Engineering Notes for Design
with Concrete Block Masonry

MASONRY CHRONICLES

2026

Pacific Sky School
Grand Award Winner of the 2024 CMACN/AIACA
Design Awards in Educational Design
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Photo by Greg Epstein

Compliance with f'_m

Concrete Masonry Association
of California and Nevada

Compliance with f'_m

Concrete Masonry Association of California and Nevada's (CMACN) recent educational efforts with owners, designers, specifiers and inspectors have been focused on optimizing the use of concrete masonry products. Sustainable building initiatives and efforts require that we optimize the use of all construction materials used in our new buildings. One method of optimizing the use of materials in concrete masonry construction is in the selection of the method by which f'_m is determined.

The 2025 California Building Code (CBC), based on the 2024 International Building Code (IBC), both referencing TMS 402/602-22, provides two methods for determining the compressive strength of a masonry assemblage. Those methods are outlined in TMS 602-22 Article 1.4.

Unit Strength Method for concrete masonry is detailed in Article 1.4 B. 2. The compressive strength of masonry is based on the strength of the concrete masonry unit and the type of mortar specified for the project. The concrete masonry units must conform to ASTM C90, and sampled and tested in accordance with ASTM C140; the thickness of bed joints cannot exceed 5/8 of an inch; and, for grouted masonry, the grout must conform to Article 2.2. To determine the required compressive strength of the concrete masonry unit, we refer to Table 2. For example, for a project requiring an f'_m of 2,000 psi, using Type S mortar, the concrete masonry unit must have a compressive strength of at least 2,000 psi.

Figure 1: Preparing a Concrete Masonry Prism

Table 1

ASTM C 476, TABLE 1 CONVENTIONAL GROUT PROPORTIONS BY VOLUME FOR MASONRY CONSTRUCTION				
TYPE	PARTS BY VOLUME OF PORTLAND CEMENT OR BLENDED CEMENT	PARTS BY VOLUME OF HYDRATED LIME OR LIME	AGGREGATE, MEASURED IN A DAMP, LOOSE CONDITION	
			Fine	Coarse
Fine grout	1	0-1/10	21/4-3 times the sum of the volumes of the cementitious materials	—
Coarse grout	1	0-1/10	21/4-3 times the sum of the volumes of the cementitious materials	1-2 times the sum of the volumes of the cementitious materials

Table 2

PORTIONS OF TMS 602 TABLE 2 COMPRESSIVE STRENGTH OF CONCRETE MASONRY		
NET AREA CMPRESSIVE STRENGTH OF CONCRETE MASONRY UNITS (psi)		NET AREA COMPRESSIVE STRENGTH OF MASONRY (PSI)[a]
Type M or S mortar	Type N mortar	
2,000	2,650	2,000
2,600	3,400	2,250
3,250	4,350	2,500
3,900	-	2,750
4,500	-	3,000
a. For units less than 4 inches in height, 85 percent of the values listed.		

Prism Test Method is outlined in TMS 602 Article 1.4 B. 3. The compressive strength of concrete masonry is determined by the prism test method when: The prism test method is specified in the construction documents, or where the masonry does not meet the requirements for application of the unit strength method. It should be noted that the prism test method does not require a minimum compressive strength of concrete masonry units, or grout greater than those found in the ASTM Standards; nor is the prism test method dependent on type of mortar used.

Figure 2: Compression Testing a Concrete Masonry Prism

The code requires that compliance with f'_m be determined by compressive strength. The compressive strength is determined by the unit strength method OR prism test method, NOT BOTH. It is common to see in project specifications both methods outlined and specified. This is not appropriate. One method should be selected for the project by the design professional, or the mason contractor.

In California and Nevada, the majority of structural concrete masonry walls are fully grouted. In an eight-inch-thick wall, the CMU is approximately half of the gross area of the wall, and grout contributes the other half of the gross area. In ten-, twelve-, and sixteen-inch-thick walls, grout contributes to well over half of the gross area of the wall. It is easy to see that in fully grouted walls, the compressive strength of the grout contributes at least half of the total compressive strength required to meet the specified f'_m. The code requires that the compressive strength of the grout equals or exceeds f'_m, but not be less than 2,000 psi. Field mixed grout generally conforms to ASTM C476 Table 1. Ready-mix grout constituents are often batched by weight (not by volume) and test records are maintained by the supplier offering a statistical record of the compressive strength of each mix design. The majority of all grout used in fully grouted walls in California and Nevada is supplied by off-site ready-mix plants. Any mix design from a ready-mix supplier submitted to the design professional must equal or exceed the required f'_m. Experience has shown that grout mixes in most of California and Nevada can well exceed 3,000 psi.

Concrete masonry units that meet the requirements of ASTM C90 must have a minimum compressive strength of 2,000 psi. When a design professional uses an f'_m of 2,000 psi to design a wall, a CMU meeting the requirements of ASTM C90 used in conjunction with Type S mortar, and grout with a compressive strength of at least 2,000 psi fulfills the requirements of the unit strength method of determining f'_m.

