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TECHNICAL NOTES on Brick Construction

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Hollow Brick Masonry

Abstract: This *Technical Note* presents information about the use of hollow brick in both structural and anchored veneer applications. Basic properties of hollow brick units are presented, including applicable ASTM standards. Issues specific to hollow brick masonry are discussed, including design details, structural performance and construction methods.

Key Words: compressive strength, hollow brick, reinforced masonry, veneer.

SUMMARY OF RECOMMENDATIONS:

Material Selection

- Use hollow brick units conforming to the requirements of ASTM C652
- Specify Grade SW brick for most exterior exposures and Grade MW for interior projects and exterior exposures protected from freezing
- Specify Type HBS brick for typical projects, Type HBX for projects where higher precision units are desired, and Type HBA for projects where unique variations in dimension or appearance are desired

Structural (Non-Veneer) Construction

- When placing mortar, use face-shell mortar bedding
- Place reinforcement in accordance with applicable building codes
- In single-wythe walls, add a drainage space to the interior and through-wall flashing where additional water penetration resistance is necessary

Veneer Construction

- When placing mortar, use full mortar bedding
- Use typical brick veneer details

Other Details

- For corbelling, use solid units or solidly filled units with approval of building official
- For fireboxes and chimney construction, use solid units or fully grouted units

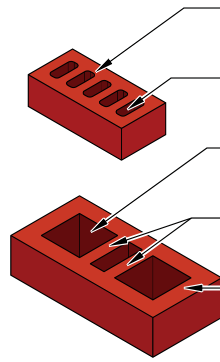
INTRODUCTION

Originally, brick was formed by placing moist clay in a mold by hand. As modern industrial methods were implemented in the brick manufacturing process, the majority of production was changed from a molded process to an extrusion process. Extrusion more easily accommodates the inclusion of holes in a brick unit, which in turn can make the manufacture and use of brick more cost-effective and material-efficient. Traditionally, the size and number of holes in a brick unit have varied based on manufacturer capabilities, type of clay being extruded, type of firing process, and intended use of the product. As part of the evolution of brick unit manufacture and classification, these various hole patterns were categorized into two basic designations: solid brick and hollow brick. Solid brick are defined as having holes (or voids) not greater than 25 percent of the unit's bed area. Hollow brick are defined as having greater than 25 percent and at most 60 percent void areas. Hollow brick are further classified into those with a void area not greater than 40 percent and those with greater than 40 percent voids.

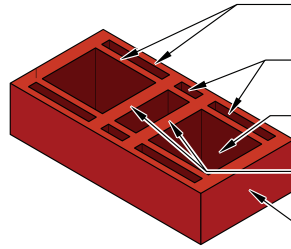
In today's construction, the majority of hollow brick produced are used in two basic applications. The first is in reinforced or unreinforced single-wythe structural walls. Hollow brick units provide both the structural component and the brick finish without the need for additional materials. Hollow brick for this type of use generally range in size from 4 to 8 in. (102 to 203 mm) in nominal thickness with void areas in the 35 to 60 percent range. Typical single-wythe applications of hollow brick include commercial, retail and residential buildings; hotels; schools; noise barrier walls; and retaining walls. The second application of hollow brick is as veneer units. These brick are generally 3 to 4 in. (76 to 102 mm) in nominal thickness with void areas typically between approximately 26 and 35 percent.

Figure 1 presents the three typical configurations of hollow brick units. Actual coring patterns vary by manufacturer and may depend on raw materials, extrusion equipment, firing methods or other factors. Note that as used in Figure 1 and throughout this *Technical Note*, a “core” is a void having a cross-sectional area of 1.5 in.² (968 mm²) or smaller, and a “cell” is a void larger than a core.

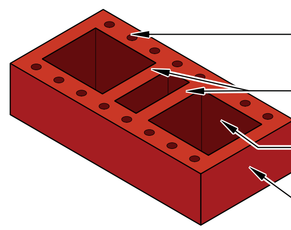
Many designers are familiar with the design, construction and performance of masonry built with solid units. Hollow brick masonry is similar in many instances. This *Technical Note* describes the classifications, properties and uses of hollow brick. Further information regarding single-wythe walls is presented in *Technical Note* 26. Information on brick veneer construction can be found within the *Technical Note* 28 Series.



