



# Standard Specification for Prefabricated Masonry Panels<sup>1</sup>

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## 1. Scope

1.1 This specification covers the structural design and quality control of fabrication for load-bearing and non-load-bearing prefabricated masonry panels. Methods of prefabrication, field erection, and jointing are not covered in this specification.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement<sup>2</sup>
- A 116 Specification for Zinc-Coated (Galvanized) Steel-Woven Wire Fence Fabric<sup>3</sup>
- A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware<sup>3</sup>
- A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip<sup>4</sup>
- A 185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement<sup>2</sup>
- A 615/A 615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement<sup>2</sup>
- A 616/A 616M Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement<sup>2</sup>
- A 617/A 617M Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement<sup>2</sup>
- B 227 Specification for Hard-Drawn Copper-Clad Steel Wire<sup>5</sup>
- C 34 Specification for Structural Clay Load-Bearing Wall Tile<sup>6</sup>
- C 55 Specification for Concrete Building Brick<sup>6</sup>
- C 62 Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)<sup>6</sup>
- C 67 Test Methods for Sampling and Testing Brick and Structural Clay Tile<sup>6</sup>
- C 73 Specification for Calcium Silicate Face Brick (Sand-Lime Brick)<sup>6</sup>
- C 90 Specification for Load-Bearing Concrete Masonry Units<sup>6</sup>

- C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)<sup>7</sup>
- C 126 Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units<sup>6</sup>
- C 140 Methods of Sampling and Testing Concrete Masonry Units<sup>6</sup>
- C 145 Specification for Solid Load-Bearing Concrete Masonry Units<sup>6</sup>
- C 212 Specification for Structural Clay Facing Tile<sup>6</sup>
- C 216 Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)<sup>6</sup>
- C 270 Specification for Mortar for Unit Masonry<sup>6</sup>
- C 476 Specification for Grout for Masonry<sup>6</sup>
- C 652 Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)<sup>6</sup>
- C 744 Specification for Prefaced Concrete and Calcium Silicate Masonry Units<sup>6</sup>
- C 780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry<sup>6</sup>
- C 1019 Test Method of Sampling and Testing Grout<sup>6</sup>
- E 72 Methods of Conducting Strength Tests of Panels for Building Construction<sup>7</sup>
- E 447 Test Methods for Compressive Strength of Masonry Prisms<sup>6</sup>
- E 518 Test Method for Flexural Bond Strength of Masonry<sup>6</sup>

## 3. Materials and Manufacture

3.1 *Masonry Units*—Masonry units shall conform to the following applicable specifications:

3.1.1 *Brick*—Specification C 62 for building brick, Specification C 216 for facing brick, Specification C 126 for ceramic glazed structural clay tile, facing brick, and solid masonry units, and Specification C 652 for hollow brick.

3.1.2 *Concrete Masonry Units*—Specification C 55 for concrete building brick, Specification C 90 for hollow load-bearing concrete masonry units, Specification C 145 for solid load-bearing concrete masonry units, and Specification C 744 for prefaced concrete masonry units.

3.1.3 *Calcium Silicate Face Brick*—Specification C 73 for calcium silicate face brick.

3.1.4 *Structural Clay Tile*—Specification C 212 for structural clay facing tile, Specification C 34 for structural clay load-bearing wall tile, and Specification C 126 for ceramic glazed structural clay tile, facing brick, and solid masonry units.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.04.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 01.06.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 02.03.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 04.05.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 04.07.

3.2 *Mortar and Grout*—Mortar and grout shall conform to the following applicable specifications:

3.2.1 *Mortar*—Specification C 270 for mortar for unit masonry.

3.2.2 *Reinforced Masonry*—Specification C 476 for grout for masonry.

3.2.3 Other mortars may be used, provided properties for such construction are established by tests made in accordance with Methods E 72.

3.3 *Metal Ties, Fittings, Anchors, Lifting Inserts, and Other Embedded Metal*—All metal embedded in masonry walls shall comply with the applicable specifications in accordance with 3.4 and, except for structural reinforcement, shall be coated with a corrosion-resistant material, such as copper, zinc, or other material having equivalent or better corrosion-resistant qualities, or shall be made of stainless steel type 304 or 316 (see Specification A 167).<sup>9</sup> Upon request by the purchaser, evidence satisfactory to the purchaser shall be provided that all corrosion-resistant metal is adequate in the atmospheric and material environment in which it is to be used.

