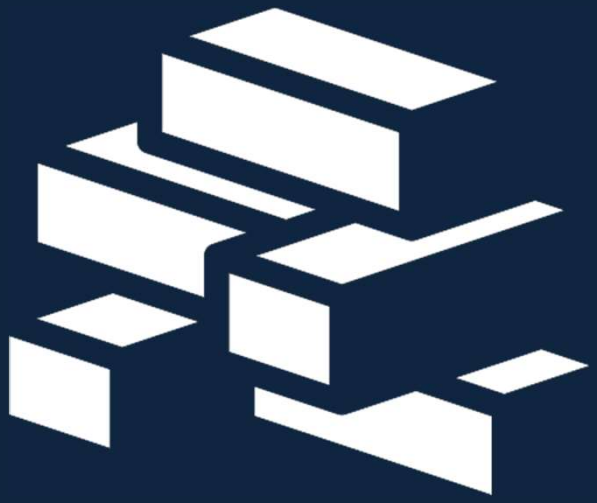


MASONRY Association of Florida

BRICK VENEER BASICS
TMS 402: Chapter 12 - Veneer

COMPONENT 1

Lisa Pelham, CSI CDT

Lisa R. Pelham, CSI CDT is a driven and result-oriented sales professional with extensive experience of materials, methods and techniques used in the construction of masonry commercial structures. Because of this knowledge, she is viewed as the Architectural Block authority in the Florida market. She is currently a Commercial Sales and Specification Specialist for the Florida commercial market at Oldcastle APG, where she has continuously collaborated within the design industry for all their masonry needs. Some of her clients include Architects, Engineers and Interior Designers, as well as general contractors, masonry contractors and occasionally a commercial owner. Equipped with over 25 years of experience in the commercial construction industry, she is considered an expert in this field with a passion and unparalleled enthusiasm that are apparent in every project she fosters.

Oldcastle APG – Coastal
Commercial Sales & Specification Rep
Lisa.Pelham@Oldcastle.com

ABOUT US

- The Masonry Association of Florida (MAF) is a not-for-profit trade association dedicated to expanding the market share of masonry construction in Florida. Masonry construction dominates the construction industry because of its adaptability to the Florida climate. One of the most durable building products available, masonry resists storms, termites and mold, while reducing energy costs, maintenance and noise. The MAF is a coalition of Florida masonry industry professionals who believe it's time to bring our industry together.

- www.floridamasonry.com

THE MAF OFFERS:

Professional Education (Architects, Engineers, Contractors & Building Inspectors

Masonry Apprentice Training

Technical Assistance through our Engineering Help Desk & Technical Library

Masonry Education and Advocacy

Florida CONCRETE MASONRY EDUCATION COUNCIL

The Florida Concrete Masonry Education Council was appointed by Governor Rick Scott. Its purpose is to bring together masonry manufacturers and contractors in an effort to plan and conduct training programs, improve access to masonry education, develop outreach programs to ensure diversity, and to inform the public about the sustainability and economic benefits of concrete masonry products.

Block Strong Initiative

It’s an effort designed to make sure that everyone-consumers, construction professionals and designers understand the vital link between quality building materials and the health and safety of those people living in the homes and structures that they design and build. But it’s also an information source for aiding prospective homebuyers in their search for knowledge as they go through the various steps of the home-buying journey.

BLOCK™ STRONG

Life’s Better With Block

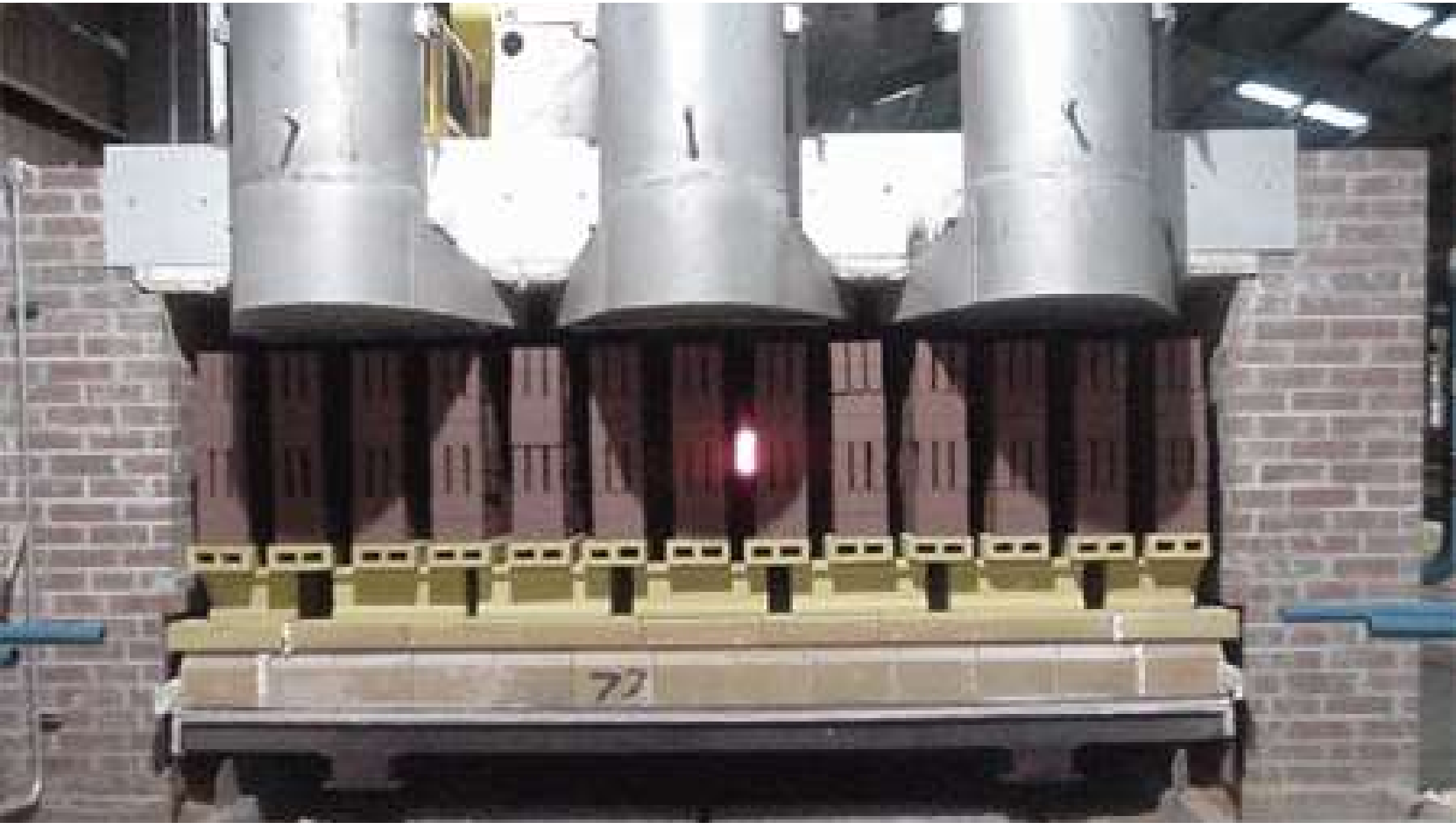
What is a Brick?

ASTM Definitions

Designation: C1232 - 17
Standard Terminology of Masonry

brick, n—a solid or hollow masonry unit of clay or shale, usually formed into a rectangular prism, then burned or fired in a kiln; brick is a ceramic product.

brick, facing, n—brick for general purposes where appearance properties such as color, texture, and chippage are important; see **Specification C 216** and **Specification C 652**.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Designation: C216 – 15

StandardSpecification for Facing Brick (Solid Masonry Units Made from Clay or Shale)[1]

Designation: C216 – 15

StandardSpecification for
Facing Brick (Solid Masonry Units Made from Clay or Shale)[1]

This standard is issued under the fixed designation C216; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

describe the brick.

1.5.1 This standard and its individual requirements shall not be used to qualify or corroborate the performance of a masonry unit made from other materials, or made with other forming methods, or other means of binding the materials.

1.6 Three types of brick in each of two grades are covered.

1.7 The text of this specification references notes and footnotes which provide explanatory material. These notes and

given in Section 7.

4.1.1 *Grade SW (Severe Weathering)*—Brick intended for use where high resistance to damage caused by cyclic freezing is desired.

4.1.2 *Grade MW (Moderate Weathering)*—Brick intended for use where moderate resistance to cyclic freezing damage is permissible.

NOTE 1—Although grade is associated with resistance to deterioration under freeze/thaw exposures, freeze/thaw resistance of a clay brick unit is also affected by the properties of the surrounding materials, the construction details, and the overall environment in which the clay unit is placed;

[1] This specification is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Brick and Structural Clay Tile.

Current edition approved Feb. 1, 2015. Published February 2015. Originally approved in 1947. Last previous edition approved in 2014 as C216 – 14. DOI: 10.1520/C0216-15.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Designation: C652 – 15

Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)[1]

This standard is issued under the fixed designation C652; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

not be used to qualify or corroborate the performance of a masonry unit made from other materials, or made with other forming methods, or other means of binding the materials.

1.4 Hollow brick differ from unglazed structural clay tile (Specifications C34 and C212) and solid brick (Specifications C62 and C216). Hollow brick require greater shell and web

[1] This specification is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Brick and Structural Clay Tile.

Current edition approved Aug. 1, 2015. Published August 2015. Originally approved in 1970. Last previous edition approved in 2014 as C652 – 14. DOI: 10.1520/C0652-15.

