



PORTLAND CEMENT ASSOCIATION PRESENTS

GUIDE TO STANDARDS AND CODES USED IN THE SPECIFICATION OF GROUTED REINFORCED MASONRY

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Specifying materials for grouted reinforced masonry projects requires knowledge of a variety of standards and codes. This introduction reviews a few essential documents that every designer (architect or engineer) should be familiar with when designing masonry construction, and a few more that may be used less frequently but are still important to have on hand for specific kinds of projects.

ESSENTIAL STANDARDS AND CODES

There are some key standards, and a set of building code requirements with an accompanying specification, that should be mastered to achieve successful specification of grouted reinforced masonry:

ASTM C 476 Standard Specification for Grout for Masonry – This standard establishes criteria for the components of grout, including cementitious materials like portland or blended cements, lime, fly ash, and slag cement, as well as aggregates, water, and admixtures. Either fine or coarse grout may be specified according to proportions or strength requirements; the standard addresses requirements for measurement and proportioning of ingredients, as well as transporting and testing of samples.

ASTM C 404 Standard Specification for Aggregates for Masonry Grout – Choosing the most appropriate aggregates is essential for creating satisfactory masonry grout. ASTM C 404 includes guidelines for evaluating the general characteristics of aggregates. Natural or manufactured sand may be used, on its own or combined with coarse aggregate. Specific requirements are outlined for grading and soundness of aggregates, and on permissible amounts of deleterious substances and organic impurities. Finally, this standard references methods for sampling and testing aggregate materials.

ASTM C 1019 Standard Test Method for Sampling and Testing Grout – Providing both laboratory and field sampling and compression testing procedures, ASTM C 1019 is essential for any specifier. The test can be used as a quality control for grout uniformity on site, or to determine correct material proportions in designing a grout mix. The standard includes detailed instructions for sampling grout, performing a

slump test, creating molds in which test specimens may be formed, transporting and curing those specimens, and testing them to ensure desired compressive strength.

ASTM C 1586 Standard Guide for Quality Assurance for Mortars – This reference tool of two key mortar documents offers an overview (but not a replacement) of C 270 Specification for Mortar for Unit Masonry, and C 780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry. It provides a clear-cut explanation of how and when to use C 270 to specify materials, and C 780 for practicing quality assurance in both laboratory and field situations.

Building Code Requirements for Masonry Structures (ACI 530-05/ASCE 5-05/TMS 402-05) and Specification for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-05) – Essential documents for architects and engineers, this Code and Specification from the Masonry Standards Joint Committee (MSJC), representing the American Concrete Institute, the Structural Engineering Institute of the American Society of Civil Engineers, and The Masonry Society) is referenced by U.S. building codes for masonry design and construction criteria. From material selection to quality assurance, contract documents to seismic design requirements, glass unit masonry to placement of embedded items, this document covers it all.

SUPPLEMENTARY STANDARDS

While not all of these standards will apply to every project, familiarity with each will help guide designers in the specification and testing of materials.

CEMENTITIOUS MATERIALS AND BINDERS

ASTM C 150 Standard Specification for Portland Cement – This essential standard examines the properties of eight types of portland cement: I, IA, II, IIA, III, IIIA, IV, and V.

ASTM C 595 Standard Specification for Blended Hydraulic Cements – Five classes of blended hydraulic cements (incorporating pozzolan, slag,

PHOTO DESCRIPTION

The Air Rescue and Fire Fighting Station #19 at Phoenix Sky Harbor International Airport is an architectural centerpiece that embodies the best of grouted reinforced masonry construction. Masonry elements provide strength to support steel floor and roof beams, yet allow for flexible alignment of entries and patios. Aesthetically, fluted, split-and ground-face concrete masonry, clay units, and glass block add color, variety, and interest as exterior and interior finishes.