(a) Solid Shell Hollow Brick



(b) Double Shell Hollow Brick



(c) Cored Shell Hollow Brick

Figure 1
Hollow Brick Configurations

PROPERTIES OF HOLLOW BRICK MASONRY

Strength

The structural design of hollow brick masonry is governed by model building codes and ACI 530/ASCE 5/TMS 402 *Building Code Requirements for Masonry Structures*, also known as the Masonry Standards Joint Committee (MSJC) Code [Ref. 4]. Hollow brick masonry can be designed by empirical requirements or by rational design procedures. Depending on materials and mortar bedding, prescriptive stresses can be different for hollow brick masonry than for solid brick masonry. The following sections highlight some of the specific requirements for hollow brick units.

Compressive Strength of Units. Compressive strength of hollow brick can be reported on either a gross or net cross-sectional area basis, depending on how the value is to be used. The gross area compressive strength is used to determine compliance with ASTM C652, *Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)* [Ref. 2] for purposes of durability and empirical design requirements. The net area compressive strength is needed for structural computations in structural applications using rational design of masonry.

An internal BIA survey conducted in 1994 showed that the range of compressive strength of 6 to 8 in. (152 to 203 mm) thick hollow brick based on gross cross-sectional area is between 2190 psi (15.1 MPa) and 12,795 psi (88.2 MPa), with an average compressive strength equal to 6740 psi (46.5 MPa). More recent testing indicates hollow brick of 3- to 4-in. (76- to 102-mm) nominal thickness have similar compressive strengths as solid units of the same size [Ref. 5].

Brick units generally have higher compressive strengths than other loadbearing masonry materials. This makes hollow brick particularly well-suited for reinforced masonry applications where the increased strength of the unit can allow thinner wall sections to handle the same loading.

Compressive Strength of Masonry. The compressive strength of hollow brick masonry depends on unit strength, mortar type, mortar bedding area, grouting and thicknesses of face shells and webs. The design strength of the masonry can be determined by testing sample prisms (prism test method). During construction, strength can be verified using prism testing or from tabulated values based on brick strength and mortar type (unit strength method). Ungrouted prisms exhibit failure in compression by a splitting of the unit through the cross webs due to

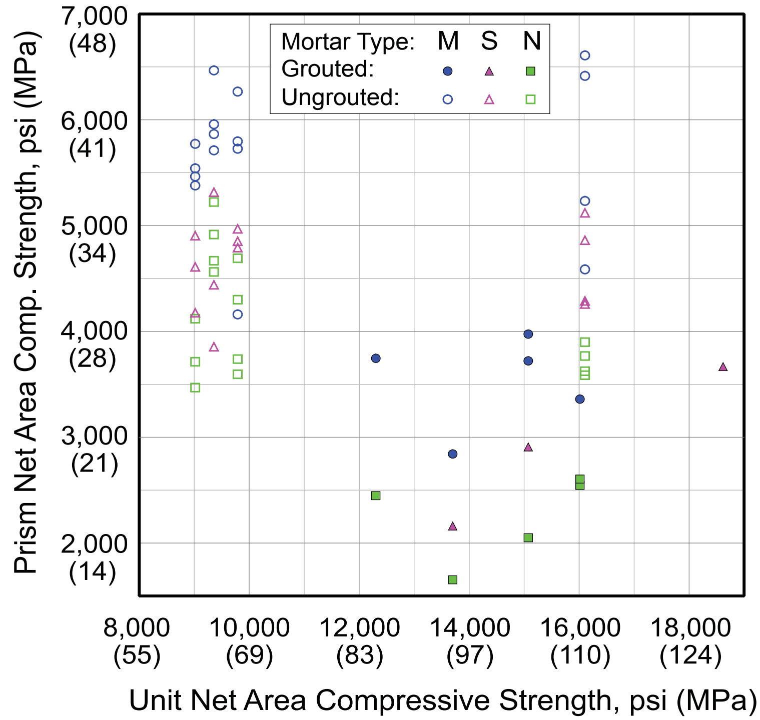


Figure 2
Hollow Brick Prism Compressive Strengths

the lateral expansion of the mortar. Filling the cells of hollow brick with grout will generally increase the masonry's capacity; however, the result is a decrease in the net area compressive strength due to the increased area of the grouted section. The strength of grouted hollow prisms is significantly affected by both the tensile strength of the unit and by the compressive strength of the mortar [Ref. 8].