Brick.
C1232 Terminology of Masonry

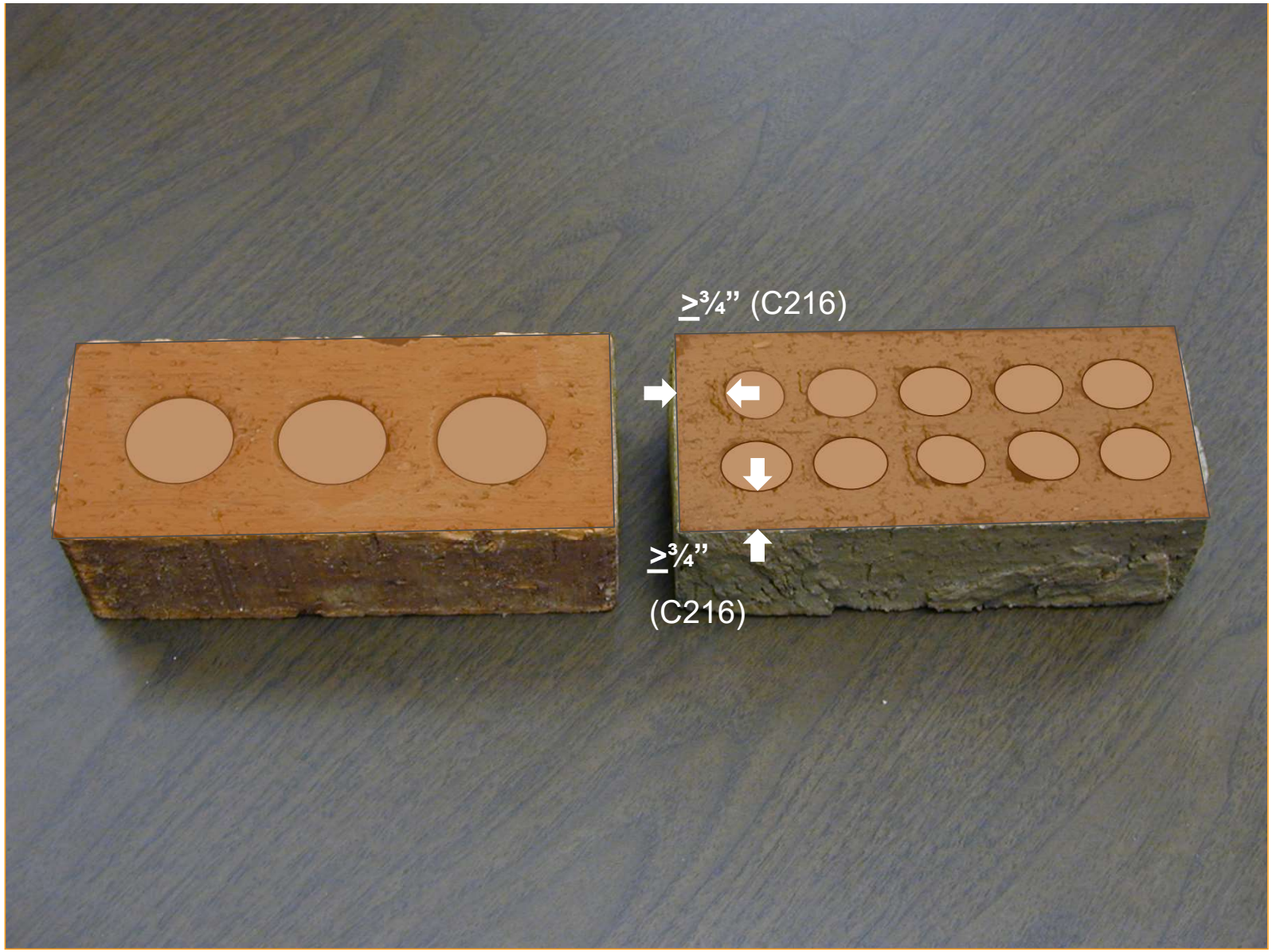
3. Terminology

3.1 *Definitions*—For definitions relating to masonry and hollow brick, refer to Terminology C1232.

4. Classification

4.1 *Grades*—Two grades of hollow brick are covered:

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.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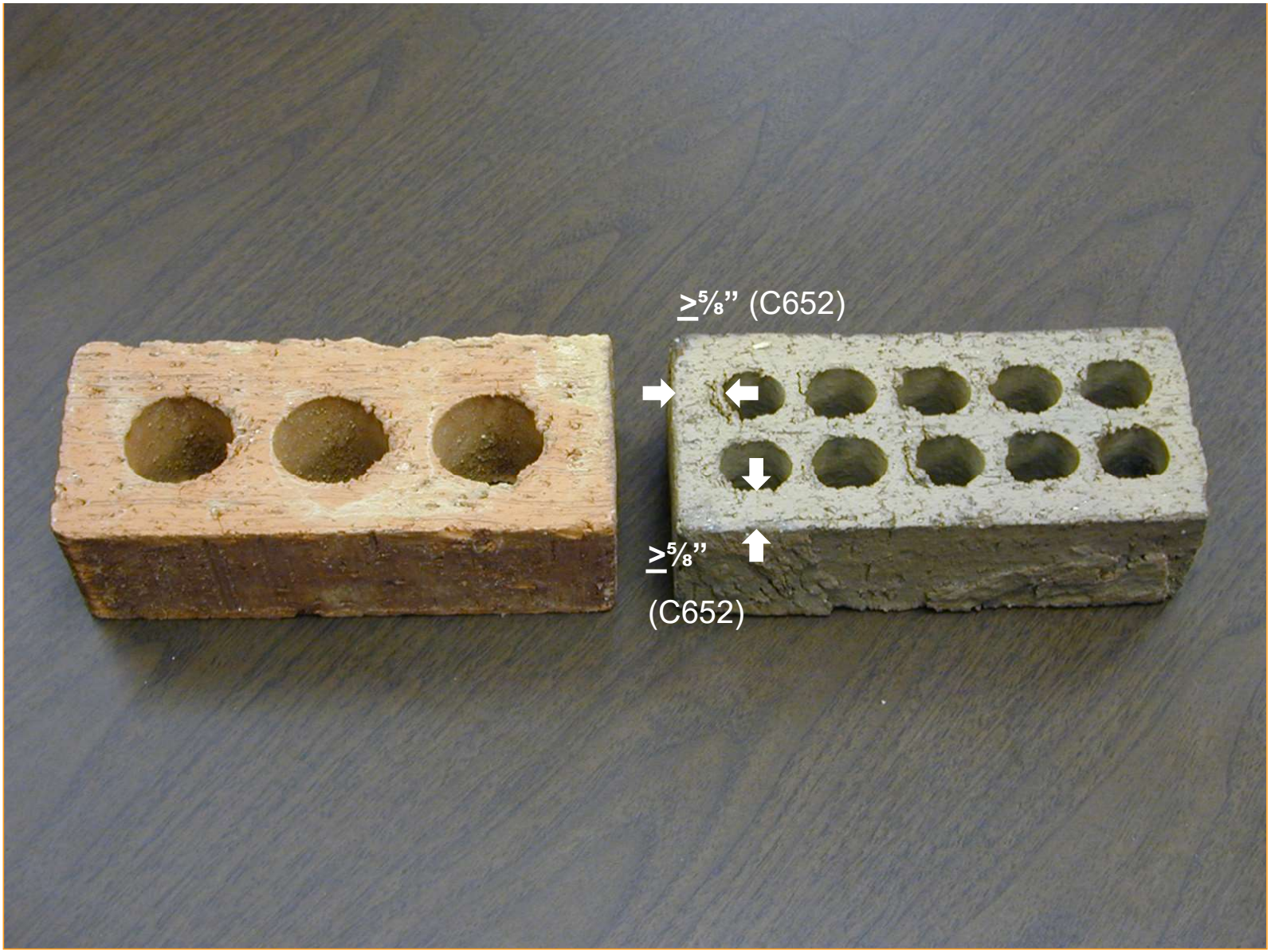
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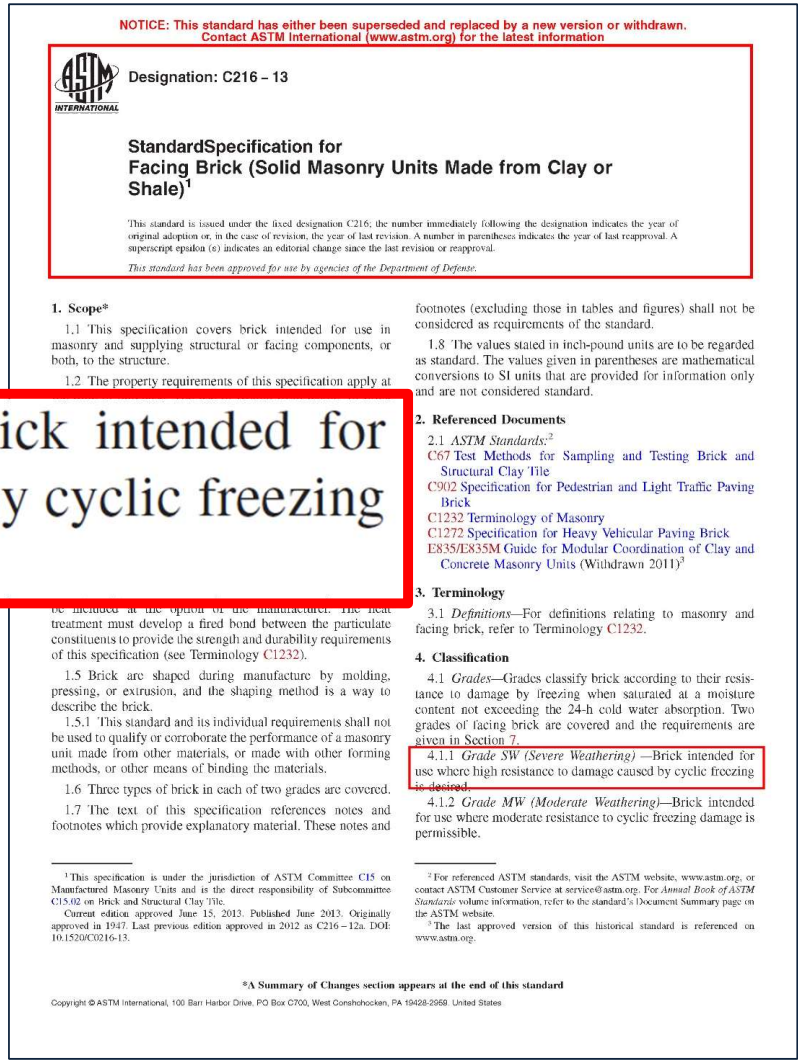
Page 1

4.1.1 *Grade SW (Severe Weathering)*—Brick intended for use where high resistance to damage caused by cyclic freezing is desired.



NOTICE: This standard has either been superseded and replaced by a new version or withdrawn.
Contact ASTM International (www.astm.org) for the latest information

Designation: C216 – 13

StandardSpecification for Facing Brick (Solid Masonry Units Made from Clay or Shale)[1]

This standard is issued under the fixed designation C216; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers brick intended for use in masonry and supplying structural or facing components, or both, to the structure.

1.2 The property requirements of this specification apply at

be included at the option of the manufacturer. The heat treatment must develop a fired bond between the particulate constituents to provide the strength and durability requirements of this specification (see Terminology C1232).

1.5 Brick are shaped during manufacture by molding, pressing, or extrusion, and the shaping method is a way to describe the brick.

1.5.1 This standard and its individual requirements shall not be used to qualify or corroborate the performance of a masonry unit made from other materials, or made with other forming methods, or other means of binding the materials.

1.6 Three types of brick in each of two grades are covered.

1.7 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C67 Test Methods for Sampling and Testing Brick and Structural Clay Tile

C902 Specification for Pedestrian and Light Traffic Paving Brick

C1232 Terminology of Masonry

C1272 Specification for Heavy Vehicular Paving Brick

E835/E835M Guide for Modular Coordination of Clay and Concrete Masonry Units (Withdrawn 2011)[3]

3. Terminology

3.1 *Definitions*—For definitions relating to masonry and facing brick, refer to Terminology C1232.

4. Classification

4.1 *Grades*—Grades classify brick according to their resistance to damage by freezing when saturated at a moisture content not exceeding the 24-h cold water absorption. Two grades of facing brick are covered and the requirements are given in Section 7.

4.1.1 *Grade SW (Severe Weathering)* —Brick intended for use where high resistance to damage caused by cyclic freezing is desired.

4.1.2 *Grade MW (Moderate Weathering)*—Brick intended for use where moderate resistance to cyclic freezing damage is permissible.

[1] This specification is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.02 on Brick and Structural Clay Tile.

Current edition approved June 15, 2013. Published June 2013. Originally approved in 1947. Last previous edition approved in 2012 as C216 – 12a. DOI: 10.1520/C0216-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

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4.2.1 *Type FBS*—Brick for general use in masonry.

TABLE 1 Physical Requirements

Designation	Minimum Compressive Strength psi, (MPa) gross area		Maximum Water Absorption by 5-h Boiling, %		Maximum Saturation Coefficient[A]	
	Average of 5 brick	Individual	Average of 5 brick	Individual	Average of 5 brick	Individual
Grade SW	3000 (20.7)	2500 (17.2)	17.0	20.0	0.78	0.80
Grade MW	2500 (17.2)	2200 (15.2)	22.0	25.0	0.88	0.90

[A] The saturation coefficient is the ratio of absorption by 24-h submersion in cold water to that after 5-h submersion in boiling water.

NOTE 1—Measurement of moisture content of brick in buildings indicates that, when the building is designed and constructed to reduce water penetration, the 24-h cold water absorption is unlikely to be exceeded.

4.2 *Types*—Three types of facing brick are covered:

4.2.1 *Type FBS*—Brick for general use in masonry.

4.2.2 *Type FBX*—Brick for general use in masonry where a higher degree of precision and lower permissible variation in size than permitted for Type FBS is required.

