

Strength of Masonry Mortar



Field testing of mortar is typically included in project specifications to measure quality control of the project. Typical field testing of mortar often references ASTM C 780 and C 270 outlined in ACI 530 Building Code Requirements for Masonry Structures.

ASTM C 780, Standard Test Method for Preconstruction and Construction of Mortar for Plain and Reinforced Masonry states the following:

"This test method covers procedures for the sampling and testing of mortars for composition and for their plastic and hardened properties, either before or during their actual use in construction."

"Preconstruction Evaluation – This test method permits comparisons of mortar made from different material under simulated field conditions. It is also used to establish baseline values for comparative evaluations of field mortar."

"Construction Evaluation – Use of this test method in the field provides a means for quality assurance of field-mixed mortar. It includes methods for verifying the mortar mix proportions, comparing test results for field mortars to preconstruction testing, and determining batch-to-batch uniformity of the mortar."

It is very important to note the following statement from the scope section of ASTM C 780: "The test results obtained under this test method are not required to meet the minimum compressive values in accordance with the property specifications in Specification C 270". Another statement from C 780 to understand is as follows: "Testing using these procedures is limited to the preconstruction evaluation of masonry mortars within the laboratory, to the evaluation of masonry mortars at the construction site, and in establishing the degree of quality control exercised during mortar production at the construction site."

Another statement from ASTM C 780 regarding the performance of compressive strength testing of construction mortars is as follows: "The measured value shall not, however, be construed as being representative of the actual strength of the mortar in the masonry". This is because the mortar in construction will be mixed with the required amount of water to obtain the desired consistency. The amount of water that absorbed from the mortar will depend on the

ambient conditions and the absorption of the block. The more absorptive and drier the block, the more water the masons will need in the mortar for workability.

ASTM C 780 does not have strength requirements of mortar types. This is because of the influence of the ambient conditions and block absorption variables. If compressive strength samples are cast from field produced mortar in cubes or cylinders, they will have excessive amounts of water which will have a diminishing effect on the strength test results. These strengths, however, do not reflect the actual strength of the mortar in the structure. In other words, if the masons were to produce mortar reflective of the water to cement ratio (w/c) of the mortar in the joint after excess water is absorbed by the units, the mortar would likely not be workable. This would obviously lead to other, more serious structural defects.

If one were to consider the mortar strengths specified in C 270, they must read and understand that the section entitled "Specification Limitations" which includes the following statements:

"Specification C 270 *is not* a specification to determine mortar strengths through field testing."

"The compressive strengths values resulting from field tested mortars do not represent the compressive strengths of mortar as tested in the laboratory, nor that of the mortar in the wall. Physical properties of field sampled mortar shall not be used to determine the acceptance or rejection of the mortar."

ASTM C 270 is solely for the determination of adequate performance of the mortar components and the strength specifications should only be applied to mortar mixed in the laboratory with the specified proportions. Again, these proportions are different than what will actually be used in the field to address the other factors that influence amount of water used that are mentioned above. Therefore, it should be further understood how the mortar produced in the laboratory is proportioned with water in accordance with C 270. "The required properties of the mortar in Table 2 are for laboratory prepared mortar mixed with a quantity of water to produce a flow of 110 +/- 5%. This quantity of water is not sufficient to produce a mortar with a workable consistency suitable for laying masonry units in the field. Mortar for use in the field must be mixed with the maximum amount of water to satisfy the initial rate of absorption (suction) of the masonry units. The properties of field prepared mortar mixed with the greater quantity of water, prior to being placed in contact with the masonry units, will differ from the property requirements in Table 2. Therefore, the property requirements in Table 2 cannot be used as requirements for quality control of field prepared mortar."



Photo of freshly mixed masonry mortar

Therefore, since less water is likely used for mortar prepared and tested for compressive strength under laboratory conditions than the amount of water used in the preparation of field mortars, the strength specifications of C 270 should not be applied to field prepared mortars for acceptance. It is a common mistake of independent testing laboratories to cast strength specimens with field prepared mortars and try to apply the strength specifications of C 270. ASTM C 270 was developed as a means for laboratory evaluation of mortar components and the strength specifications were never intended to be applied to field prepared mortars in accordance with C 270. Due to field conditions, water contents of the field prepared mortar will inherently vary on projects where quality practices are being followed to promote good workability of the mortar and sound construction of the structure.

It should be further noted and understood that no ASTM procedures exist for actual measurement of in-place masonry mortar compressive strength. To attempt to apply the C 270 strength specifications is clearly spelled out numerous times in C 270 and C 780 as improper practice.

References:

ASTM C 270-06, "Standard Practice for Mortar for Unit Masonry", American Society for Testing and Materials, West Conshohocken, PA

ASTM C 780-06a, "Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry", American Society for Testing and Materials, West Conshohocken, PA

NCMA TEK 18-5a, "Masonry Mortar Testing" (2005), National Concrete Masonry Association, Herndon, VA

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