The compressive strength of hollow brick masonry is based on the minimum net cross-sectional area. This is normally the net mortar bedded area (face-shell bedding) and is used in structural calculations. When using prism testing to determine or verify compressive strength, the MSJC Code requires that the prisms be built with units fully bedded in mortar (i.e., all face shells and webs fully mortared).

Values obtained from prism tests must be corrected based on the height-to-thickness (h/t) ratio of the prism. The h/t ratio provides a uniform basis for the determination of compressive strength. Codes stipulate the correction factors to use for masonry prisms. An h/t of 2 has been adopted as the base level.

Research shows typical values of ungrouted hollow brick masonry compressive strength based on net area ranging from 3470 psi (23.9 MPa) to 6620 psi (45.6 MPa). Figure 2 shows typical values of the net area compressive strength of grouted and ungrouted hollow brick masonry prisms from the research [Refs. 3, 8].

Flexural Strength. The flexural tensile strength of hollow brick masonry is influenced by mortar and unit configurations and the use of reinforcing steel. Previous research has indicated that face-shell bedded hollow brick masonry exhibits a lower flexural tensile strength than solid brick masonry laid with the same mortar, fully bedded. This is likely due to the relative thickness of the face-shell bedded mortar joints and the drying of the mortar before the hollow unit is laid (face-shell bedding has more surface area exposed to air relative to its volume than does a full mortar bed). More recent research has indicated that the percentage of voids, ranging from approximately 22 to 35 percent, in nominal 4-in. (102-mm) brick has no significant effect on the flexural strength of the resulting fully bedded masonry prism [Ref. 5].

Fire Resistance

The excellent fire-resistant qualities of brick masonry are well known. However, there have been relatively few full-scale fire tests of hollow brick masonry walls. This is due in part to the acknowledgment that brick masonry is inherently fire-resistant. Fired clay products provide superior fire resistance. Fire resistance ratings for hollow brick masonry assemblies can be taken from results of actual testing or can be calculated using industry standards. Results from actual wall tests performed in accordance with ASTM E119 are listed in Table 1 [see Ref. 6 and *Technical Note* 16].

TABLE 1
Fire Resistance Ratings of Hollow Brick Masonry[1]

Wall Assembly[2]	Fire Resistance Rating[3], Hours
3-in. (76-mm) hollow brick veneer, 1-in. (25.4-mm) air space, building felt, OSB sheathing, wood studs, ½-in. (12.7-mm) gypsum wallboard (fire exposure on brick side)	1
4-in. (102-mm) hollow brick veneer, 1-in. (25.4 mm) air space, building felt, OSB sheathing, wood studs, ½-in. (12.7-mm) gypsum wallboard (fire exposure on brick side)	1
4-in. (102-mm) hollow brick masonry, solid grouted	1
5-in. (127-mm) hollow brick masonry	1
6-in. (152-mm) hollow brick masonry	1
8-in. (203-mm) hollow brick masonry, units at least 71% solid, combustible members framed in	1
5-in. (127-mm) hollow brick masonry, solid grouted	2
6-in. (152-mm) hollow brick masonry, solid grouted	3
8-in. (203-mm) hollow brick masonry, units at least 71% solid, with noncombustible members or no members framed in	3
10-in. (254-mm) hollow brick masonry	3
8-in. (203-mm) hollow brick masonry, units at least 60% solid, with noncombustible members or no members framed in, cells filled with loose fill insulation	4
8-in. (203-mm) hollow brick masonry, solid grouted	4

1. Adapted from Refs. 1 and 6.
2. Nominal thicknesses given for masonry.
3. When a ⅝-in. (15.9-mm) layer of plaster is added to the surface of the masonry, the fire resistance rating may be increased by one hour.

An alternative way of determining the fire resistance of a wall assembly is by calculating the equivalent thickness of the brick. This approach has been approved by the model building codes to determine fire resistance ratings of walls not physically tested by ASTM E119. The fire resistance rating of hollow brick masonry is determined by its equivalent solid thickness. The equivalent thickness is calculated by subtracting the volume of core or cell spaces from the total gross volume of a brick unit and dividing by the exposed face area of the unit. The resulting thicknesses can be compared with the requirements given within the building code. As an example, the 2006 International Building Code requires that for a one-hour rating, an equivalent thickness of 2.3 in. (58 mm) of hollow brick be provided [Ref. 1]. For a 28 percent void area, this would equate to an actual brick thickness of 3.2 in. (81 mm). By contrast, the requirement for solid brick is an equivalent thickness of 2.7 in. (69 mm), meaning that a unit with 22 percent coring would need to be 3.5 in. (88 mm) in actual thickness.