4.2.3 *Type FBA*—Brick for general use in masonry selected to produce characteristic architectural effects resulting from nonuniformity in size and texture of the individual units.

5.1.1 *Grade* (Section 4.1)—Grade SW governs when grade is not specified.

5.1.2 *Type* (Section 4.2)—Type FBS governs when type is not specified.

5.1.2.1 For Type FBA, specify chippage (10.1), tolerances (Section 9), or approve a designated sample.

5.1.3 Color, color range, and texture (10.4) by approving a sample.

5.1.3.1 Finish on more than one face and one end (10.5).

5.1.4 *Size* (9.1)—Specify width by height by length.

5.1.5 *Sampling* (12.2)—Person to select samples and place or places of selection of samples for testing.

5.2 Orders for facing brick under this specification may include the following information:

5.2.1 *Strength* (7.2)—Specify only if above minimum compressive strength in Table 1.

5.2.2 *Coring* (11.1)—At option of manufacturer if not specified.

5.2.3 *Frogging* (11.2)—Frog permitted in one bearing face if not specified.

5.2.4 *Costs of Tests* (Note 14)—Party who will pay and conditions for payment of compliance testing.

NOTE 2—Color, color range, and texture are best specified by identifying a particular manufacturer and unit designation. Nominal dimensions should not be used to specify size.

NOTE 3—See sections 7.3 and 8 for optional information.

6. Materials and Manufacture

6.1 Colors and textures produced by application of inorganic coatings to the faces of the brick shall be permitted with the consent of the purchaser, provided that evidence is furnished of the durability of the coatings. Brick that are colored by flashing or textured by sanding, where the sand does not form a continuous coating, shall not be considered as surface-colored brick for the purpose of this specification.

NOTE 4—When surface-colored brick, other than sanded or flashed, are specified for *exterior* use, the purchaser should require that data be submitted showing that after 50 cycles of freezing thawing there is no observable difference in the applied finish when viewed from a distance of 10 ft (3.0 m) under an illumination of not less than 50 fc (538 lx) by an observer with normal vision.

Service records of the performance of the particular coated brick in exterior locations may be accepted in place of the freezing and thawing test, upon consent of the purchaser.

6.2 The brick shall be free of defects, deficiencies, and surface treatments, including coatings, that would interfere with the proper laying of the brick or significantly impair the strength or performance of the construction.

6.3 If any post-firing coatings or surface treatments are applied by the manufacturer, the manufacturer shall report the type and extent of these coatings or surface treatments in all certificates of compliance with this specification.

7. Physical Properties

7.1 *Durability*—When grade is not specified, the requirements for Grade SW shall govern.

7.1.1 *Physical Property Requirements*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table 1. For the compressive strength requirements in Table 1, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

7.1.2 *Absorption Alternate*—The saturation coefficient requirement does not apply provided that the 24-h cold water absorption of each of the five units tested does not exceed 8.0 %.

7.1.3 *Freezing and Thawing Alternative*—The requirements for 5-h boiling water absorption and saturation coefficient do not apply, provided a representative sample of five brick, meeting the strength requirements of Table 1, passes the freezing and thawing test as described in the Rating Section of the Freezing and Thawing test procedures of Test Methods C67:

NOTE 5—The 50 cycle freezing and thawing test is used as an alternative only when the brick do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the requirements of the Absorption Alternate in 7.1.2.

7.1.3.1 *Grade SW: Breakage and Weight Loss Requirement*—No individual unit separates or disintegrates resulting in a weight loss greater than 0.5 % of its original dry weight.

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4.3 When the type is not specified, the requirements for Type FBS shall govern.

TABLE 1 Physical Requirements

Designation	Minimum Compressive Strength psi, (MPa) gross area		Maximum Water Absorption by 5-h Boiling, %		Maximum Saturation Coefficient[A]	
	Average of 5 brick	Individual	Average of 5 brick	Individual	Average of 5 brick	Individual
Grade SW	3000 (20.7)	2500 (17.2)	17.0	20.0	0.78	0.80
Grade MW	2500 (17.2)	2200 (15.2)	22.0	25.0	0.88	0.90

[A] The saturation coefficient is the ratio of absorption by 24-h submersion in cold water to that after 5-h submersion in boiling water.

NOTE 1—Measurement of moisture content of brick in buildings indicates that, when the building is designed and constructed to reduce water penetration, the 24-h cold water absorption is unlikely to be exceeded.

4.2 *Types*—Three types of facing brick are covered:

4.2.1 *Type FBS*—Brick for general use in masonry.

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4.2.3 *Type FBA*—Brick for general use in masonry selected to produce characteristic architectural effects resulting from nonuniformity in size and texture of the individual units.

4.3 When the type is not specified, the requirements for Type FBS shall govern.

sample.

5.1.3.1 Finish on more than one face and one end (10.5).

5.1.4 *Size* (9.1)—Specify width by height by length.

5.1.5 *Sampling* (12.2)—Person to select samples and place or places of selection of samples for testing.

5.2 Orders for facing brick under this specification may include the following information:

5.2.1 *Strength* (7.2)—Specify only if above minimum compressive strength in Table 1.

5.2.2 *Coring* (11.1)—At option of manufacturer if not specified.

5.2.3 *Frogging* (11.2)—Frog permitted in one bearing face if not specified.

5.2.4 *Costs of Tests* (Note 14)—Party who will pay and conditions for payment of compliance testing.

NOTE 2—Color, color range, and texture are best specified by identifying a particular manufacturer and unit designation. Nominal dimensions should not be used to specify size.

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Service records of the performance of the particular coated brick in exterior locations may be accepted in place of the freezing and thawing test, upon consent of the purchaser.

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6.3 If any post-firing coatings or surface treatments are applied by the manufacturer, the manufacturer shall report the type and extent of these coatings or surface treatments in all certificates of compliance with this specification.

7. Physical Properties

7.1 *Durability*—When grade is not specified, the requirements for Grade SW shall govern.

7.1.1 *Physical Property Requirements*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table 1. For the compressive strength requirements in Table 1, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

7.1.2 *Absorption Alternate*—The saturation coefficient requirement does not apply provided that the 24-h cold water absorption of each of the five units tested does not exceed 8.0 %.

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NOTE 5—The 50 cycle freezing and thawing test is used as an alternative only when the brick do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the requirements of the Absorption Alternate in 7.1.2.

7.1.3.1 *Grade SW: Breakage and Weight Loss Requirement*—No individual unit separates or disintegrates resulting in a weight loss greater than 0.5 % of its original dry weight.

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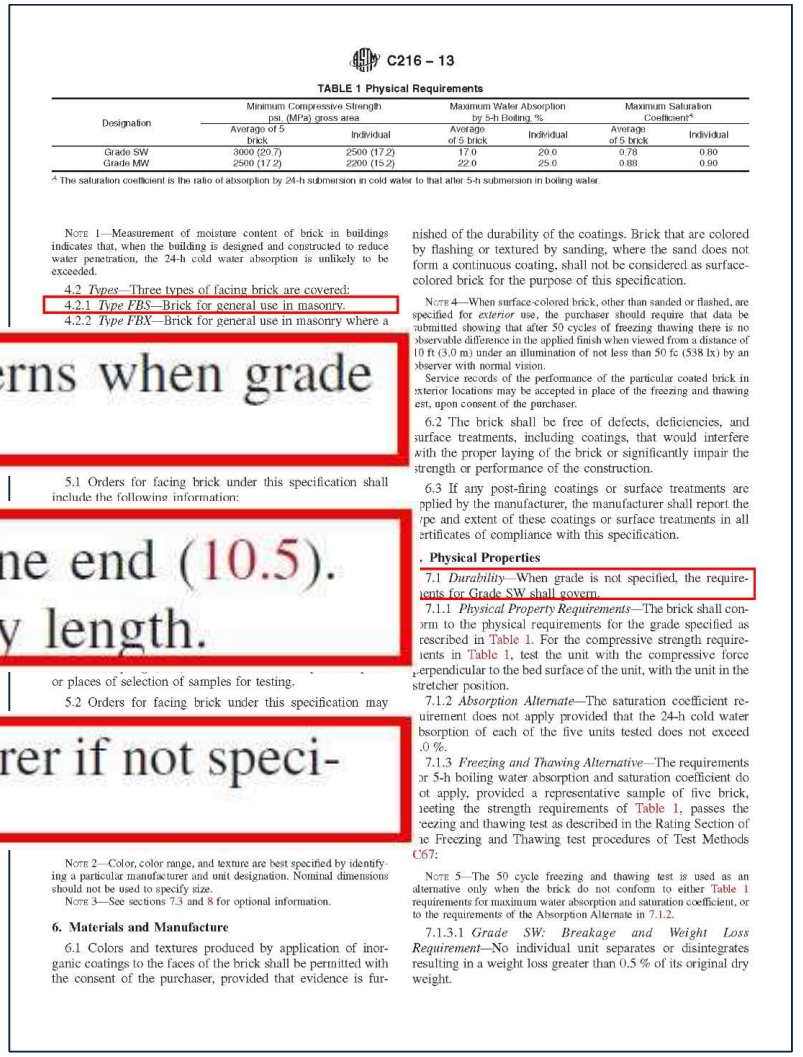
5.1.1 *Grade* (Section 4.1)—Grade SW governs when grade is not specified

5.1.3.1 Finish on more than one face and one end (10.5).

5.1.4 *Size* (9.1)—Specify width by height by length.

5.2.2 *Coring* (11.1)—At option of manufacturer if not specified



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[A] The saturation coefficient is the ratio of absorption by 24-h submersion in cold water to that after 5-h submersion in boiling water.

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4.2 *Types*—Three types of facing brick are covered:

4.2.1 *Type FBS*—Brick for general use in masonry.

4.2.2 *Type FBX*—Brick for general use in masonry where a

5.1 Orders for facing brick under this specification shall include the following information:

or places of selection of samples for testing.

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NOTE 2—Color, color range, and texture are best specified by identifying a particular manufacturer and unit designation. Nominal dimensions should not be used to specify size.

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NOTE 5—The 50 cycle freezing and thawing test is used as an alternative only when the brick do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the requirements of the Absorption Alternate in 7.1.2.

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4.2.3 *Type FBA*—Brick for general use in masonry selected

5.1.2 *Type* (Section 4.2)—Type FBS governs when type is not specified.

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5.1.3 Color, color range, and texture (10.4) by approving a sample.

5.1.3.1 Finish on more than one face and one end (10.5).

5.1.4 *Size* (9.1)—Specify width by height by length.

5.1.5 *Sampling* (12.2)—Person to select samples and place or places of selection of samples for testing.

5.2 Orders for facing brick under this specification may include the following information:

5.2.1 *Strength* (7.2)—Specify only if above minimum compressive strength in Table 1.

5.2.2 *Coring* (11.1)—At option of manufacturer if not specified.

5.2.3 *Frogging* (11.2)—Frog permitted in one bearing face if not specified.

5.2.4 *Costs of Tests* (Note 14)—Party who will pay and conditions for payment of compliance testing.

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NOTE 3—See sections 7.3 and 8 for optional information.

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6.1 Colors and textures produced by application of inorganic coatings to the faces of the brick shall be permitted with the consent of the purchaser, provided that evidence is furnished of the durability of the coatings. Brick that are colored by flashing or textured by sanding, where the sand does not form a continuous coating, shall not be considered as surface-colored brick for the purpose of this specification.

NOTE 4—When surface-colored brick, other than sanded or flashed, are specified for *exterior* use, the purchaser should require that data be submitted showing that after 50 cycles of freezing thawing there is no observable difference in the applied finish when viewed from a distance of 10 ft (3.0 m) under an illumination of not less than 50 fc (538 lx) by an observer with normal vision.

