



# MASONRY

## INFORMATION

## Selecting and Specifying Mortar and Grout for Unit Masonry

### Introduction

Masonry mortar and masonry grout are key materials in unit masonry construction. This publication provides information about functional requirements of mortars and grouts, relating those requirements to selection of types and ingredients. It also includes a guide specification for mortar and grout organized according to Construction Specifications Institute's Masterformat.

### Desirable Mortar Properties

Quality mortar is necessary for good workmanship and proper structural performance of masonry. In basic terms, masonry mortar is used to lay brick or block. The requirements for specific performance characteristics relate to this basic function of the mortar both in the construction process and in the long-term utility of the masonry assemblage.

**Workability and Board Life.** The mason's appraisal of a mortar's workability depends on its spreadability (flow and body), ability to cling to vertical surfaces (adhesion), and resist flow during placement of masonry units (cohesion). Mortar should extrude readily from the joints as units are placed but should not drop or smear. The length of time that a mortar retains its workability is its board life or stiffening time. Optimum workability and board life imply compatibility of the plastic mortar with the units and conditions of application.

Workability and board life are best evaluated by the mason using the mortar, but generally relate to other measured properties of the mortar such as water retention, consistency retention, and air content. Sometimes overlooked in the selection of mortar types and materials, the importance of workability and board life to the quality of the finished masonry wall is evident when one considers the critical role of workmanship in the performance of masonry construction. All of the mortar's plastic characteristics have an impact on performance of the hardened mortar.

**Strength and Durability.** Shortly after mixing, masonry mortars begin to harden as the cement

compounds in the mortar react with the mixing water. The mortar in place must interact with the masonry unit to provide a masonry assemblage that meets structural design requirements and remains serviceable. Characteristics of the hardened mortar that affect strength and durability include compressive strength, bond to units, resistance to freeze-thaw deterioration, soundness, shrinkage, water absorption, resistance to sulfate attack, and elasticity.

**Appearance.** The visual appeal of masonry is often a primary factor in its selection as a construction system. Depending on the application, it may be desirable to have a mortar that complements, contrasts, or blends with the color of masonry units. Factors that affect the appearance of finished mortar joints include:

1. Selection of mortar materials - The color of mortar materials (sand, masonry cement, mortar cement, portland cement, and lime) contributes to the appearance of mortar joints. Pigments may be included in the mortar system to provide desired color. This can be accomplished either by using pre-pigmented colored ingredients, such as a colored masonry cement, or by adding pigment to the mixer at the job site.
2. Texture of the mortar joint surface - Gradation of sand, consistency of the mortar at time of tooling, type of jointer used in tooling joints, and the effect of the cleaning operation determine the texture of mortar joint surfaces and thus appearance.

### Selection of Mortar

All of the mortar properties noted above are important. None should be emphasized to the exclusion of other properties in the selection of mortar type or materials. For example, high-strength mortars should not be arbitrarily specified under the assumption that the increased strength will improve the quality of the masonry. Reduced workability, board life, and elasticity generally accompany higher strength. It thus may actually result in a lower level of quality and serviceability in the finished masonry. As another example, using non-air-

entrained mortar materials may increase initial bond strength, but may also reduce workability and resistance to freeze-thaw deterioration.

Specifiers should maintain a balanced viewpoint in selecting both mortar type and mortar ingredients, basing the decision on comparison of the advantages of each with the requirements of the project. PCA publications IS040, *Mortars for Masonry Walls*, IS181, *Masonry Cement Mortars*, IS281, *Mortar Cement: Product Data Sheet*, and IS282, *Masonry Cement: Product Data Sheet*, provide more detailed discussion of mortar properties and mortar materials.

## Mortar Materials

Conventional masonry mortars are composed of water, sand, and cementitious materials. The cementitious materials can be masonry cement, mortar cement, or a combination of portland cement with hydrated lime, Type N masonry cement, or Type N mortar cement. Each of these ingredients contributes to the performance of the mortar.

**Water.** Water acts as a lubricant in the plastic mortar and is required for hydration of the cement. Strength gain of mortar is not related to evaporation of water but to the chemical combination of water with cement compounds in the mortar. Since some mixing water is lost to absorptive units and evaporation, the maximum amount of water consistent with optimum workability should be added to mortar.

