



# TECHNICAL NOTES on Brick Construction

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## Technical Notes 11E - Guide Specifications for Brick Masonry, Part 5, Mortar and Grout September 1991

**Abstract:** This *Technical Notes* is a guide specification for mortar and grout used in brick masonry. Using this *Technical Notes*, a specifier can prepare a job specification for Section 04100. Notes are provided to help the specifier understand certain decisions that affect the project specifications. The guide specification is in accordance with the Construction Specifications Institute's (CSI) Masterformat.

**Key Words:** brick masonry, grout, guide specification, mortar.

### INTRODUCTION

This *Technical Notes* is a continuation of *Technical Notes* 11 Series on "Guide Specifications for Brick Masonry" and contains the requirements for mortar and grout for brick masonry. This *Technical Notes* is appropriate for both empirically designed and rationally designed brick masonry.

The guide specification in this *Technical Notes* is in accordance with the Construction Specifications Institute's Masterformat and is based on the requirements of BIA M1 Standard Specification for Portland Cement-Lime Mortar for Brick Masonry contained in *Technical Notes* 8A and ASTM C 270 Mortar for Unit Masonry. Mortar conforming to the requirements of BIA M1 will meet all of the requirements of portland cement-lime mortars of ASTM C 270. A complete discussion of mortar properties is contained in *Technical Notes* 8.

### GENERAL

Mortar requirements differ from concrete requirements because the primary function of mortar is to bond masonry units into an integral element. The basic mortar ingredients include portland cement, hydrated lime, sand and water. Masonry cements, proprietary mortar mixes, are sometimes used to replace portland cement and hydrated lime or combined with portland cement to make mortar. BIA M1, ASTM C 270 and ASTM C 1142 Ready-Mixed Mortar for Unit Masonry are the recommended standards for mortar to be used with brick masonry.

Grout is different from both concrete and mortar. Grout is a high slump mixture used to fill cells of masonry units or between wythes of masonry to resist stresses and develop bond with reinforcement. Grout can consist of portland cement, hydrated lime, fine or coarse aggregate and water. Grout should be specified by ASTM C 476 Grout for Masonry.

### RECOMMENDED MORTAR USES

Selection of a particular mortar type is usually a function of the needs of the finished structural element. For example, where high wind loads are expected, high lateral strength may be required and, hence, mortar with high flexural bond strength should be considered. For loadbearing walls and reinforced brick masonry, high compressive strength may be the governing factor. In some projects considerations of durability, color, flexibility, etc., may be of most concern. No single type of mortar is best for all purposes. Factors which improve one property of mortar may do so at the expense of others. For this reason, when selecting a mortar, evaluate properties of each mortar type and choose that type and materials which will best meet all requirements. *Technical Notes* 8B discusses the selection of mortar types in depth. The following sections briefly discuss selection of mortar.

### **Type N Mortar**

Type N mortar is suitable for general use in exposed masonry above grade. It is recommended for use in parapet walls, chimneys and exterior walls when subject to severe exposure.

### **Type S Mortar**

Type S mortar is recommended for use in reinforced and unreinforced masonry where higher flexural strengths than Type N are required.

### **Type M Mortar**

Type M mortar is recommended for use in masonry in contact with earth such as foundations, retaining walls, paving, sewers and manholes, and in reinforced masonry.

### **Type O Mortar**

Type O mortar is suitable for interior use in non-loadbearing applications.

## **SPECIFYING MORTAR**

Mortars are specified in one of two ways: proportions or properties, but not both. Mortar prepared by the proportion requirements should not be compared to mortar prepared by the property requirements.

The proportion specification requires that mortar materials be mixed according to given volumetric proportions or weight. If mortar is specified by this method, no laboratory testing of the mortar is required.

If mortar is specified by the property specifications, compressive strength, water retention and air content tests must be performed on mortar mixed in the laboratory. Field mortar is then mixed to the proportions selected from these laboratory tests.

When neither proportion nor property is specified, the proportion specifications govern.

## **SPECIFYING GROUT**

Grout is specified by proportion using ASTM C 476. Either fine or fine and coarse aggregate can be used in grout. Experience has shown that grout mixed to the specified proportions performs well with brick masonry since the grout compressive strength closely matches the compressive strength of the brick masonry. Grout must have adequate compressive strength, bonding with reinforcement and for embedment of anchor bolts. There is usually no need to specify compressive strength of grout unless required by design. Grout strength can be verified by field testing using ASTM C 1019. Slump of the grout is usually specified to be between 8 and 11 in. (203.2 and 279.4 mm).

## **CONCLUSION**

This *Technical Notes* is a guide specification for mortar and grout for brick masonry. Notes are provided to assist in

editing the specification.