For additional information on fire resistance ratings and calculations, refer to *Technical Note* 16.

Water Penetration Resistance

The water penetration resistance of hollow brick masonry depends upon the materials, wall construction and workmanship used. The best water penetration resistance is provided by drainage wall systems, such as those incorporating brick veneer. For hollow brick veneer applications, water penetration resistance is provided by proper detailing, including clean air spaces, through-wall flashing and weeps. Testing has shown fully mortar-bedded hollow brick veneer to have water penetration resistance similar to that of solid brick veneer [Ref. 5]. For all brick veneer, water penetration resistance depends on proper design and detailing, as presented in *Technical Note* 7 and the *Technical Note* 28 Series. Flashing should be provided at the wall base, below and above all wall openings, at roof/wall intersections, and at the tops of parapet walls. Flashing and weeps will collect water that enters the wall and direct it back to the exterior.

Many hollow brick used as single-wythe walls are designed to act as a variation of a barrier wall, relying on the thickness and mass of the materials to act as a barrier to water penetration. The single-wythe wall design is not inherently as resistant to water penetration as are drainage wall systems or multi-wythe barrier wall systems and may not be appropriate for some severe exposures. With careful detailing and good construction practices, however, they can perform well. For example, vertically reinforced and grouted brickwork often provides good water penetration resistance. With single-wythe masonry, it is especially important to use a mortar joint profile that sheds, rather than collects, water. Concave and "V" joints are recommended over raked joints, for example. Appropriate details and methods to increase the water penetration resistance of single-wythe hollow brick masonry walls can be found in the *Technical Note* 7 Series and *Technical Note* 26.

In cases where water penetration resistance is critical, a drainage space should be provided on the interior of the wall assembly. The interior may be furred out and insulation and gypsum board attached. Flashing and weeps are used to drain the space. Another precaution may be the use of a water-resistant membrane placed on the inside face of the wall. Waterproof membranes or polyethylene sheets have been used to resist water that has penetrated the hollow brick wall. Any puncture in the membrane must be properly sealed.

Sound Resistance

Because sound insulation increases with increasing wall weight, brick masonry provides very good sound penetration resistance. The sound transmission class (STC) rating is used to determine the sound insulation of walls. Hollow brick veneer generally has an STC of approximately 40 to 45, slightly less than the STC of 45 for solid brick veneer of the same thickness. The STC for through-the-wall brick units is typically calculated as a linear function of weight. A grouted 8-in. (203-mm) brick wall generally has an STC of approximately 50 to 55. In the absence of test results for a particular wall, calculated values of STC ratings can be determined from the following equation:

$$\text{STC} = 19.6W^{0.23} \ \text{(Imperial)} \quad \text{or} \quad 913.6W^{0.23} \ \text{(SI)}$$

The STC rating is a function of the weight of the wall, W, expressed in pounds per cubic foot (kg/m^3). This equation is a best-fit curve based on the average of historical test data [Ref. 7].

DESIGN AND DETAILING

Mortar Bedding

Requirements for brickwork constructed of hollow brick vary depending on the intended use of the brickwork. For larger hollow brick units used in structural (non-veneer) walls, mortar should be applied to the full thickness of the face shell (face-shell bedding). For smaller hollow brick units that are used in veneer applications, mortar should be applied to the full width of the brick veneer (full bedding) to maintain proper anchor embedment and cover.

Reinforcement

Although reinforcement is not always used in hollow brick masonry, the large cells allow the units to be easily reinforced and grouted. The reinforcing must be embedded in grout, not mortar. Reinforcing is most often positioned in the center of the wall but may be placed to one side to maximize the distance from the compression face. Reinforcement is grouted into hollow brick walls to increase the flexural strength, to provide ductility and to carry tensile forces. The flexural strength of a reinforced hollow brick wall depends primarily on the amount of vertical reinforcement because the compressive strength is rarely the limiting factor. The reinforcement resists the flexural tension and the brickwork resists the flexural compression. Building codes may dictate a minimum amount of reinforcement for improved ductility in seismic regions. In reinforced masonry design, any tension resistance provided by the masonry is neglected.