Service records of the performance of the particular coated brick in exterior locations may be accepted in place of the freezing and thawing test, upon consent of the purchaser.

6.2 The brick shall be free of defects, deficiencies, and surface treatments, including coatings, that would interfere with the proper laying of the brick or significantly impair the strength or performance of the construction.

6.3 If any post-firing coatings or surface treatments are applied by the manufacturer, the manufacturer shall report the type and extent of these coatings or surface treatments in all certificates of compliance with this specification.

7. Physical Properties

7.1 *Durability*—When grade is not specified, the requirements for Grade SW shall govern.

7.1.1 *Physical Property Requirements*—The brick shall conform to the physical requirements for the grade specified as prescribed in Table 1. For the compressive strength requirements in Table 1, test the unit with the compressive force perpendicular to the bed surface of the unit, with the unit in the stretcher position.

7.1.2 *Absorption Alternate*—The saturation coefficient requirement does not apply provided that the 24-h cold water absorption of each of the five units tested does not exceed 8.0 %.

7.1.3 *Freezing and Thawing Alternative*—The requirements for 5-h boiling water absorption and saturation coefficient do not apply, provided a representative sample of five brick, meeting the strength requirements of Table 1, passes the freezing and thawing test as described in the Rating Section of the Freezing and Thawing test procedures of Test Methods C67:

NOTE 5—The 50 cycle freezing and thawing test is used as an alternative only when the brick do not conform to either Table 1 requirements for maximum water absorption and saturation coefficient, or to the requirements of the Absorption Alternate in 7.1.2.

7.1.3.1 *Grade SW: Breakage and Weight Loss Requirement*—No individual unit separates or disintegrates resulting in a weight loss greater than 0.5 % of its original dry weight.

SPECIFYING BRICK

	Solid ASTM C216	Hollow ASTM C652
Durability (Grade)	MW	MW
	SW	SW
Appearance (Type)	FBA	HBA
	FBS	HBS/HBB
	FBX	HBX
Class		HV40
		HV60

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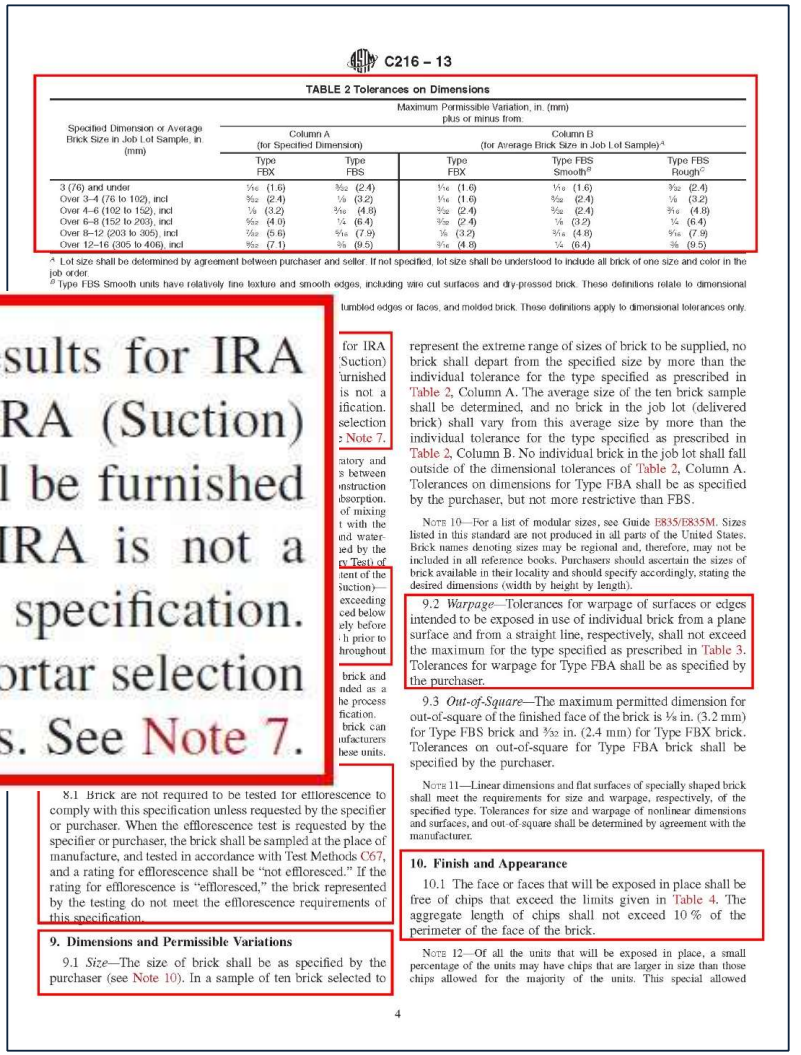

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TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Column A (for Specified Dimension) Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBS Smooth[B]	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)	3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
Over 8–12 (203 to 305), incl	7/32 (5.6)	5/16 (7.9)	1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

[A] Lot size shall be determined by agreement between purchaser and seller. If not specified, lot size shall be understood to include all brick of one size and color in the job order.

[B] Type FBS Smooth units have relatively fine texture and smooth edges, including wire cut surfaces and dry-pressed brick. These definitions relate to dimensional

tumbled edges or faces, and molded brick. These definitions apply to dimensional tolerances only.

7.3 *Initial Rate of Absorption (IRA)*—Test results for IRA shall be determined in accordance with the IRA (Suction) (Laboratory Test) of Test Methods C67 and shall be furnished at the request of the specifier or purchaser. IRA is not a qualifying condition or property of units in this specification. This property is measured in order to assist in mortar selection and material handling in the construction process. See Note 7.

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8.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be "not effloresced." If the rating for efflorescence is "effloresced," the brick represented by the testing do not meet the efflorescence requirements of this specification.

9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to represent the extreme range of sizes of brick to be supplied, no brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table 2, Column A. The average size of the ten brick sample shall be determined, and no brick in the job lot (delivered brick) shall vary from this average size by more than the individual tolerance for the type specified as prescribed in Table 2, Column B. No individual brick in the job lot shall fall outside of the dimensional tolerances of Table 2, Column A. Tolerances on dimensions for Type FBA shall be as specified by the purchaser, but not more restrictive than FBS.

NOTE 10—For a list of modular sizes, see Guide E835/E835M. Sizes listed in this standard are not produced in all parts of the United States. Brick names denoting sizes may be regional and, therefore, may not be included in all reference books. Purchasers should ascertain the sizes of brick available in their locality and should specify accordingly, stating the desired dimensions (width by height by length).

9.2 *Warpage*—Tolerances for warpage of surfaces or edges intended to be exposed in use of individual brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table 3. Tolerances for warpage for Type FBA shall be as specified by the purchaser.

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the finished face of the brick is 1/8 in. (3.2 mm) for Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 11—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 12—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed

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8. Efflorescence

8.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be "not effloresced." If the rating for efflorescence is "effloresced," the brick represented by the testing do not meet the efflorescence requirements of this specification.

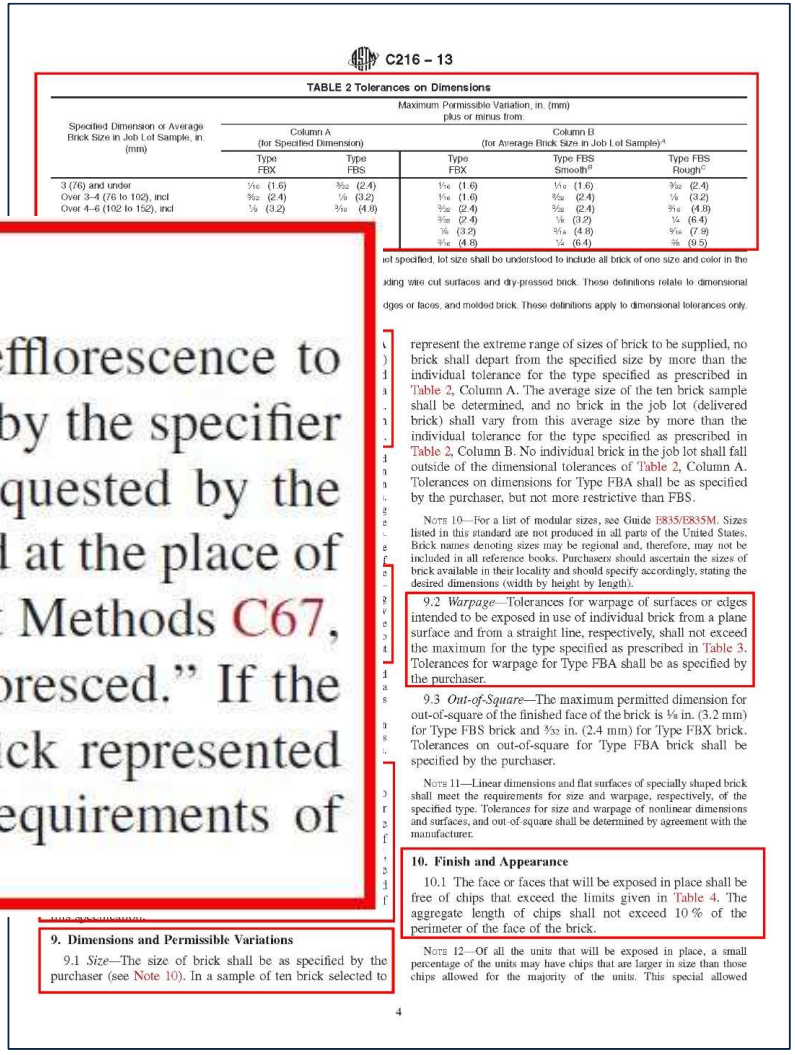

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TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Type FBS Smooth[B]	Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
			3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
			1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
			3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

lot specified, lot size shall be understood to include all brick of one size and color in the

ding wire cut surfaces and dry-pressed brick. These definitions relate to dimensional

dges or faces, and molded brick. These definitions apply to dimensional tolerances only.

represent the extreme range of sizes of brick to be supplied, no brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table 2, Column A. The average size of the ten brick sample shall be determined, and no brick in the job lot (delivered brick) shall vary from this average size by more than the individual tolerance for the type specified as prescribed in Table 2, Column B. No individual brick in the job lot shall fall outside of the dimensional tolerances of Table 2, Column A. Tolerances on dimensions for Type FBA shall be as specified by the purchaser, but not more restrictive than FBS.

NOTE 10—For a list of modular sizes, see Guide E835/E835M. Sizes listed in this standard are not produced in all parts of the United States. Brick names denoting sizes may be regional and, therefore, may not be included in all reference books. Purchasers should ascertain the sizes of brick available in their locality and should specify accordingly, stating the desired dimensions (width by height by length).

9.2 *Warpage*—Tolerances for warpage of surfaces or edges intended to be exposed in use of individual brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table 3. Tolerances for warpage for Type FBA shall be as specified by the purchaser.