3.3.1 Zinc coatings on iron or steel shall conform to Class B-1, B-2, or B-3 of Specification A 153.

3.3.2 Zinc coating on wire shall conform to Class 3 of Specification A 116.

3.3.3 Copper-coated wire shall conform to Grade 30HS of Specification B 227.

3.3.4 Stainless steel shall conform to type 304 or type 316 in Specification A 167.

3.4 *Reinforcement*—Reinforcement shall conform to the following applicable specifications:

3.4.1 Specification A 82 for cold-drawn steel wire for concrete reinforcement.

3.4.2 Specification A 185 for welded steel wire fabric for concrete reinforcement.

3.4.3 Specification A 615 or A 615M for deformed and plain billet-steel bars for concrete reinforcement.

3.4.4 Specification A 616 for rail-steel deformed and plain bars for concrete reinforcement.

3.4.5 Specification A 617/A 617M for axle-steel deformed and plain bars for concrete reinforcement.

## 4. Structural Design

4.1 *General*—Structural design of panels shall be performed in accordance with the provisions of the applicable local building code and the requirements of this specification. In the absence of a local building code, the requirements of a national model building code shall govern. The applicable code shall be identified on the plans. Structural design of panels shall consider all loading and restraint conditions from initial fabrication to in-service conditions in the completed structure, including storage, transportation, and erection. The design loads shall be of the type and magnitude required by the applicable building code. Panels and connections required to resist wind, seismic, or other dynamic loads shall be designed to resist the required positive and negative forces in all directions. The joints

between dissimilar materials within each panel, between panels, and between panels and their structural supports shall be designed to accommodate differential movement and deflections of each material, panel, and adjacent building elements.

4.2 *Lifting Devices*—Lifting devices and their connections to the panels shall have an ultimate capacity of four times the dead weight of the appropriate portion of the panel. Inclination of the lifting forces shall be considered.

## 5. Dimensions and Permissible Variations

5.1 *Standard Dimensions*—The standard nominal widths and heights of the panels shall be in multiples of nominal individual masonry unit heights and lengths. The nominal thickness of panels shall be the sum of the nominal thicknesses of the masonry units in the panels plus the nominal thickness of cavities, if any. The specified dimensions may be less than the required nominal dimensions by the thickness of one mortar joint but not by more than 1/2 in. (13 mm).

5.2 *Custom Dimensions*—For custom installations, all dimensions of panels shall be as shown on the drawings or as specified.

5.3 *Thickness of panels*—The actual thickness of the panels shall be as required for adequate strength, fire resistance, or other design criteria for the type of construction and occupancy as required by the applicable building code.

5.4 *Dimensional Tolerances*—Based on actual dimensions, a prefabricated masonry wall panel shall not vary from the specified face dimensions by more than the following:

10 ft (3.05 m) or under— $\pm 1/8$  in. (3.2 mm)

10 to 20 ft (3.5 to 6.1 m)— $\pm 1/8$  in. (3.2 mm) or  $\pm 3/16$  in. (4.8 mm)

20 to 30 ft (6.096 to 9.144 m)— $\pm 1/8$  in. (3.2 mm) or  $\pm 1/4$  in. (6.4 mm)

For each additional 10 ft (3.5 m)— $\pm 1/16$  in. (1.6 mm)

The maximum permissible variation from the specified thickness of prefabricated masonry panels shall be not greater than  $-1/8$  in. (3.2 mm) or  $+1/4$  in. (6.4 mm). Prefabricated masonry panels shall have maximum out-of-square differential dimensions (difference in length of the two diagonal face measurements) not greater than 1/8 in./6 ft (3.2 mm/1.83 m) nor an absolute maximum of greater than 1/4 in. (6.4 mm).

## 6. Workmanship, Finish, and Appearance

6.1 *General*—For facing panels, the workmanship and appearance shall be equal to or better than that of the approved sample. The method of fabrication shall be such as to prevent this misalignment of individual units, and the joints shall be even and aligned properly within each panel and with adjacent panels. Mortar, grout, or other stains on all panel surfaces to be left exposed shall be removed before the panel is delivered to the job site. Panels shall be protected from further staining during storage, shipment, and erection.