Significant levels of contaminants such as alkalis, sulfates, sugars, or detergents may adversely affect the performance of mortar. Therefore potable water, free of such contaminants, should be used for mixing mortar.

**Sand.** Masonry sand provides the basic “framework” for mortar. Sand particles are coated and lubricated by the mortar paste to provide the body and flowability required in the plastic mortar and are bonded together as the paste hardens to provide required structural properties. Masonry sand is obtained from natural sand deposits or it is produced by crushing and grading stone, gravel, or other mineral materials. Quality of sand affects both workability characteristics of plastic mortar and properties of hardened mortar such as compressive strength, bond strength, and drying shrinkage. Sand used for masonry construction should be clean and well graded.

ASTM C144, the Standard Specification for Aggregate for Masonry Mortar, outlines gradation requirements for both natural and manufactured sand. The specification also provides for qualification of sands that do not meet the gradation requirements. Thus, a sand not meeting the gradation requirements of ASTM C144 may be used in a mortar if that mortar meets the property requirements of ASTM C270, the Standard Specification for Mortar for Unit Masonry. In many regions most masonry sands used are qualified on this basis.

**Masonry Cement.** Masonry cement is a product specifically formulated and manufactured to be used in producing mortar for masonry construction. Masonry cement consists of a controlled homogeneous mixture

of portland or blended cement and inorganic plasticizing materials such as hydrated lime or pulverized limestone, together with other materials introduced to enhance mortar properties. The portland or blended cement contributes to compressive and bond strength of mortar. Plasticizers and other materials optimize workability, board life and water retention; contribute to improved durability; and reduce water absorption of mortar. As a result of the balanced performance provided by masonry cement mortars, they are widely used in brick and block construction in the United States.

ASTM C91, the Standard Specification for Masonry Cement, defines requirements for three classifications of masonry cement:

Type N - For use in preparation of ASTM C270 Type N mortar.

Type S - For use in preparation of ASTM C270 Type S mortar without further addition of cements or hydrated lime.

Type M - For use in preparation of ASTM C270 Type M mortar without further addition of cements or hydrated lime.

**Mortar Cement.** Mortar cements are similar to masonry cements, but they have lower air contents than masonry cements, and the mortar cement specification includes a minimum bond strength requirement. It is the only mortar material or system which must meet bond strength performance criteria. Mortar cement mortars are appropriate for use in structural applications that require high tensile flexural bond strength masonry.

ASTM C1329, the Standard Specification for Mortar Cement, classifies mortar cements as Type N, Type S, and Type M. These classifications are intended to produce ASTM C270 mortars of corresponding type designation when mixed with sand and water. No further addition of cement or hydrated lime is required.

**Portland Cement.** Whether present as an integral part of masonry or mortar cement or as a separate ingredient added at the mixer with hydrated lime, portland cement acts as the glue that holds the mortar and ultimately the masonry together. Portland cement is defined as a hydraulic cement produced by grinding clinker consisting of hydraulic calcium silicates, usually containing one or more of the calcium sulfates as an interground addition. The term hydraulic indicates that the material sets and hardens in a reaction with water and will do so under water. Compressive strength and bond strength are related to the portland cement content of mortar.

ASTM C150, the Standard Specification for Portland Cement, defines eight different types of portland cements. However, only types I, IA, II, IIA, III, and IIIA are used in conventional masonry construction.

**Blended Cements.** Blended hydraulic cements are produced from portland cement or portland cement clinker and pozzolans or slags. ASTM C595 blended cements Types IS, IS-A, IP, IP-A, I(PM), and I(PM)-A may be used as an alternative to portland cement in producing mortar. Types S and SA may also be used, but only under the property specification requirements of ASTM C270.

**Hydrated Lime.** Hydrated lime is produced by burning limestone to produce quicklime that is then treated with sufficient water to satisfy its chemical affinity for water. It consists essentially of calcium hydroxide or a mixture of calcium hydroxide and magnesium oxide or magnesium hydroxide, or both. Hydrated lime may be batched with portland cement, sand, and water at the job site. In this system, lime functions as a plasticizer contributing to workability, board life, and water retention of the mortar.

Hydrated lime for masonry purposes is covered by specification ASTM C207. This specification defines requirements for Type N, NA, S, and SA limes. These designations should not be confused with the ASTM C270 mortar Types N and S. Most mortar specifications require the use of Type S lime to assure the soundness of the mortar.