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the finished face of the brick is 1/8 in. (3.2 mm) for Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 11—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 12—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed

9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to

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10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

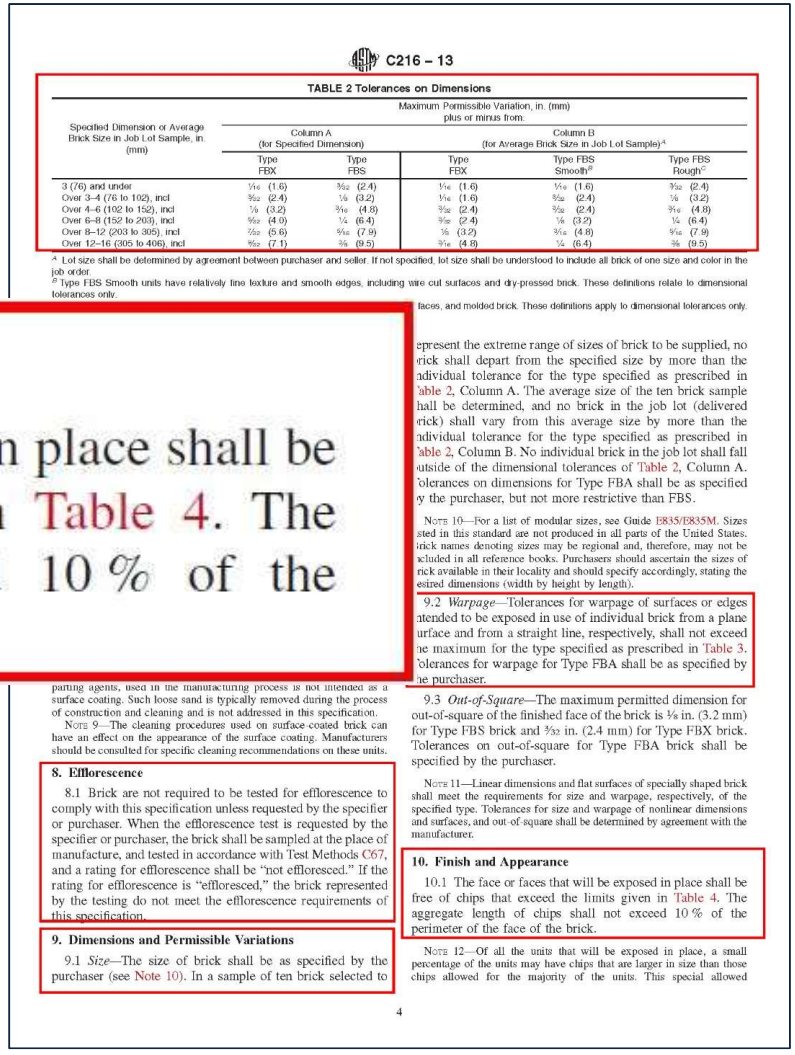

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TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Column A Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Column B Type FBS Smooth[B]	Column B Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)	3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
Over 8–12 (203 to 305), incl	7/32 (5.6)	5/16 (7.9)	1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

[A] Lot size shall be determined by agreement between purchaser and seller. If not specified, lot size shall be understood to include all brick of one size and color in the job order.

[B] Type FBS Smooth units have relatively fine texture and smooth edges, including wire cut surfaces and dry-pressed brick. These definitions relate to dimensional tolerances only.

faces, and molded brick. These definitions apply to dimensional tolerances only.

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NOTE 10—For a list of modular sizes, see Guide E835/E835M. Sizes sted in this standard are not produced in all parts of the United States. rick names denoting sizes may be regional and, therefore, may not be ncluded in all reference books. Purchasers should ascertain the sizes of rick available in their locality and should specify accordingly, stating the esired dimensions (width by height by length).

9.2 *Warpage*—Tolerances for warpage of surfaces or edges ntended to be exposed in use of individual brick from a plane urface and from a straight line, respectively, shall not exceed he maximum for the type specified as prescribed in Table 3. olerances for warpage for Type FBA shall be as specified by he purchaser.

parting agents, used in the manufacturing process is not intended as a surface coating. Such loose sand is typically removed during the process of construction and cleaning and is not addressed in this specification.

NOTE 9—The cleaning procedures used on surface coated brick can have an effect on the appearance of the surface coating. Manufacturers should be consulted for specific cleaning recommendations on these units.

8. Efflorescence

8.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be "not effloresced." If the rating for efflorescence is "effloresced," the brick represented by the testing do not meet the efflorescence requirements of this specification.

9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the finished face of the brick is 1/8 in. (3.2 mm) for Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 11—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 12—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed

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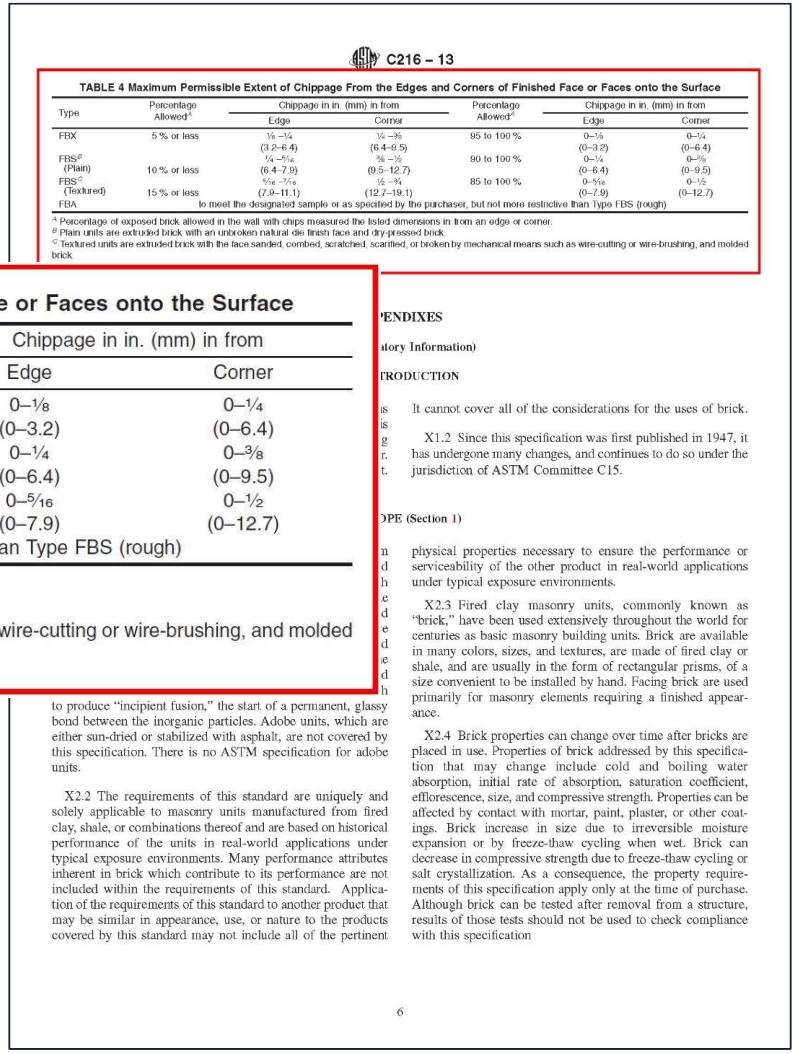

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TABLE 4 Maximum Permissible Extent of Chippage From the Edges and Corners of Finished Face or Faces onto the Surface

Type	Percentage Allowed[A]	Chippage in in. (mm) in from Edge	Chippage in in. (mm) in from Corner	Percentage Allowed[A]	Chippage in in. (mm) in from Edge	Chippage in in. (mm) in from Corner
FBX	5 % or less	⅛ –¼ (3.2–6.4)	¼ –⅜ (6.4–9.5)	95 to 100 %	0–⅛ (0–3.2)	0–¼ (0–6.4)
FBS[B] (Plain)	10 % or less	¼ –5⁄16 (6.4–7.9)	⅜ –½ (9.5–12.7)	90 to 100 %	0–¼ (0–6.4)	0–⅜ (0–9.5)
FBS[C] (Textured)	15 % or less	5⁄16 –7⁄16 (7.9–11.1)	½ –¾ (12.7–19.1)	85 to 100 %	0–5⁄16 (0–7.9)	0–½ (0–12.7)
FBA	to meet the designated sample or as specified by the purchaser, but not more restrictive than Type FBS (rough)					

[A] Percentage of exposed brick allowed in the wall with chips measured the listed dimensions in from an edge or corner.
[B] Plain units are extruded brick with an unbroken natural die finish face and dry-pressed brick.
[C] Textured units are extruded brick with the face sanded, combed, scratched, scarified, or broken by mechanical means such as wire-cutting or wire-brushing, and molded brick.

'ENDIXES

atory Information)

TRODUCTION

is It cannot cover all of the considerations for the uses of brick.
is
g X1.2 Since this specification was first published in 1947, it
r. has undergone many changes, and continues to do so under the
t. jurisdiction of ASTM Committee C15.

OPE (Section 1)

n physical properties necessary to ensure the performance or
d serviceability of the other product in real-world applications
h under typical exposure environments.
e
d X2.3 Fired clay masonry units, commonly known as
e "brick," have been used extensively throughout the world for
d centuries as basic masonry building units. Brick are available
e in many colors, sizes, and textures, are made of fired clay or
d shale, and are usually in the form of rectangular prisms, of a
h size convenient to be installed by hand. Facing brick are used primarily for masonry elements requiring a finished appearance.

to produce "incipient fusion," the start of a permanent, glassy bond between the inorganic particles. Adobe units, which are either sun-dried or stabilized with asphalt, are not covered by this specification. There is no ASTM specification for adobe units.

X2.2 The requirements of this standard are uniquely and solely applicable to masonry units manufactured from fired clay, shale, or combinations thereof and are based on historical performance of the units in real-world applications under typical exposure environments. Many performance attributes inherent in brick which contribute to its performance are not included within the requirements of this standard. Application of the requirements of this standard to another product that may be similar in appearance, use, or nature to the products covered by this standard may not include all of the pertinent

X2.4 Brick properties can change over time after bricks are placed in use. Properties of brick addressed by this specification that may change include cold and boiling water absorption, initial rate of absorption, saturation coefficient, efflorescence, size, and compressive strength. Properties can be affected by contact with mortar, paint, plaster, or other coatings. Brick increase in size due to irreversible moisture expansion or by freeze-thaw cycling when wet. Brick can decrease in compressive strength due to freeze-thaw cycling or salt crystallization. As a consequence, the property requirements of this specification apply only at the time of purchase. Although brick can be tested after removal from a structure, results of those tests should not be used to check compliance with this specification

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TABLE 4 Maximum Permissible Extent of Chippage From the Edges and Corners of Finished Face or Faces onto the Surface

Type	Percentage Allowed[A]	Chippage in in. (mm) in from Edge	Chippage in in. (mm) in from Corner	Percentage Allowed[A]	Chippage in in. (mm) in from Edge	Chippage in in. (mm) in from Corner
FBX	5 % or less	⅛ –¼ (3.2–6.4)	¼ –⅜ (6.4–9.5)	95 to 100 %	0–⅛ (0–3.2)	0–¼ (0–6.4)
FBS[B] (Plain)	10 % or less	¼ –5⁄16 (6.4–7.9)	⅜ –½ (9.5–12.7)	90 to 100 %	0–¼ (0–6.4)	0–⅜ (0–9.5)
FBS[C] (Textured)	15 % or less	5⁄16 –7⁄16 (7.9–11.1)	½ –¾ (12.7–19.1)	85 to 100 %	0–5⁄16 (0–7.9)	0–½ (0–12.7)
FBA	to meet the designated sample or as specified by the purchaser, but not more restrictive than Type FBS (rough)					

