



MASONRY INSIGHTS

written in conjunction with International Masonry Institute

How to Properly Specify Masonry Wall Assemblies for $f'_m = 2500$ psi

For economical use of materials and speed of construction, the WI Structural Masonry Coalition is recommending structural engineers use design strengths of 2500 psi or greater. If you want a masonry design strength of 2500 psi on your next project, it is not enough to indicate a minimum value of f'_m on the design documents. Employing the unit strength method to determine f'_m , it is important to specify the masonry block strength as well as mortar type to achieve the desired f'_m . In addition, specifying the f'_m value does not represent the strength of grout needed on the project, grout strength needs to be specifically indicated.

There are two methods to verify masonry compressive strength: the unit strength method or the prism test method. In a prism test, an assembly of materials (masonry block, mortar, and grout) representative of the actual materials used on the project are tested for its compressive strength at 28 days or any designated test age. The unit strength method utilizes an empirical table based on masonry block strength and mortar type, per TMS 602-13 Section 1.4B.2. Although prism tests typically yield higher compressive strength, they are more expensive and involve specialized testing equipment that may not be readily available. TMS 602 further discusses prism testing that was done (Figures SC-1 and SC-2) which supports the assembly strength shown in the unit method table. Therefore, the unit strength method is more commonly used to determine f'_m , and will be referenced herein.

In regards to strength, a common mistake is to believe that masonry is only as good as its weakest element - the mortar. It is important to remember that mortar makes up 4% to 7% of the overall wall (depending on wall thickness and amount of grouting). Properties of mortar bond strength and workability are more important in many cases than compressive strength. TMS 602 (formerly MSJC) clearly defines the wall strength to be more than the strength of the mortar. Mortar strength has been shown to be a relatively unimportant factor in determining overall wall strength. In TMS 602-13, Table 2 (section 1.4B.2.b) shows the type of mortar and unit strength that can be used to find the assembly compressive strength. 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.

When using the tables from TMS 602, it is important to remember that mortar type (not mortar strength) is required to use the tables. Therefore, the two components to specify on design documents are CMU block strength and mortar type consistent with the desired f'_m .

Also, when specifying masonry, don't forget about grout strength. TMS 602 requires grout compressive strength to be equal to or exceed f'_m , but not less than 2000 psi. So if the goal is to have f'_m of 2500 psi, then the grout strength must be at least 2500 psi or greater. Some in the industry suggest using grout strength comparable to the CMU block strength. The strength of grout is left to engineering judgment within the range between: f'_m or 2000psi (low end value) — CMU block strength (high end value).

Therefore, indicating $f'_m = 2500$ on the design documents is not enough for masonry. We need to indicate the required block strength, mortar type, and grout strength. Following are samples of material strength specifications that can be used in structural notes.

Sample 1: Recommended

MASONRY NOTES	MINIMUM REQUIRED STRENGTH
CONCRETE MASONRY UNITS, ASTM C 90	$f'_{cmu} = 3250$ PSI (NET AREA COMPRESSIVE STRENGTH)
MORTAR, ASTM C-270	TYPE S
GROUT, ASTM C-476	$f'_g > 2500$ PSI
MASONRY ASSEMBLY	$f'_m = 2500$ PSI (NET AREA COMPRESSIVE STRENGTH)

Note: In this sample, f'_g was indicated to be 2500 psi, even though it could have been higher. The additional grout strength doesn't allow for a higher design strength (f'_m is still 2500 psi) however it may be desirable to have grout strength similar to block strength for better block/grout capability.

Sample 2:

MASONRY NOTES	MINIMUM REQUIRED STRENGTH
CONCRETE MASONRY UNITS, ASTM C 90	$f'_{cmu} = 4350$ PSI (NET AREA COMPRESSIVE STRENGTH)
MORTAR, ASTM C-270	TYPE N (ABOVE GRADE) TYPE S (BELOW GRADE)
GROUT, ASTM C-476	$f'_g = 2500$ PSI
MASONRY ASSEMBLY	$f'_m = 2500$ PSI (NET AREA COMPRESSIVE STRENGTH)

Note: sample 1 is recommended and supported by IMI and Structural Masonry Coalitions. Type S mortar is recommended, however Type N mortar could be used if block strengths are higher, and the assembly will still achieve $f'_m = 2500$ psi.