Either air-entrained portland cement or air-entrained hydrated lime may be used to improve the workability and durability of the portland cement-hydrated lime mortar. However, air-entrained cement and air-entrained lime should not be combined in the same mix.

**Admixtures.** Admixtures may be used to modify specific mortar properties. Perhaps the most common example is the use of accelerators to shorten the setting time of mortar during cold weather. The manufacturer of an admixture should provide data substantiating performance of the product, referencing applicable ASTM standards. ASTM C270 indicates that admixtures are not to be added to mortar unless specified. Do not use chloride-based admixtures in mortar. Chlorides contribute to corrosion of steel reinforcement, ties, and accessories.

## Standards and Specifications

Proper use of standards related to masonry mortar in project specifications requires an understanding of certain specific provisions of those standards.

**ASTM C270.** ASTM C270 (or UBC Standard 21-15) provides two alternatives for specifying mortars: proportion specifications and property specifications. Under the proportion specifications, mortar ingredients must meet indicated product standards and be volumetrically proportioned within limits given (ASTM C270, Table 1). No physical requirements are placed on the mortar itself. Under the property specifications, in addition to meeting the individual product standards, mortar materials mixed in the laboratory using job site proportions must meet certain property requirements of the specification (ASTM C270, Table 2). **Either the proportion specifications or the property specifications should be selected, not both.** If project specifications do not indicate which has been selected, the proportion specifications govern, unless data qualifying the mortar under the property specifications are presented to and accepted by the specifier.

It should be understood that the property requirements of ASTM C270 are for laboratory specimens and are not for field quality control. The ASTM standard presumes that the proportions developed in the laboratory, to yield the strength required, will result in satisfactory performance in the field.

Four different types of mortar may be specified using either the property or the proportion specifications. Type O mortar may be used for interior non-load-bearing use. Type N mortar is commonly used in interior walls and above-grade exterior walls under normal loads. Type S mortar is used in exterior masonry structures at or below grade, such as foundation walls or retaining walls. Type S should also be considered for masonry under heavy loads and masonry exposed to severe freeze-thaw environments. Type M mortar may be used in below grade or load-bearing applications. High-strength mortar, such as Type M, should not be used indiscriminately; lower strength mortar, such as Type N, has the advantage of greater workability, water retention, and elasticity.

### **ACI 530/ASCE 5/TMS 402 and Model Codes.**

ACI 530/ASCE 5/TMS 402 "Building Code Requirements for Masonry Structures" (the Code) and ACI 530.1/ASCE 6/TMS 602 "Specification for Masonry Structures" (the Specification) have been adopted by the BOCA National Building Code and the Standard Building Code. Specifiers should be familiar with both the design requirements of the Code and the provisions of the Specifications.

The Code makes several distinctions in the structural characteristics of masonry constructed using Type N mortar compared to those of masonry constructed using Type S or M mortar. In addition, for masonry design that takes into consideration the flexural tensile resistance of masonry, allowable flexural tensile stresses are different for non-air-entrained portland cement-lime mortars and mortar cement mortars, than for air-entrained portland cement-lime mortars, or for masonry cement mortars.

The Uniform Building Code (UBC) has similar provisions except that air-entrained portland cement-lime mortars are not specifically addressed. Mortar cement mortars are used on an equivalent basis as cement-lime mortars. The specifier should confirm that mortar types and materials indicated in project specifications are consistent with structural design requirements of the masonry.

**ASTM C780.** Titled "Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry", ASTM C780 outlines field test methods for evaluating: consistency by cone penetration, consistency retention, initial consistency and consistency retention using a modified concrete penetrometer, mortar aggregate ratio, mortar water content, mortar air content, compressive strength, and splitting tensile strength.

Although it is sometimes mistakenly referenced as a mortar "specification", C780 is an ASTM "method" intended to evaluate mortars prior to construction and for quality control of field mixed mortar during construction. Compressive strength results using C780 test procedures are not to be used to establish or evaluate conformance of a mortar with the property specifications of ASTM C270, a fact clearly stated in both C270 and C780. Field testing of compressive strength of mortar for quality control has little value unless accompanied by careful preconstruction testing to establish baseline values, and careful records of test conditions

and related mortar test parameters. When quality control of the mortar batching and mixing process is the objective, the mortar aggregate ratio test of C780 and inspection of batching and mixing procedures offer more timely and reliable means of control.