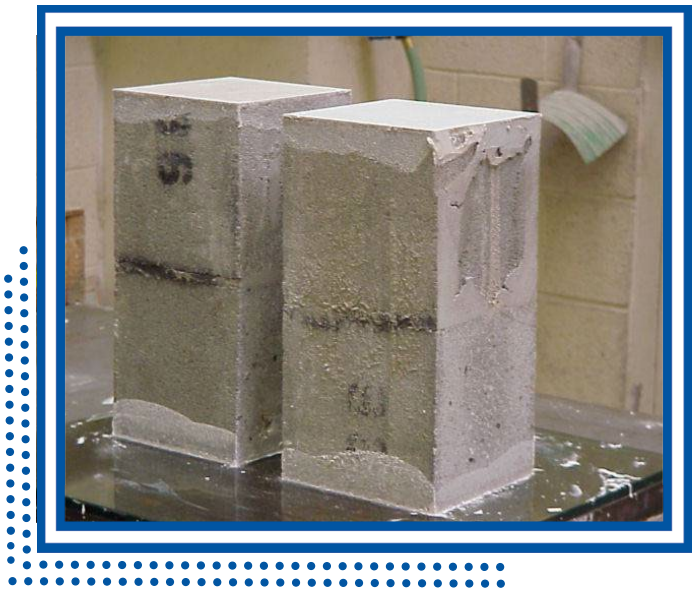

Figure 3: Concrete Masonry Prisms Capped and Ready for Testing

It is common that concrete masonry units produced in California and Nevada exceed the minimum strength required by ASTM C90, and that field and ready-mixed grout exceed the minimum requirement of 2,000 psi. A producer that commonly provides a CMU with compressive strength of 2,400 psi can only provide those CMU's to a project with f'_m of 2,000 psi when compliance with f'_m is determined by unit strength method. But if the prism method were used to determine

compliance with f'_m, that same 2,400 psi CMU could be combined with a grout specified with a minimum compressive strength of 2,250 psi and meet the f'_m design requirement of 2,250 psi. In this example, a premium CMU would not be required to meet the job required f'_m 2,250 psi. For a large job, this could be a considerable cost savings to the project with a very small increase in the cost of material testing. Even greater saving can be had when the f'_m design requirement is 2,500 psi or greater.

Occasionally, due to a variety of reasons which may include anomalies in testing procedures, improper sampling, curing or handling of CMU's, grout, or prisms, the Unit Strength Method and Prism Test Method may not accurately represent the masonry assemblage conformance with the required f'_m, TMS 602 Article 1.4 B. 4. outlines provisions for testing prisms from constructed masonry. This is a destructive test method requiring repair of the concrete masonry. This destructive test method should be employed before rejecting a completed masonry wall, which may in fact be structurally sound.

f'_m and Essential Services Buildings in California

Verifying compliance with f'_m for essential services buildings (schools, hospitals, etc.) in California differs from non-essential structures.

2025 CBC section 2105A.2. allows the use of unit strength method when the f'_m does not exceed 2,000 psi. When the f'_m exceeds 2,000 psi, only the prism method may be used to verify compliance. Design strength limits are outlined in Table 4.3.1.

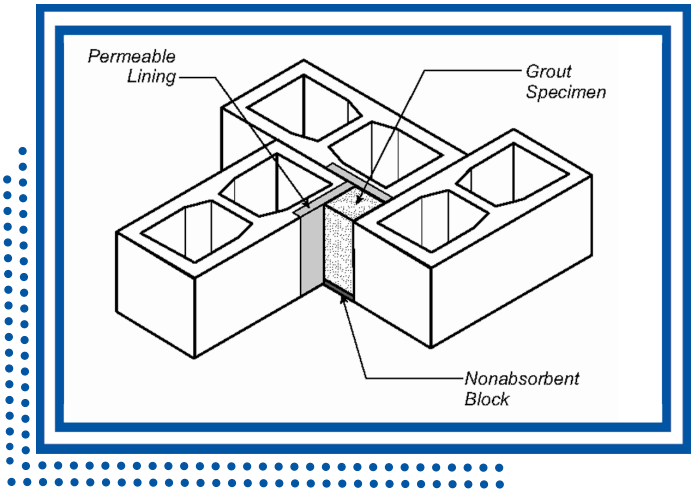

Figure 4 : Grout Mold for Testing (Note: Front Unit Not Shown to Allow View of Specimen)

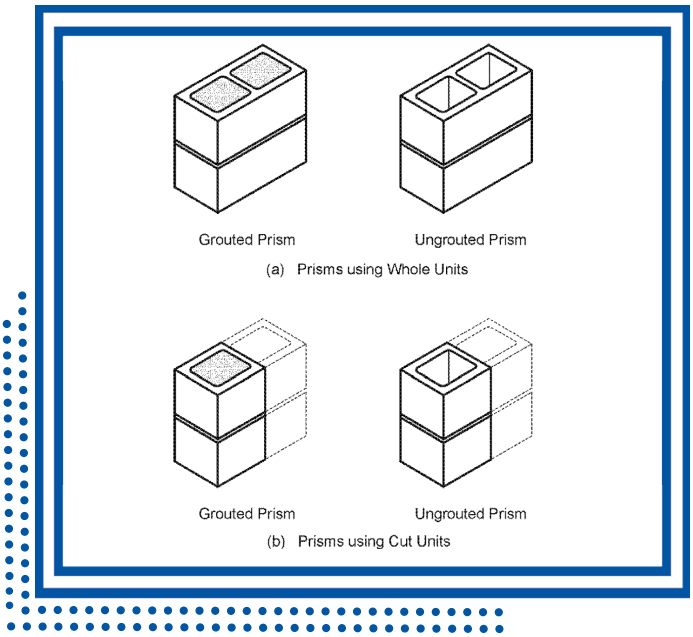

Figure 5: Prisms

CMACN is working with owners, designers, specifiers and inspectors to better optimize the use of concrete masonry products. Concrete masonry is economical, beautiful, earthquake resistant, fire resistant, and safe and sound.

This article is reprinted from the CMACN Spring 2008 edition of Masonry Chronicles, which was written by Kurtis K. Siggard, Executive Director, Concrete Masonry Association of California and Nevada

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CMACN

Concrete Masonry Association of California and Nevada
7844 Madison Avenue, Suite 140
Fair Oaks, CA 95628
(916) 722-1700
info@cmacn.org
www.cmacn.org

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