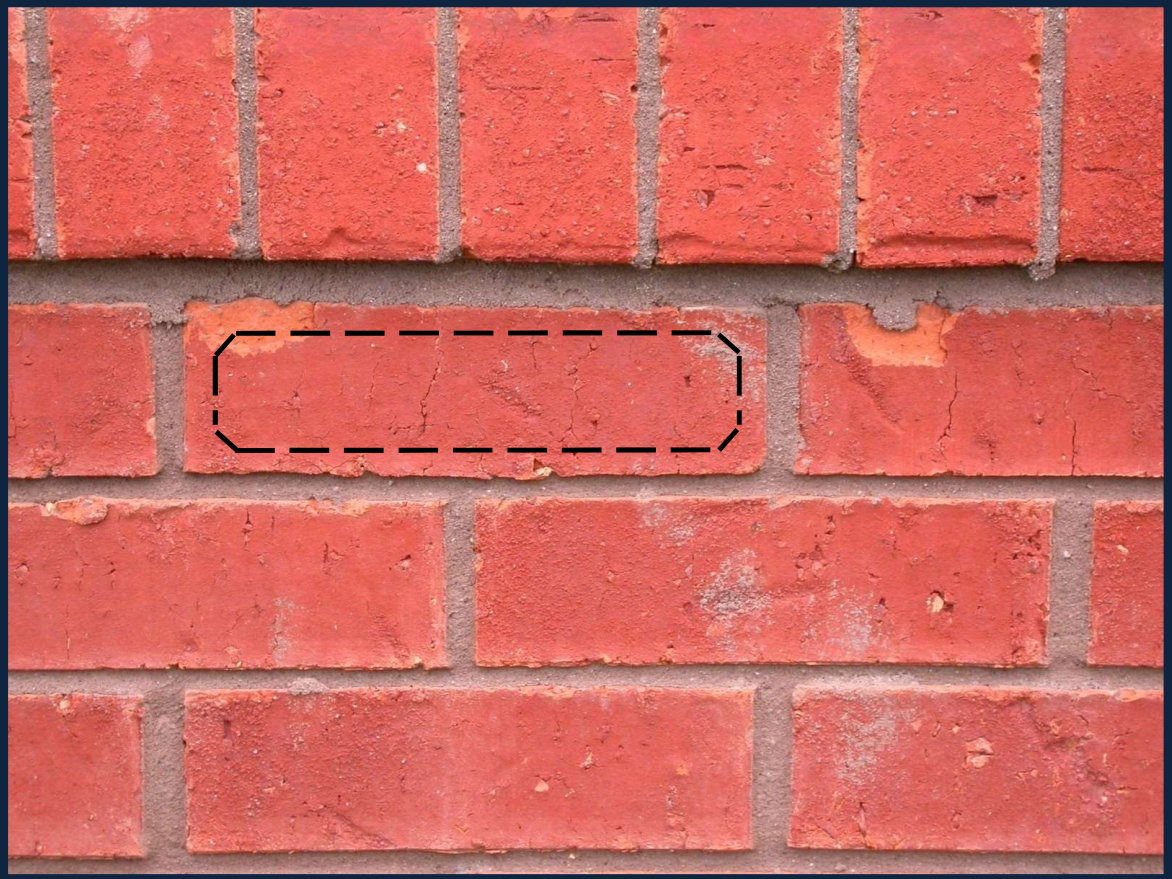
[A] Percentage of exposed brick allowed in the wall with chips measured the listed dimensions in from an edge or corner.
[B] Plain units are extruded brick with an unbroken natural die finish face and dry-pressed brick.
[C] Textured units are extruded brick with the face sanded, combed, scratched, scarified, or broken by mechanical means such as wire-cutting or wire-brushing, and molded brick.

TOLERANCES FOR CHIPS

FBX	<5%	95-100%
FBS (smooth)	<10%	90-100%
FBS (rough)	<15%	85-100%

Aggregate length of chips shall not exceed 10% of the perimeter of the face brick.
(C216 – 8.4)

TOLERANCES FOR CHIPS



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10.1.1 Other than chips, the face or faces shall be free of cracks or other imperfections detracting from the appearance of the designated sample when viewed under diffused lighting from a distance of 15 ft (4.6 m) for Type FBX and a distance of 20 ft (6.1 m) for Types FBS and FBA.

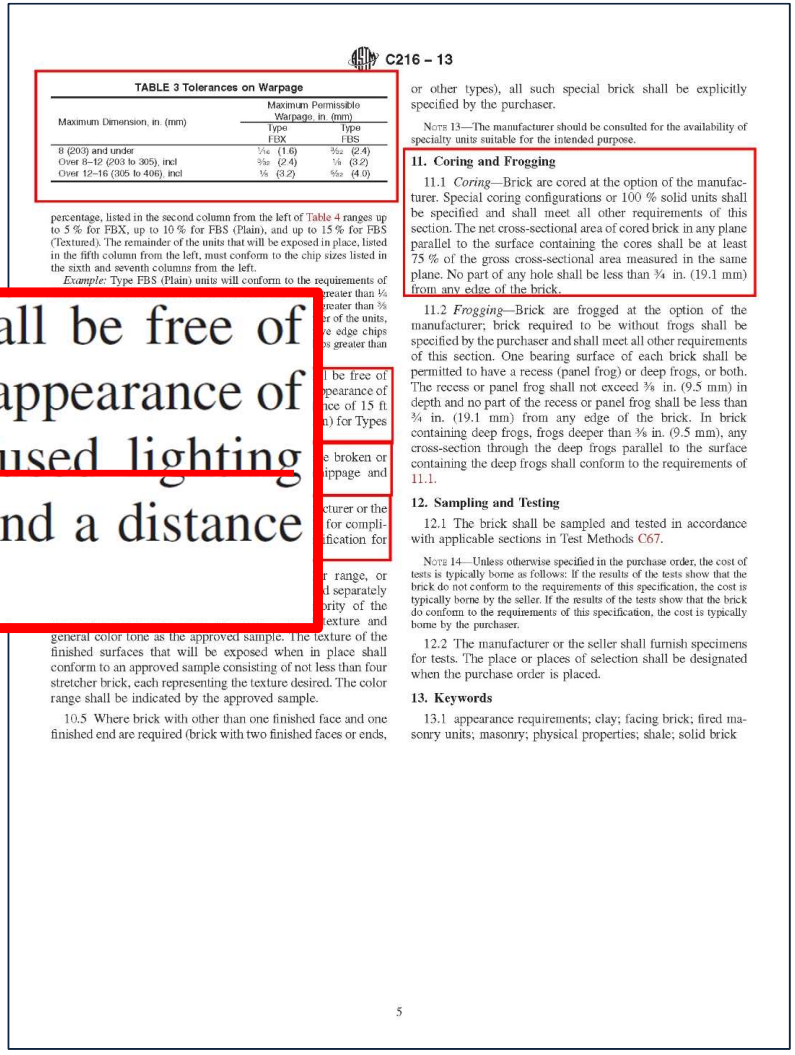

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TABLE 3 Tolerances on Warpage

Maximum Dimension, in. (mm)	Maximum Permissible Warpage, in. (mm)	
	Type FBX	Type FBS
8 (203) and under	1/16 (1.6)	3/32 (2.4)
Over 8–12 (203 to 305), incl	3/32 (2.4)	1/8 (3.2)
Over 12–16 (305 to 406), incl	1/8 (3.2)	5/32 (4.0)

percentage, listed in the second column from the left of Table 4 ranges up to 5 % for FBX, up to 10 % for FBS (Plain), and up to 15 % for FBS (Textured). The remainder of the units that will be exposed in place, listed in the fifth column from the left, must conform to the chip sizes listed in the sixth and seventh columns from the left.

Example: Type FBS (Plain) units will conform to the requirements of

general color tone as the approved sample. The texture of the finished surfaces that will be exposed when in place shall conform to an approved sample consisting of not less than four stretcher brick, each representing the texture desired. The color range shall be indicated by the approved sample.

10.5 Where brick with other than one finished face and one finished end are required (brick with two finished faces or ends, or other types), all such special brick shall be explicitly specified by the purchaser.

NOTE 13—The manufacturer should be consulted for the availability of specialty units suitable for the intended purpose.

11. Coring and Frogging

11.1 *Coring*—Brick are cored at the option of the manufacturer. Special coring configurations or 100 % solid units shall be specified and shall meet all other requirements of this section. The net cross-sectional area of cored brick in any plane parallel to the surface containing the cores shall be at least 75 % of the gross cross-sectional area measured in the same plane. No part of any hole shall be less than ¾ in. (19.1 mm) from any edge of the brick.

11.2 *Frogging*—Brick are frogged at the option of the manufacturer; brick required to be without frogs shall be specified by the purchaser and shall meet all other requirements of this section. One bearing surface of each brick shall be permitted to have a recess (panel frog) or deep frogs, or both. The recess or panel frog shall not exceed ⅜ in. (9.5 mm) in depth and no part of the recess or panel frog shall be less than ¾ in. (19.1 mm) from any edge of the brick. In brick containing deep frogs, frogs deeper than ⅜ in. (9.5 mm), any cross-section through the deep frogs parallel to the surface containing the deep frogs shall conform to the requirements of 11.1.

12. Sampling and Testing

12.1 The brick shall be sampled and tested in accordance with applicable sections in Test Methods C67.

NOTE 14—Unless otherwise specified in the purchase order, the cost of tests is typically borne as follows: If the results of the tests show that the brick do not conform to the requirements of this specification, the cost is typically borne by the seller. If the results of the tests show that the brick do conform to the requirements of this specification, the cost is typically borne by the purchaser.

12.2 The manufacturer or the seller shall furnish specimens for tests. The place or places of selection shall be designated when the purchase order is placed.

13. Keywords

13.1 appearance requirements; clay; facing brick; fired masonry units; masonry; physical properties; shale; solid brick

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As a guideline, probably not visible at 20 feet

- credit card ~ 0.030 inches thick
- business card ~ 0.010 to 0.015 inches thick

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10.3 After brick are placed in usage, the manufacturer or the manufacturer's agent shall not be held responsible for compliance of brick with the requirements of this specification for chippage and tolerances.

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TABLE 3 Tolerances on Warpage

Maximum Dimension, in. (mm)	Maximum Permissible Warpage, in. (mm)	
	Type FBX	Type FBS
8 (203) and under	1/16 (1.6)	3/32 (2.4)
Over 8–12 (203 to 305), incl	3/32 (2.4)	1/8 (3.2)
Over 12–16 (305 to 406), incl	1/8 (3.2)	5/32 (4.0)

percentage, listed in the second column from the left of Table 4 ranges up to 5 % for FBX, up to 10 % for FBS (Plain), and up to 15 % for FBS (Textured). The remainder of the units that will be exposed in place, listed in the fifth column from the left, must conform to the chip sizes listed in the sixth and seventh columns from the left.

Example: Type FBS (Plain) units will conform to the requirements of Table 4 if not more than 10 % of the units have edge chips greater than ¼ in. (6.4 mm) but less than 5/16 in. (7.9 mm) or corner chips greater than 3/8 in. (9.5 mm) but less than ½ in. (12.7 mm) and the remainder of the units,

individual brick shall have the same general texture and general color tone as the approved sample. The texture of the finished surfaces that will be exposed when in place shall conform to an approved sample consisting of not less than four stretcher brick, each representing the texture desired. The color range shall be indicated by the approved sample.

10.5 Where brick with other than one finished face and one finished end are required (brick with two finished faces or ends, or other types), all such special brick shall be explicitly specified by the purchaser.

NOTE 13—The manufacturer should be consulted for the availability of specialty units suitable for the intended purpose.

11. Coring and Frogging

11.1 *Coring*—Brick are cored at the option of the manufacturer. Special coring configurations or 100 % solid units shall be specified and shall meet all other requirements of this section. The net cross-sectional area of cored brick in any plane parallel to the surface containing the cores shall be at least 75 % of the gross cross-sectional area measured in the same plane. No part of any hole shall be less than ¾ in. (19.1 mm) from any edge of the brick.