## Desirable Grout Properties

Masonry grout is most often used in conjunction with steel reinforcement in masonry walls. While mortar is placed between units as they are laid, grout is poured or pumped into the cores or cavities between wythes of masonry walls already in place. The grout must uniformly fill these grout spaces, harden to provide desired compressive strength, and bond to reinforcing steel and masonry units. To satisfactorily meet these performance requirements, the flowability, aggregate size, and proportions of a grout mix must be compatible with the application.

**Slump.** The flowability of grout at the time of placement is measured by its slump. The slump should be in the range of 8 to 11 inches. Although this is high compared to ranges common for concrete, it is needed to assure that grout spaces are completely filled. Some of the water used to achieve slump is absorbed by the masonry units, thus lowering the water-cement ratio of the grout in place.

**Compressive Strength.** In certain engineered masonry applications, the compressive strength of the grout may be specified at a value consistent with the desired compressive strength of the masonry  $f'_m$ , but not less than 2,000 psi. The compressive strength of grout so specified should be determined according to ASTM C1019 (UBC 21-18). This method requires that specimens be cast in molds of the units being used in the masonry construction. Therefore, the test specimen is subjected to the absorption characteristics of the units more closely approximating actual conditions of application.

## Grout Materials and Specifications

The primary ingredients of grout are water, portland cement, and aggregates. Sometimes hydrated lime is added in limited quantities (as may certain pumping aids or other admixtures) to improve flowability of the grout.

**Water.** Water functions as a lubricant in the plastic grout and reacts with the portland cement. It should be potable. Grout is mixed to a highly fluid consistency to facilitate filling voids.

**Aggregates.** Grout may contain only fine aggregates (fine grout) or a mixture of fine and coarse aggregates (coarse grout). The selection of grout aggregate size is based on criteria established by the Code or by the UBC on the minimum clear dimensions and height of open spaces being grouted. The quality of aggregates used is important both to the flowability and the strength development of the grout. Requirements for both coarse and fine aggregates are included in ASTM C404, Specification for Aggregates for Masonry Grout.

**Portland Cement.** Portland cement reacts with water to provide required grout strength. ASTM C150 Types I, IA, II, IIA, III, and IIIA may be used.

**Blended Cements.** ASTM C595 blended cement Types IS, IS(MS), IS-A, IS(MS)-A, IP, or IP-A may be used in grout in lieu of portland cement.

**Admixtures.** Grout admixtures may be used to modify grout properties. Examples are pumping aids or admixtures to reduce shrinkage. The manufacturer of such admixtures should provide data substantiating the performance of the products, referencing applicable ASTM standards. Do not use chloride-based admixtures in grout. Chlorides contribute to corrosion of steel reinforcement and accessories.

**ASTM C476.** ASTM C476, the Standard Specification for Grout for Masonry, classifies grout as either fine or coarse grout depending on the size of aggregate used to produce the grout. The grout may be specified either by the volumetric proportion requirements (ASTM C476, Table 1) or by specifying a compressive strength. When the compressive strength is specified, ASTM C476 requires the grout to have a minimum compressive strength of 2,000 psi at 28 days as determined in accordance with ASTM Method C1019.

ASTM C1019 outlines procedures for sampling and testing of the grout and should be used both for preconstruction evaluation of materials and for any quality control tests required during construction.

As previously noted, the decision whether to use a fine or a coarse grout should be based on consideration of the dimensions of the grout space to be filled as well as the height grouted. Within the guidelines of the applicable building code, there may be some latitude in the selection of a grout for a given application. In such circumstances, consideration of the particular job conditions should be included in selecting the grout mix to ensure satisfactory placement of the grout and embedment of reinforcement.

## Related Publications

Readers of this publication may also be interested in the following publications available for purchase from the Portland Cement Association. PCA's free catalog of publications (MS254) includes a complete listing of PCA publications and services. To order, write or call Order Processing, Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077-1083, phone 800-868-6733.