The information and suggestions contained in this *Technical Notes* are based on the available data and the experience of the engineering staff of the Brick Institute of America. The information contained herein must be used in conjunction with good technical judgment and a basic understanding of the properties of masonry. Final decisions on the use of information contained in this *Technical Notes* are not within the purview of the Brick Institute of America and must rest with the project architect, engineer, owner or all.

## 04100 MORTAR AND GROUT

### Guide Specification & Notes

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.
- C. Repointing mortar.

##### 1.02 RELATED SECTIONS

- A Concrete: Section 03\_\_\_\_\_.
- B. Masonry: Section 04\_\_\_\_\_.
- C. Masonry Cleaning: Section 04500.
- D. Structural Metal Framing: Section 05100.
- E. Rough Carpentry: Section 06100.
- F. Waterproofing: Section 07100.

#### NOTE:

1.02 Some of these broadscope sections may not be included. Other narrow scope sections under these broadscope sections may be added.

##### 1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Reinforcing Steel: Section 03210.
- B. Metal Accessories: Section 04150.
- C. Masonry Units: Section 04200.
- D. Flashing and Sheet Metal: Section 07600.

## 1.04 REFERENCES

- A. ACI 530.1/ASCE 6-\_\_\_\_\_ - Specifications for Masonry Structures.
- B. ASTM C 91 - \_\_\_\_\_, [UBC Standard No. 24-16] - Masonry Cement.
- C. ASTM C 144 - \_\_\_\_\_ - Aggregate for Masonry Mortar.
- D. ASTM C 150 - \_\_\_\_\_, [UBC Standard No. 26-1] - Portland Cement.
- E. ASTM C 207-\_\_\_\_\_, [UBC Standard No. 24-18] - Hydrated Lime for Masonry Purposes.
- F. ASTM C 270-\_\_\_\_\_, [UBC Standard No. 24-20] - Mortar for Unit Masonry.
- G. ASTM C 404-\_\_\_\_\_ - Aggregates for Masonry Grout.
- H. ASTM C 476-\_\_\_\_\_, [UBC Standard No. 24-29] - Grout for Masonry.
- I. ASTM C 780-\_\_\_\_\_ - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- J. ASTM C 979-\_\_\_\_\_ - Pigments for Integrally Colored Concrete.
- K. ASTM C 1019-\_\_\_\_\_, [UBC Standard No. 24-28] - Sampling and Testing Grout.
- L. ASTM C 1142-\_\_\_\_\_ - Ready-Mixed Mortar for Unit Masonry.
- M. BIA *Technical Notes* 8A - "Specifications for Portland Cement-Lime Mortar for Brick Masonry" BIA M1-88).

**NOTE:**

1.04 The applicable date for each reference can be given here or in Section 01090-Reference Standards. Alternate standards are given for Uniform Building Code specifications.

## 1.05 SUBMITTALS

- A. Submit data indicating proportion or property specifications used for mortar.
- B. Submit test reports for mortar materials indicating conformance to ASTM C 270 [UBC Standard No. 24-20] property specifications. Report proportions resulting from laboratory testing used to select mortar mix.
- C. Submit test reports for field sampling and testing mortar in conformance to ASTM C 780.
- D. Submit test reports for grout materials indicating conformance to ASTM C 476 [UBC Standard No. 24-29].
- E. Submit test reports for field sampling and testing grout in conformance to ASTM C 1019 [UBC Standard No. 24-28].
- F. Samples: Submit two ribbons of mortar for conformance with color.

**NOTE:**

1.05.A ASTM C 270 and UBC Standard No. 24-20 require that mortar be specified by proportion or property, not both.

1.05.B ASTM C 270 and UBC Standard No. 24-20 require comparison of laboratory prepared mortars to establish proportions for field-mixed mortar when the property specifications are used.

1.05.C ASTM C 780 allows preconstruction evaluation of mortar and comparison of field prepared mortars. Mortar prepared in the field should not be compared to values found in the property specifications of ASTM C 270 or UBC Standard No. 24-20.

1.05.E ASTM C 1019 or UBC Standard No. 24-28 is used to test uniformity of grout preparation during construction.

