Field Testing of Masonry Mortar

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FAIRBORN CEMENT COMPANY

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Planning Ahead for Successful Project Management

Field testing of mortar is often included in project specifications as a measure of quality assurance[1]. Typical specifications refer to ASTM C270[2] and C780[2]; however, the well-intentioned specification language may confuse the contractor, inspector and specifier regarding their responsibilities of mixing, testing and interpreting the field test results. This document serves to differentiate between the two specifications for a better understanding of the test method designed for the field evaluation of mortar.

ASTM C270, "Standard Specification for Mortar for Unit Masonry" provides specifications for mortars for use in the construction of non-reinforced and reinforced unit masonry structures. The mortar may be specified by either the proportion specification or the property specification. There are no strength requirements for the proportion specification (Table 1).

C270 - Table 1: Proportion Specification (Proportions by Volume)

Mortar Type	Masonry Cement Type N	Masonry Cement Type S	Masonry Cement Type M	Mason Sand
N	1	-	-	2 ¼ - 3
S	-	1	-	2 ¼ - 3
M	-	-	1	2 ¼ - 3

The C270 property specification outlines 28-day strengths for Type M, S, N, and Type O masonry mortars (Table 2) **tested in the laboratory using a laboratory sand, at a consistency established with a flow table**. The water content of the mortar made in the lab is much less than mortar mixed in the field. Laboratory mortar contains less water in an attempt to replicate the mortar after being subjected to the suction action of the board and masonry units, which draw water out of the mixture. **Field mortar is not subject to the strength requirements of ASTM C270.**

C270 - Table 2: Property Specification

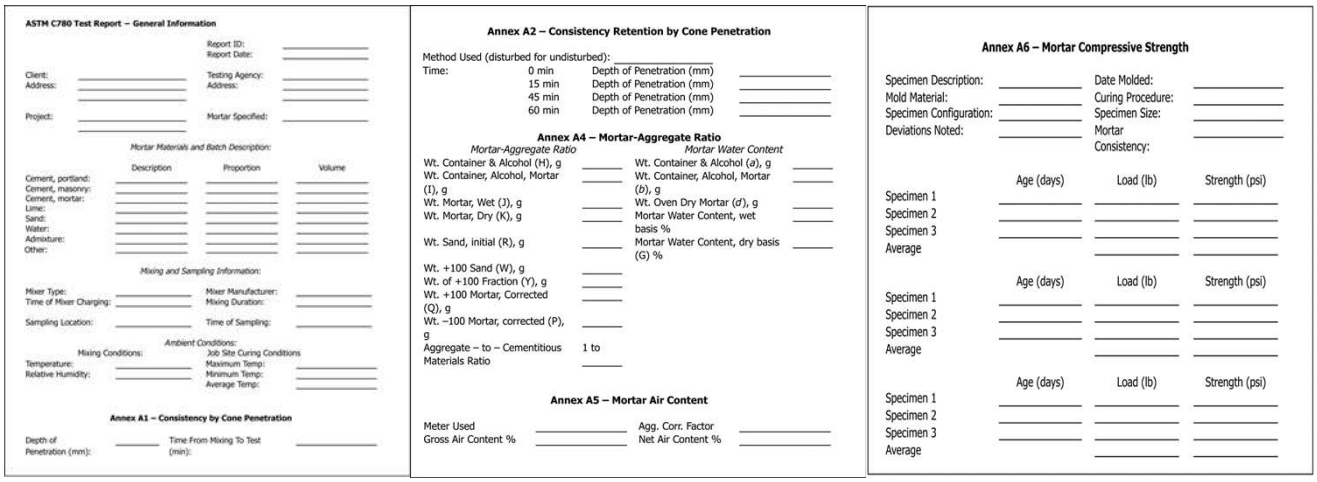
Mortar Type	Compressive Strength minimum, psi	Water Retention minimum, %	Air Content maximum, %
N	750	75	20
S	1800	75	18
M	2500	75	18

The Project Manager should schedule the laboratory[2] to test the pre-construction mortar in accordance with C780, which can coincide with the construction of mock-up panels for owner/architect approval.

ASTM C780, "Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry", provides specifications for testing mortar before and during construction. The **Scope** under C780 Item A6.1.1 states, "*Strength values for mortars obtained through these testing procedures are not required, nor expected, to meet strength requirements of laboratory Specification C270 mortars or necessarily represent the strength of the mortar in the wall. The values obtained from construction testing are to be correlated only with those of preconstruction mortars made with the same materials, in the same proportions, mixed to a similar consistency, cured under similar conditions, and tested at the same age*". Refer to ASTM C1586[2] *"…for guidance on the proper use of C270 and C780 in evaluating masonry mortar produced in the laboratory and at the construction site*" [5].

Strength samples prepared under Method C780 are molded in either 2" cubes, or 2"x 4" or 3"x 6" cylinder molds using the mortar made with the sand intended to be used on the project, and mixed at the consistency used on the project. The mortar used to construct the walls will require more water than mortar used for strength specimens because the specimen molds will not absorb water like the masonry units would; therefore, there is no way to expect the strength results to be the same.