*Concrete Masonry Handbook*, EB008M  
*Mortars for Masonry Walls*, IS040M  
*Masonry Cement Mortars*, IS181M  
*Compressive Strength of Masonry*, IS276M  
*Factors Affecting Bond Strength of Masonry*, IS278M  
*Quality Assurance for Masonry Mortars*, IS279M  
*Mortar Cement: Product Data Sheet*, IS281M  
*Masonry Cement: Product Data Sheet*, IS282M  
*Masonry Cement: Beauty to Last a Lifetime*, PA 163M  
*Trowel Tips: Field Testing Mortar*, IS 242M

Guide Specification	Comments
<p><b>04100 MORTAR AND GROUT</b></p> <p><b>PART I GENERAL</b></p> <p>1.01 SECTION INCLUDES</p> <ul style="list-style-type: none"> <li>A. Mortar for Unit Masonry</li> <li>B. Grout for Unit Masonry</li> </ul> <p>1.02 RELATED SECTIONS</p> <ul style="list-style-type: none"> <li>A. Section 03__ - Concrete</li> <li>B. Section 04__ - Masonry</li> <li>C. Section 05100 - Structural Metal Framing</li> <li>D. Section 06100 - Rough Carpentry</li> <li>E. Section 07100 - Waterproofing</li> </ul> <p>1.03 REFERENCES</p> <ul style="list-style-type: none"> <li>A. ACI 530.1/ASCE6/TMS 602-__ - Specification for Masonry Structures.</li> <li>B. ASTM C91-__ [19__ UBC Standard 21-11] - Masonry Cement.</li> <li>C. ASTM C94-__ [19__ UBC Standard 19-3] - Ready-Mixed Concrete.</li> <li>D. ASTM C144-__ - Aggregate for Masonry Mortar.</li> <li>E. ASTM C150-__ [19__ UBC Standard 19-1] - Portland Cement.</li> <li>F. ASTM C207-__ [19__ UBC Standard 21-13] - Hydrated Lime for Masonry Mortar.</li> <li>G. ASTM C270-__ [19__ UBC Standard 21-15] - Mortar for Unit Masonry.</li> <li>H. ASTM C404-__ - Aggregates for Masonry Grout.</li> <li>I. ASTM C476-__ [19__ UBC Standard 21-19] - Grout for Masonry.</li> <li>J. ASTM C595-__ [19__ UBC Standard 19-1] - Blended Hydraulic Cements.</li> <li>K. ASTM C780-__ - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.</li> <li>L. ASTM C1019-__ [UBC Standard 21-18] - Method of Sampling and Testing Grout</li> </ul> <p>1.04 SUBMITTALS</p> <ul style="list-style-type: none"> <li>A. Submit mix design for mortar indicating whether the proportion or the property specification of ASTM C270 [UBC 21-15] is to be used.</li> <li>B. Submit mix design for grout indicating conformance of grout to requirements of ASTM C476 [UBC 21-19].</li> <li>C. Submit test reports indicating conformance of mortar materials to property specifications of ASTM C270 [UBC 21-15].</li> <li>D. Submit test reports of preconstruction tests of mortar for [consistency,] [mortar aggregate ratio,] [water content,] [air content,] [and] [compressive strength] in conformance with ASTM C780.</li> <li>E. Submit test reports of grout tests in conformance with ASTM C1019 [UBC Standard 21-18].</li> <li>F. Submit Manufacturer's certification for [products] indicating conformance with [specified requirements].</li> <li>G. Submit two samples representative of mortar color.</li> </ul>	<p><b>1.01.B</b> If no grout is required, delete this paragraph and remaining articles and paragraphs related to grout in section 04100.</p> <p><b>1.02</b> Some of these broadscope sections may not be required. Other narrowscope sections may need to be added.</p> <p><b>1.03</b> The applicable date for each reference should be given here or in Section 01090-REFERENCE STANDARDS. Alternate standards are given for specifications written for Uniform Building Code regions. Delete or add references as need to be consistent with remainder of 04100.</p> <p><b>1.04</b> Include paragraph A in conjunction with applicable additional paragraphs in this article.</p> <p><b>1.04.A</b> Mortar is to be specified by either the proportion specification or property specification of ASTM C270 (or UBC 21-15), but not both.</p> <p><b>1.04.C</b> When property specifications of ASTM C270 (or UBC 21-15) are used, laboratory tests of mortar materials are required to establish proportions for field mixed mortar.</p> <p><b>1.04.D</b> Include only if field tests of mortar are required for quality control purposes. Field test values of compressive strength of mortar should not be compared to the property specification requirements of ASTM C270.</p> <p><b>1.04.E</b> Include when grout strength is specified or field testing is required for quality control.</p>

