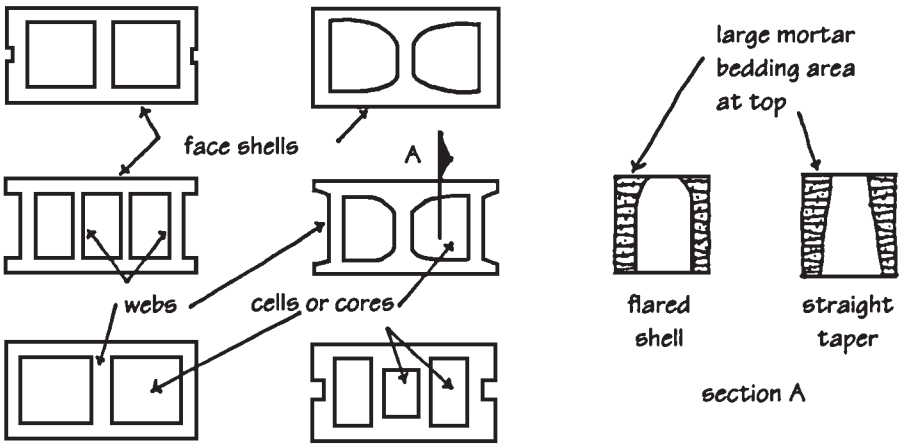
Units defined as solid must have a minimum of 75% net solid area. Although the industry has standardized exterior dimensions of modular units, no such standardization exists for the number, size, or configuration of cores. Coring design and percent of solid volume vary, depending on the unit size, the equipment, and the methods of the individual manufacturers. For structural reasons, ASTM standards for loadbearing units specify minimum face shell and web thickness, but these stipulations do not apply for non-loadbearing units. Although minimum face shell and web thickness will not necessarily correspond to actual dimensions for all units, they can be used to estimate properties for preliminary design (*see Fig. 4-7*).



Minimum Required Face Shell and Web Thickness for Loadbearing (ASTM C90 Only) Concrete Masonry Units

Nominal Width of Unit (in.)	Minimum Face Shell Thickness† (in.)	Web Thickness	
		Minimum Web Thickness† (in.)	Minimum Equivalent Web Thickness‡ (in./linear ft.)
3 and 4	3/4	3/4	1-5/8
6	1	1	2-1/4
8	1-1/4	1	2-1/4
10	1-3/8 1-1/4§	1-1/8	2-1/2
12	1-1/2 1-1/4§	1-1/8	2-1/2
Any width unit solidly grouted	5/8	–	–

† Average of measurements on three units, taken at thinnest point.
§ Allowable design load must be reduced in proportion to reduction in face shell thickness.
‡ Sum of measured thickness of all webs, multiplied by 12, and divided by length of unit.

Figure 4-7 Unit coring and minimum face shell thickness.

4.5.1 Coring

Block is produced in two-core and three-core designs and with smooth or flanged ends (*see Fig. 4-7*). Two-core designs offer several advantages, including a weight reduction of approximately 10% and larger cores for the placement of vertical reinforcing steel and conduit. In addition, the thickened area of the face shell at the center web increases tensile strength and helps to reduce cracking from drying shrinkage and temperature changes. Accurate vertical alignment of both two-core and three-core designs is important in grouted and reinforced construction. End designs of block may be smooth or flanged, and some also have a mortar key or groove for control joints and jamb units. Smooth face ends must be used for corner construction, piers, pilasters, and so on. The cores of hollow units are usually tapered, with the face-shell thickness wider at the top than at the bottom of the unit. This facilitates form removal, provides a larger bedding area for mortar, and allows a better grip for the mason. Minimum thickness required by ASTM standards for loadbearing units refers to the narrowest cross section, not an average thickness of top and bottom. Since compressive strengths of hollow units are established on the basis of gross area, and fire-resistance ratings on equivalent solid thickness, these details of unit design become important in determining actual ratings for a particular unit.

Hollow concrete masonry units (CMUs) are more widely used than solid units because of reduced weight, ease of handling, and lower cost. Most hollow blocks have core areas of 40 to 50%, leaving a net solid volume of 50 to 60%. Some concrete brick manufacturers have begun to capitalize on this economy by producing a cored "through-the-wall" unit that has an increased thickness of 8 in., but maintains the typical face dimensions of brick. They may be classified as either solid or hollow depending on the percentage of voids created.

4.5.2 Grading and Moisture Content

Unlike concrete brick, concrete block no longer has grade classifications. Until recently, however, two types of concrete block were recognized, based on moisture content of the units. The limits on moisture content for some units were based on efforts to minimize shrinkage cracking. Since moisture content was difficult to control at the construction site, NCMA has developed new guidelines for crack control joints and ASTM has eliminated the type designation from its standards. Refer to Chapter 9 for a discussion on controlling movement and cracking in masonry construction.

4.5.3 Sizes and Shapes

Concrete masonry units are governed by the same modular standards as clay masonry products. The basic concrete block size is derived from its relationship to modular brick. A nominal $8 \times 8 \times 16$-in. block is the equivalent of two modular bricks in width and length, and three brick courses in height. Horizontal ties may be placed at 8- or 16-in. vertical intervals with either brick or structural clay tile facing. These are nominal dimensions that include allowance for a standard ⅜-in. mortar joint. Concrete brick dimensions are the same as for clay brick, but fewer sizes are generally available. Some variation in face size of standard concrete block stretcher