This building brings style and substance to a busy, noisy, and highly visible site, fitting in with the neighboring passenger terminal buildings, taxiway, and aircraft holding apron while providing a functional location—safe, secure, fire resistant, and quiet—for air rescue and fire fighting operations and personnel. Even better, masonry contributes to energy conservation via thermal stability in this hot climate. Photo courtesy of the National Concrete Masonry Association.

or a combination of both) are examined in this specification. Unlike C 1157, which examines only performance of these materials, C 595 examines ingredients and proportions in addition to performance requirements.

ASTM C 1157 Standard Performance Specification for Hydraulic Cement – Unlike C 595, this standard does not restrict the ingredients of hydraulic cements, instead focusing on classification of cements based on requirements for general use, high early strength, (high or moderate) resistance to sulfate attack, and (low or moderate) heat of hydration.

ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete – This specification is a must for architects seeking to design concrete, mortar, or grout incorporating fly ash and/or raw or calcined natural pozzolans—supplementary cementitious materials that can bring added benefits to a material’s fluid and finished states.

ASTM C 989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars – Another specification that examines the use and benefits of incorporating a supplementary cementitious material, C 989 focuses on three strength grades of ground granulated blast-furnace slag (otherwise known as slag cement).

ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes – Useful for specifiers incorporating portland cement and lime mixes in mortar, C 207 establishes criteria for four types of hydrated lime: N, S, NA, and SA. Lime provides workability and water retention to portland cement-lime mortars but is neither necessary nor allowed in masonry cement (or mortar cement) mortar mixes.

REINFORCEMENT

ASTM A 615/A 615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement – This standard is most commonly used when specifying reinforcement for masonry construction. It addresses deformed and plain carbon steel bars in cut lengths and

coils, and discusses: use of steel bars with alloy additions; standard dimensions and sizes of reinforcement components; the three designated minimum yield strength levels; and the use of hot-rolled plain rounds.

ASTM A 951 Standard Specification for Masonry Joint Reinforcement – This specification covers masonry joint reinforcement fabricated from cold drawn steel wire. Joint reinforcement consists of longitudinal wires welded to cross wires. This type of reinforcement is laid along horizontal joints and becomes embedded in mortar to help control cracking.

Additional standards governing other types of reinforcement are available, such as low-alloy steel bars, zinc-coated bars, and epoxy-coated bars.

TESTING

ASTM C 143/C 143M Standard Test Method for Slump of Hydraulic Cement Concrete – This standard examines laboratory and field testing of slump, including instructions for correctly obtaining samples, conducting the test, and measuring results.

For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM customer service at service@astm.org.

For more detailed information about grouted reinforced masonry construction, contact the masonry department at the Portland Cement Association, or go online to www.cement.org/masonry for additional resources.

CHOOSING A GROUT BASED ON JOB PARAMETERS

Note: Regarding placement, each of these grout types are placed with the same type of equipment, which includes large or small buckets and grout pumps. Contractor experience and grout volume affect the method of placing grout.

| | TRADITIONAL HIGH-LIFT | TRADITIONAL LOW-LIFT | SCG | TRADITIONAL EXTENDED SET |
|-----------------------------|---|---|-----------------------------|--|
| MIXING | Plant or Field | Plant or Field | Plant | Plant |
| LOCATION | All locations except remote (unless field-mixed) | All locations except remote (unless field-mixed) | All locations except remote | Suited to remote or hard-to-reach locations or large volume placements |
| LABOR/CREW | Standard | Standard | Smaller crews | Standard |
| CONSOLIDATION | Required | Required | Not required | Required |
| RECONSOLIDATION | Required | Only required if lifts are greater than 12 in. (305 mm) | Not required | Only required if lifts are greater than 12 in. (305 mm) |
| SPEED OF PLACEMENT | Faster | Standard | Faster | Standard |
| DEMONSTRATION PANEL* | Required for lift heights over 12.67ft (3.86m) and other methods that deviate from required practices | Not typically required | Probably required | Not typically required |

*Higher grout pours, higher grout lifts, smaller cavity widths, or smaller cell sizes than those given in the MSJC Code are permitted if the results of a grout demonstration panel show that the grout spaces are filled and adequately consolidated.