**1.06 DELIVERY, STORAGE AND HANDLING**

A. Store materials in dry location and protected from dampness and freezing.

B. Stockpile and handle aggregates to prevent contamination from foreign materials.

**1.07 ENVIRONMENTAL REQUIREMENTS**

A. Follow requirements for cold and hot weather construction in ACI 530.1/ASCE 6 [Uniform Building Code].

**PART 2 PRODUCTS****2.01 MORTAR MATERIALS**

A. Cementitious materials:

1. Portland Cement: ASTM C 150 [UBC Standard No. 26-1], Type\_\_\_\_\_.

2. Hydrated Lime: ASTM C 207 [UBC Standard No. 24-18], Type S\_\_\_\_\_.

3. Masonry Cements: ASTM C 91 [UBC Standard No. 24-16], Type\_\_\_\_\_.

B. Sand: ASTM C 144.

C. Admixtures:

1. No air-entraining admixtures or material containing air-entraining admixtures.

2. No antifreeze compounds shall be added to mortar.

3. No admixtures containing chlorides shall be added to mortar.

D. Water: Clean and potable.

E. Mortar pigment:

1. ASTM C 979: Pigment shall not exceed 10% of the weight of portland cement.

2. Carbon black shall not exceed 2% of the weight of portland cement.

**NOTE:**

2.01.A Allowable flexural tensile stresses for masonry built with air-entrained portland cement-lime mortars, or with masonry cement mortars are lower than those built with portland cement-lime mortars.

2.01.A.1 Only Types I, II or III.

2.01.A.3 Types M, S, or N.

2.01.B Sand not conforming to ASTM C 144 must have mortar meet the property specification requirements.

2.01.E Limits on amount of pigments should be halved when using masonry cement mortars.

## 2.02 GROUT MATERIALS

### A. Cementitious materials:

1. Portland Cement: ASTM C 150 [UBC Standard No. 26-1], Type\_\_\_\_\_.

2. Hydrated Lime: ASTM C 207 [UBC Standard No. 24-18], Type S\_\_\_\_\_.

### B. Aggregates:

1. Fine aggregate: ASTM C404.

2. Coarse aggregate: ASTM C 404.

### C. Water: Clean and potable.

### D. Admixtures.

#### **NOTE:**

2.02.A.1 Only Types 1, II or III.

2.02.D Grout admixtures are used to decrease grout shrinkage, aid in pumping grout, or for other reasons. The use of such admixtures should not adversely affect the performance of the grout.

## 2.03 MORTAR AND GROUT MIXES

### A. Mortar - ASTM C 270 [UBC Standard No. 24-20] or BIA M1:

1. Type based on proportion specifications.

**\*\*OR\*\***

1. Type\_\_\_\_\_based on property specifications to achieve \_\_\_\_\_ psi strength, \_\_\_\_\_% air content, \_\_\_\_\_% water retention.

#### **NOTE:**

2.03.A Mortar mixes can be specified separately by specifying ASTM C 270, UBC Standard No. 24-20 or BIA M1; or by specifying ASTM C 1142 alone.

2.03.A.1 Type M, S, N or O depending on design requirements.

**\*\*OR\*\***

A. Mortar - ASTM C 1142: Type\_\_\_\_\_.

**NOTE:**

2.03.A Ready mixed mortar can be mixed on-site or off-site. Types RM, RS, RN or RO.

B. Grout: ASTM C 476 [UBC Standard No. 24-29]

1. Fine grout.
2. Coarse grout.
3. Slump: \_\_\_\_\_ inches (\_\_\_\_\_ mm).

**NOTE:**

2.03.B The use of fine or coarse grout is based on the size of the grout space and the height of the grout pour.

2.03.B.3 Specify desired slump between 8 and 11 inches (203.2 and 279.4 mm). Higher slump is necessary for smaller dimensioned grout spaces and with higher unit/grout volume ratios.

## PART 3 EXECUTION

### 3.01 FIELD MORTAR MIXING

- A. All cementitious materials and aggregate shall be mixed between 3 and 5 min. in a mechanical batch mixer with the maximum amount of water to produce a workable consistency.
- B. Control batching procedure to ensure proper proportions by measuring materials by volume. Sand measurement by shovel count shall not be permitted.
- C. If water is lost by evaporation within 2 1/2 hours after initial mixing, retemper with water.
- D. Discard all mortar which is more than 2 1/2 hours old.

**NOTE:**

3.01 ASTM C 270 or BIA M1 can be referenced for field mortar mixing.

3.01.B Materials can be specified by weight if volume proportions are converted to weight proportions

### 3.02 FIELD GROUT MIXING

A. Control batching procedure to ensure proper proportions by measuring materials by volume.

**NOTE:**

3.02 ASTM C 476 can be referenced for field grout mixing.

3.02.A Materials can be measured by weight if volume proportions are converted to weight proportions.

### 3.03 INSTALLATION

A. Install mortar and grout in accordance with ACI 530.1/ASCE 6.

### 3.04 REPOINTING MORTAR

A. Use mortar materials listed in 2.01, Type N.

B. Prehydrate the mortar by the following method. Mix dry ingredients together. Then add only enough water to make a damp, stiff mix which will retain its form when pressed in a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistency.

**NOTE:**

3.04.A If materials and proportions of existing mortar are known, use those instead of Type N mortar if the existing mortar provided sufficient durability.