Wil-Spec LLC

News Note

Fall Edition
2009

TECHNICAL SUPPLEMENT

Masonry Mortar & Cement

Masonry Mortar, Masonry Cement, Mortar Cement,
Portland Cement, Prepackaged Mortar, Field Mixed Mortar
Type S Mortar, Type M Mortar, Type N Mortar, Type O Mortar, Sand
Hydrated Lime, Lime Putty, Crushed Limestone, Type N Lime,
Type NA Lime, Type S Lime, Type SA Lime .....

Definitions

Masonry mortar: A combination of portland cement, masonry cement or mortar cement with lime (when applicable), aggregate (sand) and water which when mixed is used to bond masonry units into an assemblage. Masonry mortar is classified as Type M, N, S and O as defined under ASTM C 270 – Standard Specification for Mortar for Unit Masonry.

Site-mixed mortar: A combination of portland cement, lime, sand and water field mixed and tested to meet the proportion or property specifications of ASTM C 270.

Masonry cement: A formulated and manufactured mix of portland cement, or blended hydraulic cement, and plasticizing materials (such as limestone or hydrated or hydraulic lime together with admixtures conforming to ASTM C 91.

Mortar cement: A formulated and manufactured mix of portland cement, or blended hydraulic cement, and plasticizing materials (such as limestone or hydrated or hydraulic lime together with admixtures conforming to ASTM C 1329.

Pre-packaged mortar: A combination of masonry or mortar cement, sand and water field mixed and tested to meet the proportion or property specification of ASTM C 270.

ARE YOU CONFUSED?

Understanding where the masonry industry is today and how it arrived here may be one of the most overlooked and confusing aspects of any project. In the myriad of technical issues already confronting the modern design team the need to properly select products, detail and specify masonry construction is often a significant component missing from the design process. Knowledge of the standards, options and variables involved will benefit the design team, the contract documents, and ultimately the facility itself.

Discussion on this subject has filled an untold number of books, design guides, technical articles and forensic studies of failures. In this short space, we will devote ourselves to a discussion of one component of the wall system - its mortar.

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Why Did the Specifier Do That?

One of the questions we receive often during the construction administration phase of a project with significant amounts of new masonry work is why we specify site-mixed mortar. The primary reason: No expressed preference on the part of the Architect for either site-mixed mortar or prepackaged masonry/mortar cements. Technical analysis does not often reach this level of detail. It is presumptively designated a specification or structural issue.

In truth, site-mixed mortar has historically been the preferred choice to produce a full range of true portland cement-lime mortar types. For many years Type M and Type S mortars could not be mixed using masonry cement or mortar cement without using additional portland cement. Even today, the current ASTM standard still reflects this fact. Disclosure issues relating to proprietary additives, the use of crushed limestone, and mix design for workability or additional air entrainment and concerns about their potential effect on the mortar's compressive and bond strength further galvanized our opinion. We believed pre-packaged mortar's use should be limited to small projects where structural or below grade masonry was not required.

Today there are a number of commercially available products compliant with ASTM C 270 of all types that do not require any additional portland cement. Independent laboratory test data is available from the manufacturers supporting compliance with the proportion or property specification of ASTM C 270. Therefore, end of the story, manufacturing technology has caught up with time tested field practices. Such an opinion would be conceived in haste.

Here, as Paul Harvey would say, "is the rest of the story".

• Portland Cement • Masonry Cement
• Mortar Cement

It is reasonable safe to assume that sand compliant with ASTM C 144 is a standard component of any mix. Water is always specified as potable and the amount used is always left to the discretion of the masonry subcontractor. Decisions regarding the remaining component, the cement, is where many technical and aesthetic issues reside.

