

## Specifying Reinforced Hollow Clay Masonry: A Comprehensive Guide

When specifying the compressive strength for clay or concrete masonry on your project, it is not sufficient to indicate  $f'_m$  only. The clay or concrete unit strength, mortar type, and grout strength are key items to include in your General Notes and/or Specifications. This article will focus primarily on the specification for hollow clay masonry, and we have provided similar guidance for concrete masonry strength in the SE Insight article titled 'How to Specify Concrete Masonry'.

**Table I from TMS 602-16: UNIT STRENGTH METHOD TABLE**  
Compressive strength of masonry based on the compressive strength of clay masonry units and type of mortar used in construction (formatting revised for this paper)

$f'_m$ Net area compressive strength of clay masonry	Type S Mortar	Type N Mortar
	$f'_{clay}$ Net area compressive strength of clay masonry units per ASTM C62, C216, or C652	
1,000 psi	1,700 psi	2,100 psi
1,500 psi	3,350 psi	4,150 psi
2,000 psi	4,950 psi	6,200 psi
2,500 psi	6,600 psi	8,250 psi
<b>3,000 psi</b>	<b>8,250 psi</b>	10,300 psi
<b>3,500 psi</b>	<b>9,900 psi</b>	----
<b>4,000 psi</b>	<b>11,500 psi</b>	----

The design strength of masonry ( $f'_m$ ) can be determined using the Unit Strength Method outlined in TMS 602 as shown in Table I, the "Specification for Masonry Structures." This method relies on the compressive strength of the masonry units and the type of mortar used in construction. A specified  $f'_m$  can be achieved through different combinations of unit and mortar strengths:

- Higher-strength clay masonry with lower-strength mortar.
- Lower-strength clay masonry with higher-strength mortar.

Simply specifying a minimum  $f'_m$  on construction documents does not provide enough information for contractors to select appropriate materials. It is essential to include the specific requirements for clay masonry units, mortar type, and grout to achieve the intended structural performance.

The key components for the strength of clay masonry walls are the hollow structural clay units. Clay masonry units are available as either common/face brick or hollow clay masonry. Hollow clay masonry allows for reinforcing to be added within its cells similar to concrete masonry block. More information can be found at Brick Industry Association (BIA) [gobrick.com](http://gobrick.com) under technical Note 41.

**The common compressive strength for hollow clay masonry,  $f'_{\text{clay}}$  as determined by ASTM C652 tests, is 8,250 psi or higher. Higher strengths above 11,500 psi are also available.**

The next component that needs to be specified is the mortar. There is a lot of confusion over mortar strength and its effects on  $f'_m$ . The common mistake is to believe that masonry is only as good as its weakest element - the mortar. It's important to remember that mortar only makes up a small percentage of the overall wall as most of the material in a wall is higher strength clay masonry. There is also confusion over testing; mortar tests are done in non-absorptive molds that result in a higher moisture content and less strength than mortar placed in a masonry wall between clay units. Properties of mortar such as bond strength and workability are more important in many cases than compressive strength. TMS 602 clearly defines the strength of the wall to be more than the strength of the mortar. Mortar strength has been shown to be a relatively unimportant factor in determining  $f'_m$ . In TMS 602, Table 1 (section 1.4B.2.a) shows the type of mortar and unit strength can be used to find the assembly compressive strength,  $f'_m$ . TMS 602 also refers to the prism testing that was done (Figures SC-1 and SC-2) which supports the  $f'_m$  values shown in the table. Therefore, it is also important to recognize that  $f'_m$  is dependent on the *type* of mortar, not the mortar *strength* - the requirements for the mortar strength are set once one selects the mortar type per ASTM C270 specification. The two most common mortars to use in structures are Type S and Type N. Type S has benefits to strength and durability that make it ideal for walls that have structural load demands, such as bearing walls, exterior walls, shear walls, fire walls, stair shaft walls, elevator shaft walls, etc. **Type S is the common mortar type for structural reinforced** masonry walls. Therefore, if your clay masonry wall is designed as a structural reinforced wall to resist gravity and/or lateral loads, Type S is the recommended mortar type to specify. If your clay wall is a non-structural unreinforced veneer or partition wall, Type N is the mortar type preferred by contractors for its high workability.

Following the recommendations above, designers should research available clay masonry strengths and specify accordingly. For example,  $f'_{\text{clay}}=11,500\text{psi}$  and Type S mortar for structural clay masonry. Using the **Unit Strength Method, the resulting  $f'_m$  will be 4,000 psi or higher;** see Table 1 on previous page.

Once  $f'_m$  is determined, the last material to define when specifying hollow clay masonry is grout. Grout compressive strength,  $f'_g$  must be defined. TMS code requires  $f'_g$  to be equal to, or exceed  $f'_m$ , but not less than 2000 psi. **When  $f'_m = 4000\text{ psi}$ ,  $f'_g$  must be 4000 psi or greater.**

MATERIAL NOTES FOR MASONRY	REQUIRED STRENGTH
HOLLOW CLAY MASONRY, ASTM C-652	$f'_{\text{clay}} = 11,500$ PSI (MINIMUM) (NET AREA COMPRESSIVE STRENGTH)
MORTAR, ASTM C-270	TYPE S
GROUT, ASTM C-476	$f'_g = 4,000$ PSI (MINIMUM)
<b>MASONRY ASSEMBLY</b>	<b><math>f'_m = 4,000</math> PSI</b> (NET AREA COMPRESSIVE STRENGTH)

### **EXAMPLE SPECIFICATION**

#### **SUMMARY of a PRACTICAL EXAMPLE OF SPECIFYING HOLLOW CLAY MASONRY**

To specify hollow clay masonry with an  $f'_m$  of 4,000 psi:

Clay Masonry Unit Strength ( $f'_{\text{clay}}$ ): Select units with a minimum compressive strength of 11,500 psi (net area), following ASTM C652 standards.

Mortar Type: Use Type S mortar, per ASTM C270, for structural reinforced walls.

Grout Strength ( $f'_g$ ): Specify grout with a minimum compressive strength of 4,000 psi, as per ASTM C476.

These specifications should be included in the General Notes or Material Specifications section of the construction documents to ensure clarity and compliance with the code requirements.

Specifying reinforced hollow clay masonry requires more than just indicating a target compressive strength for the masonry assembly. Designers must also specify the strengths of the clay masonry units, the type of mortar, and the grout to achieve the intended  $f'_m$ . By following the guidelines provided, structural performance can be optimized while ensuring compliance with masonry codes and standards.