11.2 *Frogging*—Brick are frogged at the option of the manufacturer; brick required to be without frogs shall be specified by the purchaser and shall meet all other requirements of this section. One bearing surface of each brick shall be permitted to have a recess (panel frog) or deep frogs, or both. The recess or panel frog shall not exceed 3/8 in. (9.5 mm) in depth and no part of the recess or panel frog shall be less than ¾ in. (19.1 mm) from any edge of the brick. In brick containing deep frogs, frogs deeper than 3/8 in. (9.5 mm), any cross section through the deep frogs parallel to the surface containing the deep frogs shall conform to the requirements of

ampling and Testing

1 The brick shall be sampled and tested in accordance applicable sections in Test Methods C67.

E 14—Unless otherwise specified in the purchase order, the cost of typically borne as follows: If the results of the tests show that the do not conform to the requirements of this specification, the cost is ly borne by the seller. If the results of the tests show that the brick form to the requirements of this specification, the cost is typically borne by the purchaser.

12.2 The manufacturer or the seller shall furnish specimens for tests. The place or places of selection shall be designated when the purchase order is placed.

13. Keywords

13.1 appearance requirements; clay; facing brick; fired masonry units; masonry; physical properties; shale; solid brick

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9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to

5.1.3.1 Finish on more than one face and one end (10.5).
5.1.4 *Size* (9.1)—Specify width by height by length.

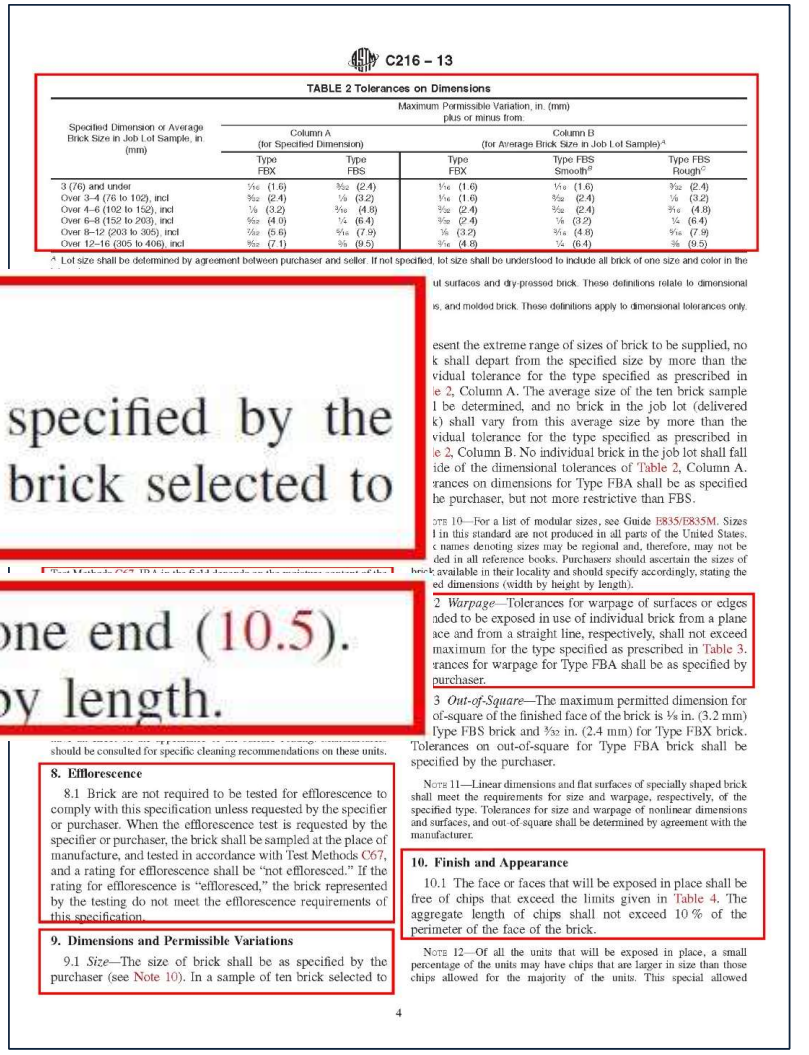

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TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Column A Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Type FBS Smooth[B]	Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)	3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
Over 8–12 (203 to 305), incl	1/32 (5.6)	5/16 (7.9)	1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

[A] Lot size shall be determined by agreement between purchaser and seller. If not specified, lot size shall be understood to include all brick of one size and color in the

ut surfaces and dry-pressed brick. These definitions relate to dimensional

s, and molded brick. These definitions apply to dimensional tolerances only.

esent the extreme range of sizes of brick to be supplied, no k shall depart from the specified size by more than the vidual tolerance for the type specified as prescribed in le 2, Column A. The average size of the ten brick sample l be determined, and no brick in the job lot (delivered k) shall vary from this average size by more than the vidual tolerance for the type specified as prescribed in le 2, Column B. No individual brick in the job lot shall fall ide of the dimensional tolerances of Table 2, Column A. rances on dimensions for Type FBA shall be as specified he purchaser, but not more restrictive than FBS.

OTE 10—For a list of modular sizes, see Guide E835/E835M. Sizes l in this standard are not produced in all parts of the United States. c names denoting sizes may be regional and, therefore, may not be ded in all reference books. Purchasers should ascertain the sizes of brick available in their locality and should specify accordingly, stating the ed dimensions (width by height by length).

2 *Warpage*—Tolerances for warpage of surfaces or edges nded to be exposed in use of individual brick from a plane ace and from a straight line, respectively, shall not exceed maximum for the type specified as prescribed in Table 3. rances for warpage for Type FBA shall be as specified by purchaser.

3 *Out-of-Square*—The maximum permitted dimension for of-square of the finished face of the brick is 1/8 in. (3.2 mm) Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 11—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

should be consulted for specific cleaning recommendations on these units.

8. Efflorescence

8.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be "not effloresced." If the rating for efflorescence is "effloresced," the brick represented by the testing do not meet the efflorescence requirements of this specification.

9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to

10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 12—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed

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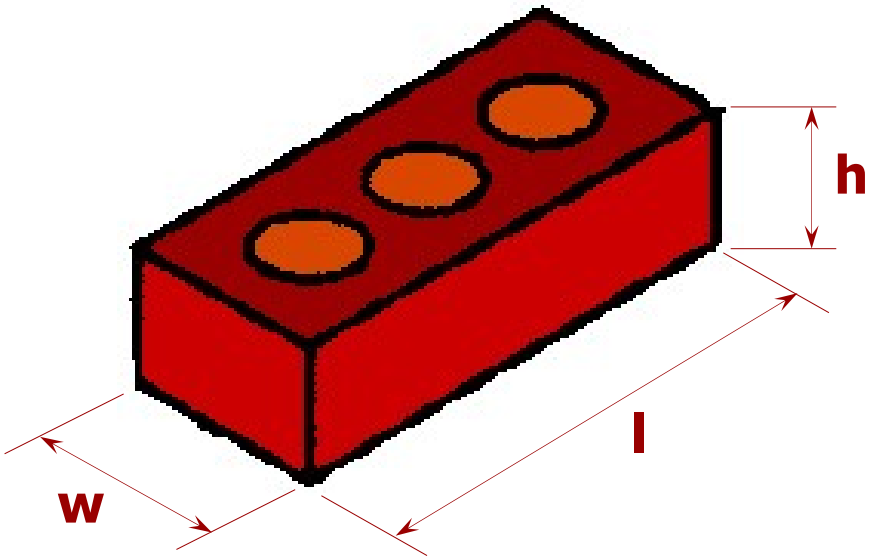
Specifying Brick Dimensions (ASTM C216 - 5.1.4)



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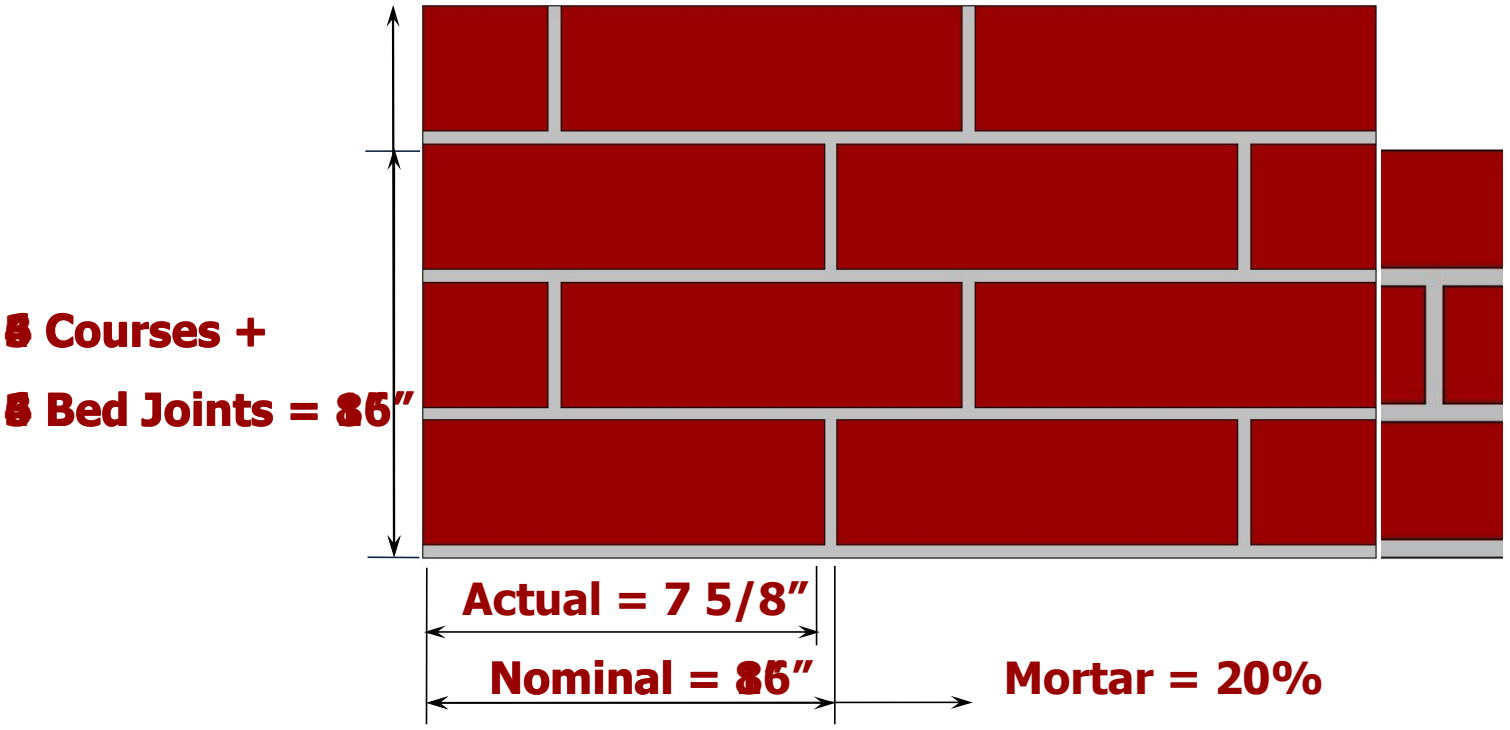
NOMINAL VS. ACTUAL



Modular Units - (Utility Size)