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Our definition of site mixed mortar always presumes the use of a portland cement-lime mortar mix. This mix balances the high strength and early setting characteristics of portland cement with the workability and water retention characteristics imparted by lime. One potential limitation is the control of color although the use of pre-measured color packs should alleviate any problems in this regard. When using the proportion specification quality control using ASTM C 1324 can be required to confirm the proportions of materials in hardened mortars, if desired. When using the property specification laboratory testing of the proposed mix might be necessary utilizing ASTM C 780 – Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry. Since this is a long lead activity, it would necessitate early coordination by the Contractor to ensure that the appropriate testing, submittals and approvals are complete in a timely fashion to allow work to proceed.

Pre-packaged masonry cements have gained control of a large market share of the masonry mortar industry. Since this product is proportion controlled and dry mixed at the plant they are marketed around the notion they have consistent workability, color, durability and strength. This is certainly true, however, it is important to keep in mind our earlier discussion regarding additives and the effect they may have on the actual mortar used in the field.

Limitations regarding additives and the variance between laboratory test specimens and field mixes still apply. It is also important to note that under ASTM C 91 there is no requirement for bond strength. The submitted independent laboratory test data must demonstrate compliance with the proportion or property specification of ASTM C 270 as well as the physical requirements of C 91.

Mortar cement is similar to masonry cement in most respects although regulated under a different standard ASTM C 1329. The key difference between the two is that mortar cement has a defined criteria for bond strength. This requirement interestingly was established to ensure comparable bond strength with portland cement-lime mortars. Limitations regarding additives and the variance between laboratory test specimens and field mixes still apply.

The Rest of the Story

To the Contractor it will always be desirable to find the compliant product that is most readily available. Substitution requests when pre-packaged products are not specified need to provide a substantive body of information allowing the Architect to determine that true equivalency can be obtained.

Well in advance of this, the project parameters need to be developed and coordinated between the Architect, consulting structural engineer and specifier to ensure the quality of the work and conformance with applicable codes. Decisions regarding compressive and flexural bond strength, mortar types required, color consistency and field and laboratory testing need to be thoroughly reviewed and decisions rendered to facilitate preparation of the construction documents. It would be short sighted not to also address issues that will be raised regarding lead time, workability and cost that undoubtedly will arise during construction administration.

As always, we are available to assist our clients with all aspects of this process.

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ASTM C270

Proportion Specification or Property Specification

Either the proportion specifications or the property specifications may be specified, but not both.

The proportion specification refers to the volumetric relationship of the mortar components (i.e. 1 part portland, mortar or masonry cement, 1/4 part lime when applicable, and 2-1/4 parts sand or any similar compliant combination). Mortar specified using the proportion specification is accepted subject to submission of evidence that the component materials comply with the referenced ASTM standards listed in Section-4 of ASTM C 270 (which are indicated in our specifications) and that the field mix proportions are controlled to meet Table-1 of ASTM C 270. Mortar prepared using this method often yields laboratory samples exceeding the minimum compressive strength listed in the property specification for each mortar type. Caution is required when the compressive strength of the mortar exceeds that of the adjacent masonry product in an exterior wall where freeze-thaw cycling may result in cracking. Masonry restoration projects on older buildings with soft brick need to pay particular attention to this.

Physical Properties of Mortar Cement

ASTM C270 | ASTM C270

Mortar Type	Compressive Strength Minimum
M	2500 psi
S	1800 psi
N	750 psi
O	350 psi

The property specification establishes minimum values for three key attributes; average compressive strength at 28 days, water retention and air content. Mortar specified using the property specification is accepted subject to submission of evidence that the component materials comply the referenced ASTM standards that laboratory prepared and tested samples meet the requirements of Table 2 of ASTM C270 (typically referenced by type in the specifications) and that the field mix proportions are controlled to meet the proportions used in the laboratory test specimens. Many prepackaged mortar companies have products tested under the property specification. It is important to keep in mind that a laboratory prepared sample is intended to replicate mortar after it has been placed in service and therefore the property values in the standard "cannot be used as requirements for quality control of field mortar" . The reason for this is there is less water in the test sample as it intends to simulate the absorption of water or "suction" by the adjacent masonry materials. As a result, the compressive strength of field mix mortar in many cases will be lower than that of the laboratory test specimen

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