemented together with iron oxide, so it is naturally red to deep brown in color. Calcareous sandstone is cemented together with calcium carbonate, which is sensitive to acids and can deteriorate rapidly in a polluted environment. Dolomitic sandstone is cemented together with dolomite, which is more resistant to acid. Argillaceous sandstone contains large amounts of clay, which can quickly deteriorate simply from exposure to rain.

ASTM C616, *Standard Specification for Quartz-Based Dimension Stone,* recognizes three classifications of stone. Type I, sandstone, is characterized by a minimum of 60% free silica content; Type II, quartzite sandstone, by 90% free silica; and Type III, quartzite, by 95% free silica content. As a reflection of these varying compositions, minimum compressive strengths are 2000, 10,000, and 20,000 psi, respectively. Absorption characteristics also differ significantly, ranging from 20% for Type I to 3% for Type II and 1% for Type III. When first taken from the ground, sandstone contains large quantities of water, which make it easy to cut. When the moisture evaporates, the stone becomes considerably harder.

Sandstones vary in color from buff, pink, and crimson to greenish brown, cream, and blue-gray. It is traces of minor ingredients such as feldspar or mica that produce the range of colors. Both fine and coarse textures are found, some of which are highly porous and therefore low in durability. The structure of sandstone lends itself to textured finishes, and to cutting and tooling for ashlar and dimension stone in veneers, moldings, sills, and copings. Sandstone is also used in rubble masonry as fieldstone. Flagstone or bluestone is a form of sandstone split into thin slabs for flagging.

5.5 SELECTING STONE

Stone for building construction is judged on the basis of (1) appearance, (2) durability, (3) strength, (4) economy, and (5) ease of maintenance. Design and aesthetics will determine the suitability of the color, texture, aging characteristics, and general qualities of the stone for the type of building under consideration. Colors may range from dull to brilliant hues, and from warm to cool tones. Textures may vary from coarse or rough to fine and dense (*see Figs. 5-11 and 5-12*). Limestones are generally considered in the broader range of commercial and institutional applications. Some stones, such as granite, will soften very slowly in tone and outline, and will retain a sharp edge and hard contour indefinitely. Others mellow in tone and outline,