Corbelling and Other Design Details

Certain construction details require the use of solid masonry units while others require either solid units or solidly filled hollow units. The use of hollow brick is restricted by the model building codes as follows:

Corbelling. For corbelling, use solid units or solidly filled hollow units with approval of building official.

Masonry Piers. The height of masonry piers constructed of unfilled hollow units is limited to four times their least dimension.

Parapet Walls. An unreinforced hollow unit masonry parapet must be no less than 8 in. (203 mm) thick, and its height must not exceed three times its thickness.

Fireboxes and Chimneys. Fireboxes and chimneys constructed of hollow units are required to be grouted solid.

HOLLOW BRICK SPECIFICATION AND SIZES

Hollow brick should be specified to comply with ASTM C652, *Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale* [Ref. 2]. When initially issued in 1970, ASTM C652 covered units with void areas up to and including 40 percent in any plane parallel to the surface containing the voids. In 1987, the standard was modified to allow void areas up to and including 60 percent of the unit's gross area.

Grade

Two Grades exist in ASTM C652: Grades SW and MW. As with solid units (governed by ASTM C216, *Standard Specification for Facing Brick* [Ref. 2]), the Grade establishes requirements to ensure adequate freeze/thaw resistance. Grade SW units provide high and uniform resistance to frost action while saturated with water. Grade MW units are intended for applications that are unlikely to be saturated with water when exposed to freezing temperatures. When the Grade is not specified, ASTM C652 stipulates that the requirements for Grade SW govern.

The physical property requirements are shown in Table 2. Two alternates exist in the specification to demonstrate durability without meeting the requirements of Table 2. Brick with a cold water absorption less than 8 percent are exempt from the saturation coefficient requirements. Brick passing a 50-cycle freezing and thawing test are exempt from the boiling water absorption and saturation coefficient requirements. Brick meeting Table 2 requirements or the cold water absorption alternate are not required to be subjected to the freeze/thaw test.

TABLE 2

ASTM C652 Physical Property Requirements for Hollow Brick

Designation	Compressive Strength, Gross Area, min.[1], psi (MPa)		Five-hour Boiling Water Absorption, max., %		Saturation Coefficient, max.	
	Average of 5	Individual	Average of 5	Individual	Average of 5	Individual
Grade SW	3000 (20.7)	2500 (17.2)	17.0	22.0	0.78	0.80
Grade MW	2500 (17.2)	2200 (15.2)	22.0	25.0	0.88	0.90

1. Unit in stretcher position with load applied perpendicular to bed surface.

Type

Four Types of hollow brick are defined by ASTM C652: Types HBS, HBX, HBA and HBB. Each of these Types relates to the appearance requirements for the brick. Dimensional variation, chippage, warpage and other imperfections are qualifying conditions of Type. The most common, Type HBS, is considered to be standard and is specified for most applications. When the Type is not specified, ASTM C652 stipulates that the requirements for Type HBS govern. Type HBX brick are specified where a higher degree of precision is required. Type HBA brick are unique units that are specified for nonuniformity in size or texture. Where a particular color, texture or uniformity is not required, Type HBB brick can be specified (these applications are typically unexposed locations).

Class

The extent of void area of hollow brick is separated into two Classes: H40V and H60V. Brick with void areas greater than 25 percent but not greater than 40 percent of the units' gross cross-sectional area in any plane parallel to the surface containing the voids are classified as Class H40V. Brick with void areas greater than 40 percent but not greater than 60 percent of the gross cross-sectional area are classified as Class H60V. When the Class is not specified, ASTM C652 stipulates that the requirements for Class H40V govern.

Hollow Spaces (Voids)

Hollow spaces may be cores, cells, deep frogs or combinations of these. In ASTM C652, a core is defined as a void having an area equal to or less than 1½ in.^{2} (968 mm^2), while cells are voids larger than a core. A deep frog is an indentation in the bed surface of the brick that is deeper than ⅜ in. (9.5 mm). The thickness of face shells and webs are limited by ASTM C652. Figure 1 and Table 3 define the nomenclature associated with hollow brick units and the minimum required thickness of face shells and cross webs.

