Mortar: Quality Assurance on the Job Site

Rocky Mountain Masonry Institute Technical Note
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Mortar is an important part of any masonry project, but there is often an over-reliance on jobsite testing to determine mortar strength. The reality is that mortar plays a very small role in defining the structural capacity of a masonry wall system. The mortar must have some strength, to resist weathering and ensure long-term durability. Be sure not to over-emphasize the importance of mortar compressive strength.

Current industry requirements for specifying and testing mortar are confusing and often misinterpreted. There have also been substantial changes to building Code and ASTM requirements in recent years. The current state of the industry goes something like this:

- Masonry design and construction is governed by the International Building Code, which in turn references the MSJC Building Code Requirements for Masonry Structures (ACI 530-02/ASCE 5/02/TMS 402/02). The MSJC Code has 3 levels of quality assurance, depending on the building's importance and how it was designed. Mortar quality is assured by either a) reviewing submittals (Level 1 quality assurance), b) verifying mortar *proportions* are correct at the start of the project (Level 2), or c) verifying mortar is proportioned correctly continuously, throughout the project (Level 3). The Building Code does not require compression tests on mortar samples prepared at the job site.
- Mortar is specified following the requirements of ASTM C 270, *Standard Specification for Mortar for Unit Masonry*. The designer may follow the proportion specification method, listing a mortar "recipe" that includes the required proportions of cement, lime, and sand. The property specification approach may also be used; in this case the required performance is listed, to include requirements for compressive strength, air content, and water retention. Use either the proportion spec or the property spec, but not both, when listing mortar requirements. When the property specification approach is used, ASTM C 270 calls for laboratory testing of mortar to determine the proportions of cement, lime, and sand required to meet the specified properties. For either specification method, jobsite quality is assured by verifying the correct material proportions are added to the mixer.
- Field tests for mortar are described in ASTM C 780, *Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry*. This method explicitly says it is to be used only for quality control purposes, and results of field tests may not be compared to the laboratory test requirements of ASTM C 270. In other words, the strength of mortar samples prepared in the field are neither required nor expected to meet the strength properties listed in ASTM C 270. There is

discussion within ASTM of actually removing the field compression test method from ASTM C 780.

- A new standard, ASTM C 1586-04, *Standard Guide to Quality Assurance of Mortars*, gives designers and laboratories guidance on how to set up a mortar quality assurance program. This guide recommends that the proportions of the mortar, batched in the field, be verified by recording the amount of cement, lime, and sand added to the mixer.

The unfortunate reality is that mortar samples are prepared differently in the lab and the field, and it is not appropriate to compare the results of the field tests (C 780) with the lab requirements (C 270). The end result of these differences is that field samples are expected to have a compressive strength less than that of laboratory samples, sometimes by as much as 30 percent.

On a typical masonry project, quality assurance may include the following: verifying masonry material submittals match project requirements; compression testing of grout samples; compression testing of prisms (units, mortar, and grout together); and verifying proportions of materials used to batch mortar. Masonry prisms are used to verify compliance with the specified masonry compression strength f'_m. Mortar cubes should be used only to check consistency from one day to the next, rather than for verifying compressive strength. Even then, the compressive strength of mortar samples prepared in the field will vary, as the mason varies the amount of water added to the mix to adjust for day-to-day variations in temperature and humidity.

The old “wicking” method of UBC standard 21-16 gives a good approximation of the in-place mortar strength. For this approach, mortar is spread onto a masonry unit and water is allowed to be wicked from the mortar by the unit. After 60 seconds, the mortar is scraped off the unit and used to make test specimens using 2-inch by 4-inch cylinders. The Uniform Building Code specified that mortar tested using this method must reach 1500 psi in compression. This method is unfortunately not recognized by the IBC system.

One final option would be to sample the dry material in the field and return with the sample to the laboratory for testing. Test cubes are prepared, cured, and tested according to ASTM C 270 requirements. Compression strength results of these lab-prepared specimens could then be compared with C 270 requirements. This approach is often used for evaluating strength of pre-blended mortars that come in bags or silos.