On projects constructed with masonry mortar where field-testing is conducted for the determination of compressive strength, the specimens are not required nor expected to achieve the strengths achieved under Specification C270. It is imperative that the project understands the applicable specification, and that the strength results of field mortar are only to be used to compare against the preconstruction mortar strengths achieved when using the same specimen type and size. The testing technician should possess current certifications for testing masonry mortar[2]. See the example report below (Fig. 1) from the Annexes in C780-20, outlining the standard tests performed on masonry mortars. When reporting the strength tests results of mortar during construction, clearly indicate the strength results from the preconstruction mortar test as a baseline for comparison.



ASTM C780 Test Report – General Information

Report ID:
Report Date:
Client:
Address:
Testing Agency:
Address:
Project:
Mortar Specified:

Mortar Materials and Batch Description:

	Description	Proportion	Volume
Cement, portland:			
Cement, masonry:			
Cement, mortar:			
Lime:			
Sand:			
Water:			
Admixture:			
Other:			

Mixing and Sampling Information:

Mixer Type:
Time of Mixer Charging:
Mixer Manufacturer:
Mixing Duration:
Sampling Location:
Time of Sampling:

Ambient Conditions:

Mixing Conditions:
Temperature:
Relative Humidity:
Job Site Curing Conditions
Maximum Temp:
Minimum Temp:
Average Temp:

Annex A1 – Consistency by Cone Penetration

Depth of Penetration (mm):
Time From Mixing To Test (min):

Annex A2 – Consistency Retention by Cone Penetration

Method Used (disturbed for undisturbed):

Time:		
0 min	Depth of Penetration (mm)	
15 min	Depth of Penetration (mm)	
45 min	Depth of Penetration (mm)	
60 min	Depth of Penetration (mm)	

Annex A4 – Mortar-Aggregate Ratio

Mortar-Aggregate Ratio		*Mortar Water Content*	
Wt. Container & Alcohol (H), g		Wt. Container & Alcohol (*a*), g	
Wt. Container, Alcohol, Mortar (I), g		Wt. Container, Alcohol, Mortar (*b*), g	
Wt. Mortar, Wet (J), g		Wt. Oven Dry Mortar (*d*), g	
Wt. Mortar, Dry (K), g		Mortar Water Content, wet basis %	
Wt. Sand, initial (R), g		Mortar Water Content, dry basis (G) %	
Wt. +100 Sand (W), g			
Wt. of +100 Fraction (Y), g			
Wt. +100 Mortar, Corrected (Q), g			
Wt. –100 Mortar, corrected (P), g			
Aggregate – to – Cementitious Materials Ratio	1 to		

Annex A5 – Mortar Air Content

Meter Used
Gross Air Content %
Agg. Corr. Factor
Net Air Content %

Annex A6 – Mortar Compressive Strength

Specimen Description:
Mold Material:
Specimen Configuration:
Deviations Noted:
Date Molded:
Curing Procedure:
Specimen Size:
Mortar Consistency:

	Age (days)	Load (lb)	Strength (psi)
Specimen 1			
Specimen 2			
Specimen 3			
Average			

	Age (days)	Load (lb)	Strength (psi)
Specimen 1			
Specimen 2			
Specimen 3			
Average			

	Age (days)	Load (lb)	Strength (psi)
Specimen 1			
Specimen 2			
Specimen 3			
Average			

Figure 1 - Sample Report for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

Following PCA[3] guidelines for quality assurance of masonry mortar, it is important to recognize *"…that C270 focuses on acceptance criteria for mortar as a component masonry material… [*Method C780] *is <u>not</u> to be used to determine conformance of a mortar to ASTM C270 property specification requirements."*

When planning for the management of a successful masonry project, be sure to anticipate the need for quality assurance testing by coordinating the preconstruction mortar testing with the masonry contractor and a laboratory accredited for testing masonry mortars in accordance with ASTM C1093[2]. These measures provide the owner with the application of the appropriate specifications, and ensure that the requisite strength data is generated in order to appropriately evaluate the mortar produced during construction.

Referenced Documents

[1]*Building Code Requirements for Masonry Structures* (TMS 402), The Masonry Society, Longmont, CO.

[2]*Annual Book of ASTM Standards,* Volume 4.05, ASTM International, West Conshohocken, PA.

- ASTM C270 - *Standard Specification for Mortar for Unit Masonry*.
- ASTM C780 - *Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry*.
- ASTM C1093 – Standard Practice for Accreditation of Testing Agencies for Masonry.
- ASTM C1586 – *Standard Guide for Quality Assurance for Mortars.*

[3]Publication IS279.01M - *Quality Assurance for Masonry Mortar,* Portland Cement Association, 5420 Old Orchard Road, Skokie, IL.

[4]BIA Technical Note 8B: *Mortars for Brickwork – Selection and Quality Assurance,* The Brick Industry Association, 12007 Sunrise Valley Drive, Reston, VA.

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