Guide Specification	Comments
<p>1.05 DELIVERY, STORAGE, AND HANDLING</p> <ul style="list-style-type: none"> <li>A. Deliver and store packaged materials in original unopened containers and store in dry weathertight enclosures.</li> <li>B. Stockpile and handle aggregates to prevent segregation and contamination.</li> <li>C. Maintain sand for volume proportioning of mortar and grout in a damp loose condition.</li> </ul> <p>1.06 ENVIRONMENTAL REQUIREMENTS</p> <ul style="list-style-type: none"> <li>A. Follow requirements of ACI 530.1/ASCE 6/TMS 602 [Uniform Building Code] for cold and hot weather construction.</li> </ul>	
<p><b>PART 2 PRODUCTS</b></p>	
<p>2.01 MANUFACTURERS</p> <ul style="list-style-type: none"> <li>A. [manufacturer] product [product name].</li> <li>B. Substitute: Under provision of Section [01600].</li> </ul>	
<p>2.02 MORTAR MATERIALS</p> <ul style="list-style-type: none"> <li>A. Cementitious Materials: <ul style="list-style-type: none"> <li>1. Masonry Cement: ASTM C91 [UBC 21-11], Type [M] [S] [N], [gray] [ ] color.</li> <li>2. Mortar Cement: ASTM C1329 [UBC 21-14], Type [M] [S] [N].</li> <li>3. Portland Cement: ASTM C150 [UBC 19-1], Type [I] [IA] [II] [IIA] [III] [IIIA], [gray] [ ] color.</li> <li>3. Blended Cement: ASTM C595 [UBC 19-1], Type [IS] [IS-A] [IP] [IP-A] [I(PM)] [I(PM)-A].</li> <li>4. Hydrated Lime: ASTM C207 [UBC 21-13], Type [S] [SA].</li> </ul> </li> <li>B. Sand: ASTM C144.</li> <li>C. Water: Suitable for drinking, clean, and free of harmful amounts of acid, alkalis, salts, or organic materials.</li> <li>D. Admixtures: <ul style="list-style-type: none"> <li>1. When required use only non-chloride based accelerators as approved by specifier</li> <li>2. No antifreeze substances shall be added to the mortar.</li> </ul> </li> <li>E. Pigments: When required use mineral oxide pigments not to exceed 5% of the weight of masonry cement or 10% of the weight of portland cement in the mortar.</li> </ul>	<p><b>2.02.A</b> For the purpose of proportioning mortar materials, ASTM C270 classes masonry cement, mortar cement, portland cement, blended cement and hydrated lime as cementitious materials. For most masonry construction, it is appropriate to list any or all of these cementitious materials in the project specifications. For masonry design that considers the flexural tensile resistance of masonry, select only mortar type and cementitious materials consistent with design requirements. In moderate or high seismic regions, review local building code for restrictions on mortar types and cementitious materials.</p> <p><b>2.02.B</b> Sand not meeting the gradation requirements of ASTM C144 may be used only if mortar meets property requirements of ASTM C270.</p>
<p>2.03 GROUT MATERIALS</p> <ul style="list-style-type: none"> <li>A. Portland Cement: ASTM C150 [UBC 19-1], Type [I] [IA] [II] [IIA] [III] [IIIA].</li> <li>B. Blended Cement: ASTM C595 [UBC 19-1], Type [IS], [IS(MS)], [IS-A], [IS-A(MS)], [IP] or [IP-A].</li> <li>C. Hydrated Lime: ASTM C207 [UBC 21-13], Type S.</li> <li>D. Aggregates: ASTM C404</li> <li>E. Water: Suitable for drinking, clean, and free of harmful amounts of acid, alkalis, salts, or organic materials.</li> <li>F. Admixture: [ ]</li> </ul>	<p><b>2.03.A</b> For UBC specifications, select Type I, II, or III.</p> <p><b>2.03.B</b> For UBC specifications, select Type IS, IP, or I(PM).</p> <p><b>2.03.F</b> Grout admixtures to control shrinkage or to increase pumpability may be desirable. When use of such admixtures is required, list manufacturer and product here and under 2.01 – MANUFACTURERS. If applicable, include ASTM specification for admixture here and in 1.03 – REFERENCES.</p>