TABLE 3
ASTM C652 Hollow Brick Cross-Sectional Requirements

Type of Void	Minimum Distance from Void to Exposed Edge,[1, 2] in. (mm)	Minimum Distance from Void to Unexposed Edge,[3] in. (mm)	Minimum Web Thickness (Between Void and Core), in. (mm)	Minimum Web Thickness (Between Void and Cell), in. (mm)
Core	⅝ (15.9)	½ (12.7)	¼ (6.4)	⅜ (9.5)
Cell	¾ (19.1)	½ (12.7)	⅜ (9.5)	½ (12.7)

Additional Requirements for Class H60V Units			
Nominal Width of Units, in. (mm)	**Minimum Solid Face-Shell Thickness, in. (mm)**	**Minimum Cored or Double Face-Shell Thickness, in. (mm)**	**Minimum End-Shell or End Web Thickness, in. (mm)**
3 and 4 (76 and 102)	¾ (19.1)	N/A	¾ (19.1)
6 (152)	1 (25.4)	1½ (38)	1 (25.4)
8 (203)	1¼ (32)	1½ (38)	1 (25.4)
10 (254)	1⅜ (35)	1⅝ (41)	1⅛ (29)
12 (305)	1½ (38)	2 (51)	1⅛ (29)

1. Cored-shell hollow brick with cores greater than 1 in.^{2} (650 mm^2) in cored shells shall be not less than ½ in. (12.7 mm) from any edge. Cores not greater than 1 in.^{2} (650 mm^2) in shells cored not more than 35 percent shall be not less than ⅜ in. (9.5 mm) from any edge.
2. Double-shell hollow brick with inner and outer shells not less than ½ in. (12.7 mm) are permitted to have cells not greater than ⅝ in. (15.9 mm) in width nor 5 in. (127 mm) in length between the inner and outer shell.
3. Permitted where recess in unexposed edge is ½ in. (12.7 mm) or greater.

The dimensions of the unit and the configuration of its voids are critical for reinforced brick masonry. The cells intended to receive reinforcement must align so that reinforcing bars can be properly placed. Most Class H60V hollow brick contain two cells that are aligned when laid in running and stack bonds. Other bond patterns, such as one-third bond and bonds at corners, may require different unit configurations to permit placement of reinforcement. Size of cores will also influence grout type and grout placement methods. It is advisable to check with the brick manufacturer to determine the coring patterns available.

Sizes and Shapes. Hollow brick are commonly available in a variety of sizes, as listed in Table 4. Hollow brick are also made in a variety of special shapes. Special shapes include radial, bullnose, interior and exterior angled corner units and others. Bond beam units are often used where horizontal reinforcing is required. They may be specially made at the plant or cut on site. The brick manufacturer should be consulted for the availability of special shapes.

TABLE 4
Typical Nominal Hollow Brick Sizes

Unit Designations[1]	Thickness, in. (mm)	Height, in. (mm)	Length, in. (mm)
Queen	3 (76)	2⅔ or 3⅕ (68 or 81)	8 (203)
King	3 (76)	2⅔ or 3⅕ (68 or 81)	10 (254)
Modular, Engineer Modular	4 (102)	2⅔ or 3⅕ (68 or 81)	8 (203)
Engineer Norman, Utility	4 (102)	3⅕ or 4 (81 or 102)	12 (305)
Meridian, Double Meridian	4 (102)	2⅔, 4 or 8 (68, 102 or 203)	16 (406)
	4 (102)	8 (203)	8 (203)
	5 (127)	3⅕ (81)	10 (254)
	6 (152)	4 (102)	12 (305)
6" Through-Wall Meridian	6 (152)	4 or 8 (102 or 203)	16 (406)
	8 (203)	3⅕ or 8 (81 or 203)	12 (305)
8" Through-Wall Meridian, Double Through-Wall Meridian	8 (203)	4 or 8 (102 or 203)	16 (406)
	12 (305)	4 (102)	16 (406)

1. Unit designations given are standardized nomenclature and encompass the vast majority of current brick production. Additional sizes may be available from individual or regional manufacturers. Refer to *Technical Note* 10B for a complete list of standardized designations.