6.2 *Warpage*—The faces of the panels shall not be out of plane more than 1/8 in. (3.2 mm) for each 6 ft (1.83 m) of either height or width.

6.3 *Location of Inserts and Fittings*—The location of anchors, inserts, and lifting and connection devices shall not vary from center-line location shown on the plans or shop drawings, or both, by more than 3/8 in. (9.5 mm).

<sup>9</sup> In masonry panels, utilizing modified mortar or mortar admixtures, protection of structural reinforcement may be required, and the manufacturers of such materials should be consulted.

## 7. Quality Control

### 7.1 Preparation of Materials:

7.1.1 **Brick**—Test the initial rate of absorption (suction) of the brick in accordance with Method C 67, and when required, adjust the initial rate of absorption by wetting the units prior to pouring grout or spreading mortar.

7.1.2 **Mortar and Grout**—Proportion the mortar and grout by weight or volume on the basis of the unit weights of the ingredients as given in Specifications C 270 or C 476. If a high-bond mortar admixture is used, proportion and mix the mortar and grout in accordance with the admixture manufacturer's specifications.

### 7.2 Quality Control Tests:

7.2.1 Subject a sample of at least ten specimens of masonry units for each 50 000 units of a given type used in the fabrication of panels to the compressive strength and absorption tests in accordance with Methods C 67 or C 140.

7.2.2 **Mortar and Grout**—After the mortar or grout formulation, or both, has been established, sample a representative batch of each, if both are used, and mold not less than twelve standard 2-in. (50-mm) cube specimens of each, if both are used, following the procedures contained in the applicable sections of Test Method C 109 and Method C 1019, respectively.

7.2.2.1 Test three specimens, each at 1, 3, 7, and 28 days, and determine the relationship between the early age strengths and the 28-day strength for both mortar and grout, if both are used. Repeat this procedure whenever the mortar or grout formulation is changed.

7.2.2.2 Thereafter, during production, sample at least one representative batch of mortar or grout, or both, each day, and mold three cube specimens of each, if both are used, for testing at ages of 1, 3, or 7 days. Follow the applicable portions of Test Method C 780 and Method C 1019, respectively.

7.2.3 **Panel Assemblage**—Test a sample of specimens, that is, unreinforced assemblages representative of the full-size panel, for compressive and flexural strength. Test one sample of three compression specimens for every 5000 ft<sup>2</sup> of panel production or every story height. Test one sample of three flexural specimens for each day's work on panels.

7.2.3.1 The prism test specimens for both compressive and flexural tests shall be one masonry unit in length and thickness. The height and bond pattern shall be as specified in the appropriate ASTM test procedure. If the relation

between the 7-day and 28-day strengths of such small specimens has previously been established, test at age 7 days. Cap the compressive test prisms with gypsum and test as compressive prisms in accordance with Test Methods E 447. Test the flexural test prisms as simple horizontal beams with third-point loading in accordance with Test Method E 518.

NOTE—Good correlation has not been established between the results of flexural prism tests of masonry and those of full-size wall sections under a variety of loading, slenderness, and bending conditions. Quality control flexural tests of prisms should be supplemented initially with uniform transverse load tests of full-size wall panels in accordance with Methods E 72.

## 8. Identification and Marking

8.1 Each prefabricated member shall be marked to indicate its location in the structure, its top surface, and the date of fabrication. Identification marks shall correspond to those shown on the placing drawings.

## 9. Shop Drawings

9.1 Shop drawings shall consist of fabrication drawings and placement drawings that may be separate or combined into one set of shop drawings.

9.2 Fabrication drawings shall show all details and location of reinforcement, inserts, anchors, bearing seats, lifting inserts, coursing, size and shape of openings, and panel size and shape.

9.3 Placing drawings shall show panel identification, panel location, reference dimensions, panel dimensions, dimension of joints between panels, and connection details.

## 10. Handling, Storage, and Transportation

10.1 During manufacture, curing, storage, and transportation, care shall be taken not to overstress, warp, or otherwise damage the panels. Damaged panels shall be replaced, except that the architect or engineer, at his discretion, may allow repair of damaged panels instead of replacement. The damaged areas, such as minor surface or corner chippage, shall be repaired or replaced, utilizing construction practices satisfactory to the architect or engineer.

## 11. Keywords

11.1 dimensions; dimensional tolerances; masonry units; prefabricated masonry panels; quality control; structural design

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