Guide Specification	Comments
<p>2.04 MORTAR MIXES</p> <p>A. Mortar: ASTM C270 [UBC 21-15], Type [M] [S] [N] [O].</p> <p>B. Mortar: ASTM C270 [UBC 21-15], Type [M] [S] [N] [O] in conformance with proportion specifications.</p> <p>C. Mortar: ASTM C270 [UBC 21-15], Type [M] [S] [N] [O] in conformance with property specifications.</p>	<p><b>2.04</b> Select mortar type based on design requirements. Select one paragraph from A, B, or C for this section.</p> <p><b>2.04.A</b> Proportion specifications of ASTM C270 will govern unless data are presented to and accepted by specifier showing that mortar meets property requirements.</p>
<p>2.05 GROUT MIXES</p> <p>A. Grout: ASTM C476 [UBC 21-19], [coarse] [fine] grout meeting proportion requirements.</p> <p>B. Grout: ASTM C476 [UBC 21-19], [coarse] [fine] grout having [2,000 minimum] [_____] psi strength at 28 days .</p>	<p><b>2.05</b> Review building code requirements for selection of grout aggregate size.</p> <p><b>2.05.B</b> Include in place of paragraph 2.05.A to specify strength of grout either for design considerations or for ready mixed grout. Review building code requirements when specifying grout by strength.</p>
<p>2.05 MORTAR MIXING</p> <p>A. Measure sand by volume or equivalent weight; do not measure by shovel.</p> <p>B. In clean mortar mixer, mix ingredients for 3 to 5 minutes with maximum amount of water to produce proper workability.</p> <p>C. Retemper mortar as needed within 2 1/2 hours after initial mixing.</p> <p>D. Discard unused mortar 2 1/2 hours after initial mixing.</p>	
<p>2.06 GROUT MIXING</p> <p>A. Control batching procedure to ensure proper volume proportions of grout materials and achieve grout slump between 8 and 11 [8 and 10] inches.</p> <p>B. Mix grout in accordance with ASTM C94.</p> <p>C. Measure grout materials mixed at job site by volume and mix all ingredients in mechanical mixer for minimum of five minutes.</p>	<p><b>2.06</b> Include paragraph A.</p> <p><b>2.06.A</b> Use slump of 8 to 10 inches for UBC specifications.</p> <p><b>2.06.B</b> Include when ready mixed grout is required.</p> <p><b>2.06.C</b> Include when job site mixing of grout is allowed.</p>
<p>2.07 MIX TESTS</p> <p>A. Test [mortar] [and] [grout] in accordance with Section [01400].</p> <p>B. Testing of Mortar: In accordance with ASTM C270.</p> <p>D. Testing of Grout: In accordance with ASTM C1019.</p>	<p><b>2.07</b> Review Division I requirements for testing along with ACI 530.1 or Uniform Building Code. Include this section only when applicable and include only applicable paragraphs.</p>
<p><b>PART 3 EXECUTION</b></p>	
<p>3.01 INSTALLATION</p> <p>A. Install mortar [and grout] in accordance with ACI 530.1/ASCE 6/TMS 602.</p>	
<p>3.02 FIELD QUALITY CONTROL</p> <p>A. Field [inspection and] testing will be performed under the provisions of Section [01400].</p> <p>B. Testing of Mortar: In accordance with ASTM C780 for [consistency,] [mortar aggregate ratio,] [water content,] [air content,] [and] [compressive strength].</p> <p>C. Testing of Grout: In accordance with ASTM C1019.</p>	<p><b>3.02</b> Review Division I requirements for inspection and testing along with ACI 530.1 or Uniform Building Code. Include this section only when applicable and include only applicable paragraphs. Field quality control tests require preconstruction tests to establish a basis for comparison.</p>

---

This publication is intended SOLELY for use by PROFESSIONAL PERSONNEL who are competent to evaluate the significance and limitations of the information provided herein, and who will accept total responsibility for the application of this information. The Portland Cement Association and American Concrete Pavement Association DISCLAIM any and all RESPONSIBILITY and LIABILITY for the accuracy of and the application of the information contained in this publication to the full extent permitted by law.

---

Portland Cement Association 5420 Old Orchard Road, Skokie, Illinois 60077-1083  
Phone (847) 966-6200, FAX (847) 966-9781, Web Site [www.portcement.org](http://www.portcement.org)

---



An organization of cement manufacturers to improve and extend the uses of portland cement and concrete through market development, engineering, research, education, and public affairs work.