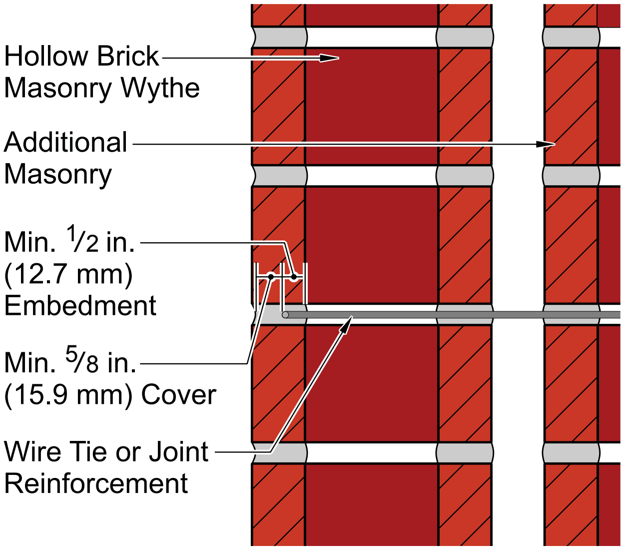


Figure 3
Wall Tie Placement in Hollow Brick Masonry

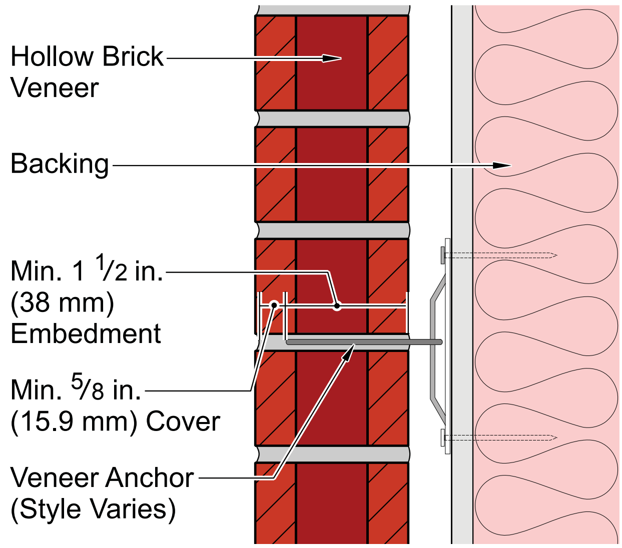


Figure 4
Anchor Placement in Hollow Brick Veneer

CONSTRUCTION REQUIREMENTS

Mortar Bedding

In structural (non-veneer) applications, hollow brick units are typically laid with face-shell bedding. Face-shell bedding consists of mortar coverage on the inner and outer face shells of the unit. Cross webs or end webs of the unit may require mortar bedding when grout must be confined within certain cells of partially grouted masonry or on the first course of brickwork.

In veneer applications, hollow units should be laid in full mortar beds. Field experience has demonstrated that a veneer constructed of hollow brick units with a nominal thickness of 3 to 4 in. (76 to 102 mm) and laid in a full mortar bed has not significantly increased mortar usage compared to the same veneer constructed of solid brick units. Care should be taken to avoid using excessively plastic mortar or placement methods that would force excessive amounts of mortar into the cells or cores of the brick below. If these steps are taken, the rule of thumb to use seven bags per thousand brick for estimating mortar usage is valid for most hollow brick veneer applications.

Anchors and Ties

In some loadbearing and all veneer applications, hollow brick masonry is connected to either another wythe of masonry or to some other structural system. For face-shell bedded hollow brick masonry, the rectangular wire tie or joint reinforcement used must be embedded across one face shell of the hollow masonry and at least ½ in. (12.7 mm) into the other face shell, as depicted in Figure 3. For hollow masonry veneer, where full mortar bedding is required, anchors must be fastened to the backing and embedded into the mortar a minimum of 1½ in. (38 mm), as depicted in Figure 4. Wire ties, joint reinforcement or sheet-metal ties are used for veneer applications. When a backing of wood stud framing is used, corrugated sheet-metal anchors can be used to anchor hollow masonry veneer. Both wall ties and veneer anchors must be recessed from the exposed exterior face of the mortar by a minimum of ⅝ in. (15.9 mm).

SUMMARY

Hollow brick are a natural evolution of clay brick manufacturing, providing durable brick units with less raw material. For typical veneer applications, hollow brick can provide a water-resistant drainage wall system. For single-wythe applications, the cells of larger hollow brick units can be reinforced to provide a structural solution. In all applications, hollow brick provide the durability, aesthetics, fire resistance, thermal resistance and overall performance characteristic of clay brick masonry.

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

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