Something for Free?

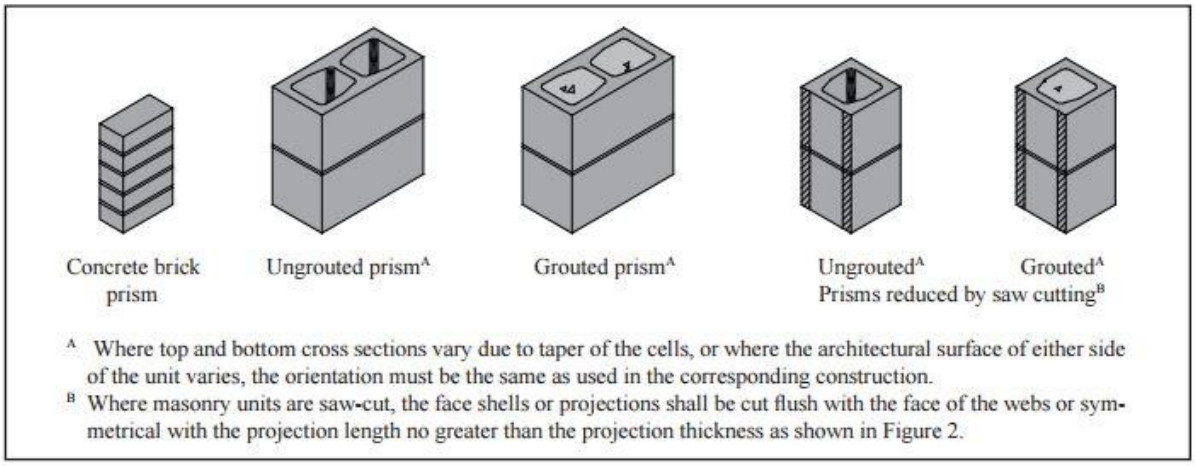
Concrete Masonry's Compressive Strength Increases an INCREDIBLE 33%

November 2016

How did this happen? Did concrete masonry unit manufacturers (like Northfield Block and Elston Materials) start adding more cement to their CMU? (CMU = Concrete Masonry Unit, aka 'concrete block' or simply 'block'). Did they improve their curing systems? Did the aggregate they use in the concrete that is molded into their block get stronger?

The answer is that none of these occurred. That is right. None of this happened. The Block industry simply realized that the test data and test methods that structural engineers relied upon to determine CMU wall strength were overly conservative. For those of us that are *not* structural engineers, the strength of a concrete masonry wall is known as the 'net area compressive strength of concrete masonry' and is symbolized as f'm (F PRIME M). (Similarly, the strength of poured concrete walls or columns is known as f'c.)

How is f'm determined? There are two methods that are widely accepted and well known. One method requires that a two-unit prism (see illustration below) is made and then tested in a compression testing machine. This method is called the "Prism Test" method.



[A] Where top and bottom cross sections vary due to taper of the cells, or where the architectural surface of either side of the unit varies, the orientation must be the same as used in the corresponding construction.
[B] Where masonry units are saw-cut, the face shells or projections shall be cut flush with the face of the webs or symmetrical with the projection length no greater than the projection thickness as shown in Figure 2.

Figure 1—Types of Prisms

The second method, known as the "Unit Strength" method, only requires that the strength of the CMU and the mortar being used are known (see Table 2 below).

Table 2 — Compressive strength of masonry based on the compressive strength of concrete masonry units and type of mortar used in construction

Net area compressive strength of concrete masonry, psi (MPa)	Net area compressive strength of concrete masonry units, psi (MPa)	
	Type M or S mortar	Type N mortar
1,700 (11.72)	---	1,900 (13.10)
1,900 (13.10)	1,900 (13.10)	2,350 (14.82)
2,000 (13.79)	2,000 (13.79)	2,650 (18.27)
2,250 (15.51)	2,600 (17.93)	3,400 (23.44)
2,500 (17.24)	3,250 (22.41)	4,350 (28.96)
2,750 (18.96)	3,900 (26.89)	-----
3,000 (20.69)	4,500 (31.03)	-----

[1]For units of less than 4 in. (102 mm) nominal height, use 85 percent of the values listed.

This table is conservative by the very fact that only the CMU and mortar's strength are used. Job site conditions or the ability of the mason to properly lay the CMU and tool the mortar joints are not specifically considered. On the other hand, prisms made on the jobsite incorporating material properties, workmanship and jobsite climate conditions, are a more accurate representation of f'm. This is similar to the concrete test cylinders often seen on commercial jobsites. Not surprisingly then, it is ***this*** table that contains the overly conservative strength data. That is up until the 2013 when NCMA's research project culminated in the publication ***and*** building code acceptance of Table 2 (above). This *new* Table is where the 33% strength increase can be found.

For example, a 'standard' CMU that met the old minimum ASTM strength requirement of 1900 psi and was used to build a wall with type M or S mortars would have a f'm equal to 1500 psi per the older version of the table. (See Table 1 below).

Compare that to today using a 2000 psi CMU (ASTM's new minimum is 2000 psi) with Type M or S mortar and you get an f'm equal to 2000 psi. *This 33% higher than we used to achieve!* And, it does not cost you a penny.

Table 1—Compressive Strength of Masonry Based on the Compressive Strength of Concrete Masonry Units and Type of Mortar Used in Construction (ref. 1)

Net area compressive strength of concrete masonry units, psi (MPa)		Net area compressive strength of masonry[A], psi (MPa)
Type M or S mortar	Type N mortar	
----	1,900 (13.10)	1,350 (9.31)
1,900 (13.10)	2,150 (14.82)	1,500 (10.34)
2,800 (19.31)	3,050 (21.03)	2,000 (13.79)
3,750 (25.86)	4,050 (27.92	2,500 (17.24)
4,800 (33.10)	5,250 (36.2)	3,000 (20.69)

[A] For units less than 4 in. (102 mm) in height, 85% of the values listed.

References: NCMA FAQ 05-14 *What is the minimum required compressive strength for concrete masonry*?

NCMA Tek Note 18-1B (2011) *Evaluating the Compressive Strength of Concrete Masonry*

For more information and advice on how to design more efficiently with CMU, give us a call at 847-297-6704.

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