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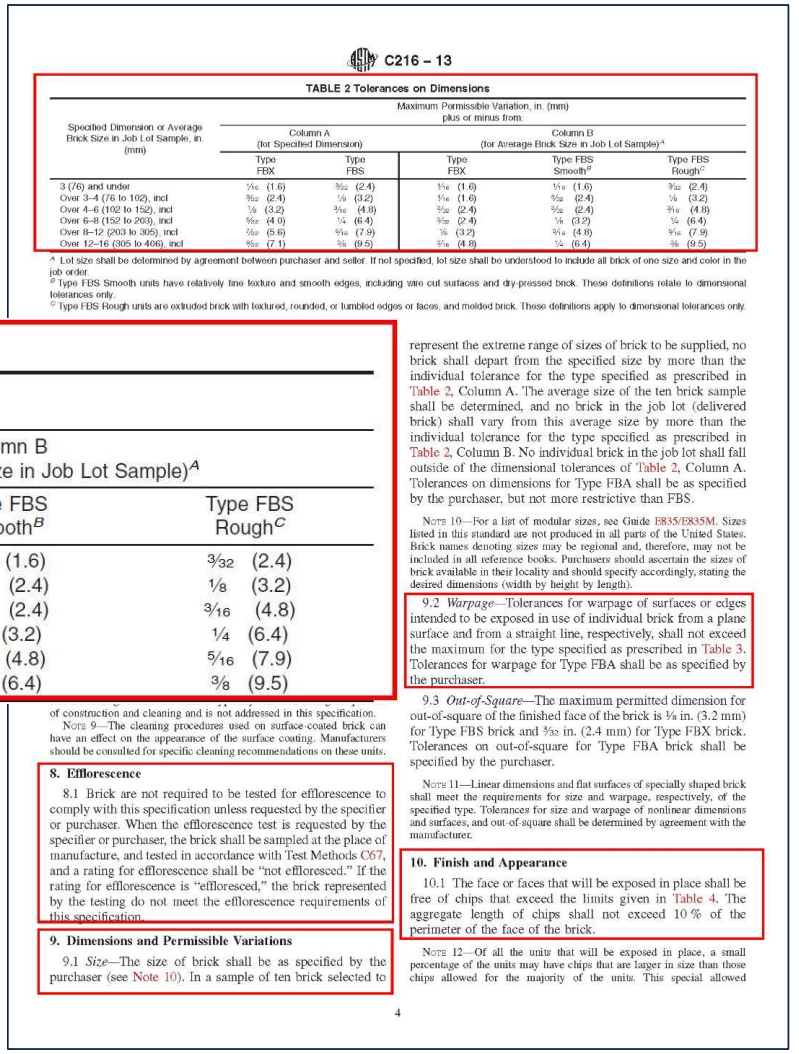

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TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Column A Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Type FBS Smooth[B]	Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)	3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
Over 8–12 (203 to 305), incl	7/32 (5.6)	5/16 (7.9)	1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

[A] Lot size shall be determined by agreement between purchaser and seller. If not specified, lot size shall be understood to include all brick of one size and color in the job order.
[B] Type FBS Smooth units have relatively fine texture and smooth edges, including wire cut surfaces and dry-pressed brick. These definitions relate to dimensional tolerances only.
[C] Type FBS Rough units are extruded brick with textured, rounded, or tumbled edges or faces, and molded brick. These definitions apply to dimensional tolerances only.

TABLE 2 Tolerances on Dimensions

Specified Dimension or Average Brick Size in Job Lot Sample, in. (mm)	Maximum Permissible Variation, in. (mm) plus or minus from: Column A (for Specified Dimension) Type FBX	Column A Type FBS	Column B (for Average Brick Size in Job Lot Sample)[A] Type FBX	Type FBS Smooth[B]	Type FBS Rough[C]
3 (76) and under	1/16 (1.6)	3/32 (2.4)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)
Over 3–4 (76 to 102), incl	3/32 (2.4)	1/8 (3.2)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)
Over 4–6 (102 to 152), incl	1/8 (3.2)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)	3/16 (4.8)
Over 6–8 (152 to 203), incl	5/32 (4.0)	1/4 (6.4)	3/32 (2.4)	1/8 (3.2)	1/4 (6.4)
Over 8–12 (203 to 305), incl	7/32 (5.6)	5/16 (7.9)	1/8 (3.2)	3/16 (4.8)	5/16 (7.9)
Over 12–16 (305 to 406), incl	9/32 (7.1)	3/8 (9.5)	3/16 (4.8)	1/4 (6.4)	3/8 (9.5)

represent the extreme range of sizes of brick to be supplied, no brick shall depart from the specified size by more than the individual tolerance for the type specified as prescribed in Table 2, Column A. The average size of the ten brick sample shall be determined, and no brick in the job lot (delivered brick) shall vary from this average size by more than the individual tolerance for the type specified as prescribed in Table 2, Column B. No individual brick in the job lot shall fall outside of the dimensional tolerances of Table 2, Column A. Tolerances on dimensions for Type FBA shall be as specified by the purchaser, but not more restrictive than FBS.

NOTE 10—For a list of modular sizes, see Guide E835/E835M. Sizes listed in this standard are not produced in all parts of the United States. Brick names denoting sizes may be regional and, therefore, may not be included in all reference books. Purchasers should ascertain the sizes of brick available in their locality and should specify accordingly, stating the desired dimensions (width by height by length).

9.2 *Warpage*—Tolerances for warpage of surfaces or edges intended to be exposed in use of individual brick from a plane surface and from a straight line, respectively, shall not exceed the maximum for the type specified as prescribed in Table 3. Tolerances for warpage for Type FBA shall be as specified by the purchaser.

9.3 *Out-of-Square*—The maximum permitted dimension for out-of-square of the finished face of the brick is 1/8 in. (3.2 mm) for Type FBS brick and 3/32 in. (2.4 mm) for Type FBX brick. Tolerances on out-of-square for Type FBA brick shall be specified by the purchaser.

NOTE 11—Linear dimensions and flat surfaces of specially shaped brick shall meet the requirements for size and warpage, respectively, of the specified type. Tolerances for size and warpage of nonlinear dimensions and surfaces, and out-of-square shall be determined by agreement with the manufacturer.

10. Finish and Appearance

10.1 The face or faces that will be exposed in place shall be free of chips that exceed the limits given in Table 4. The aggregate length of chips shall not exceed 10 % of the perimeter of the face of the brick.

NOTE 12—Of all the units that will be exposed in place, a small percentage of the units may have chips that are larger in size than those chips allowed for the majority of the units. This special allowed

of construction and cleaning and is not addressed in this specification.

NOTE 9—The cleaning procedures used on surface-coated brick can have an effect on the appearance of the surface coating. Manufacturers should be consulted for specific cleaning recommendations on these units.

8. Efflorescence

8.1 Brick are not required to be tested for efflorescence to comply with this specification unless requested by the specifier or purchaser. When the efflorescence test is requested by the specifier or purchaser, the brick shall be sampled at the place of manufacture, and tested in accordance with Test Methods C67, and a rating for efflorescence shall be "not effloresced." If the rating for efflorescence is "effloresced," the brick represented by the testing do not meet the efflorescence requirements of this specification.

9. Dimensions and Permissible Variations

9.1 *Size*—The size of brick shall be as specified by the purchaser (see Note 10). In a sample of ten brick selected to

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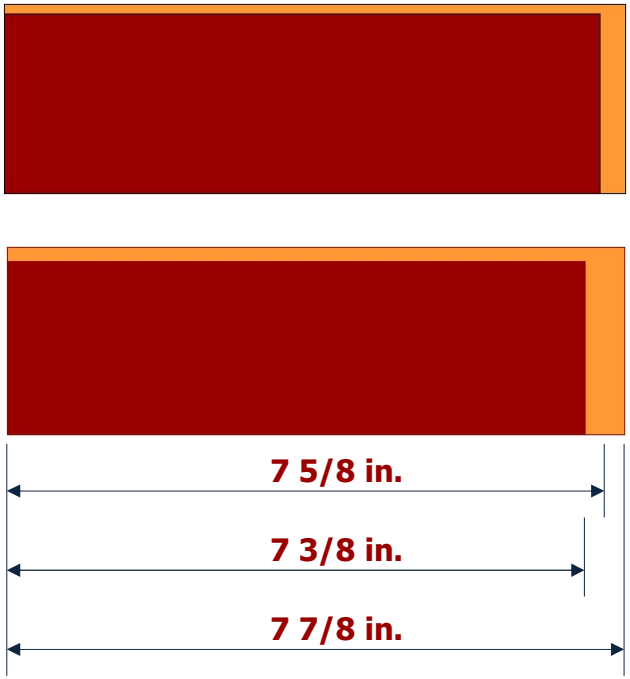
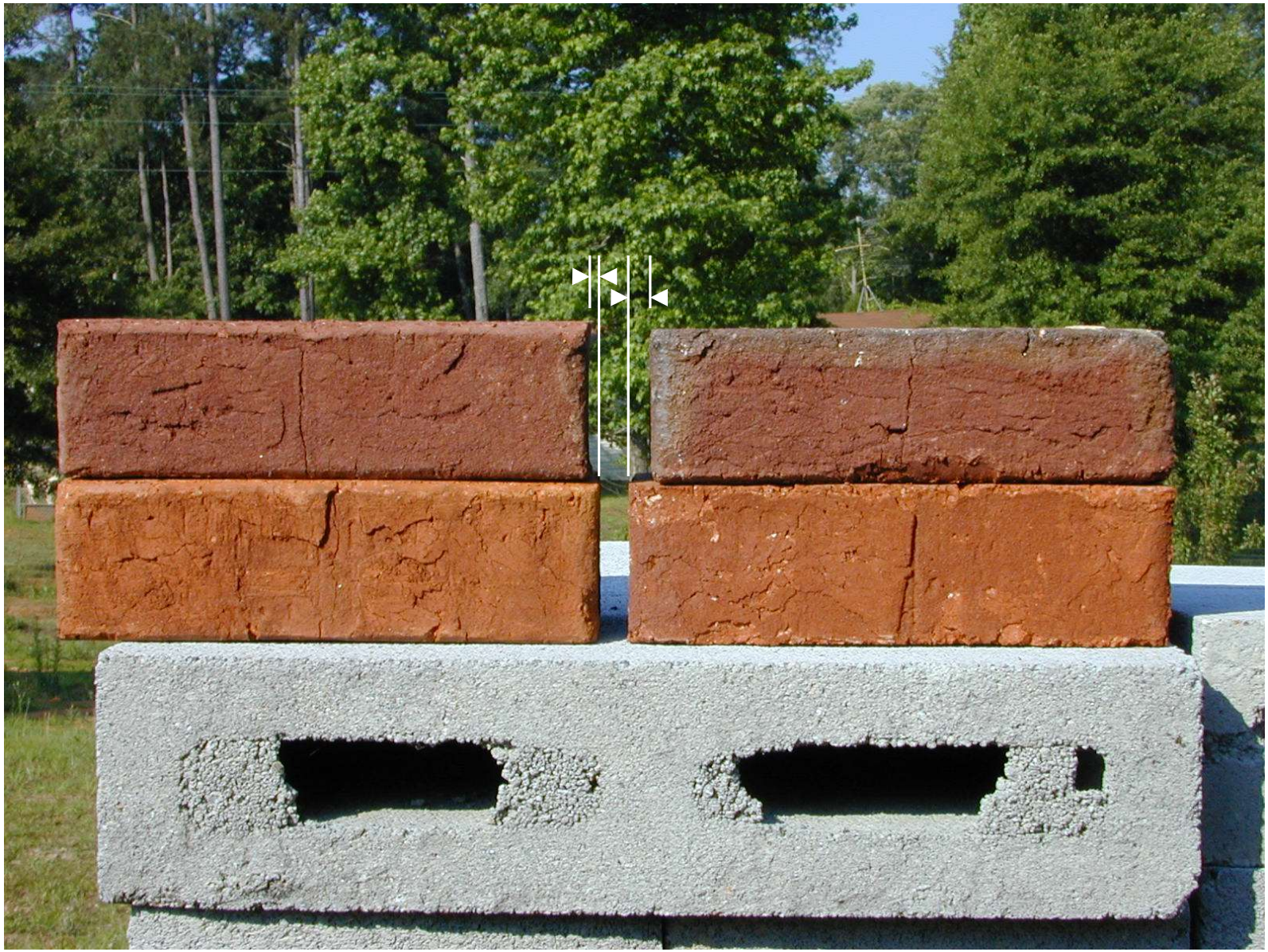
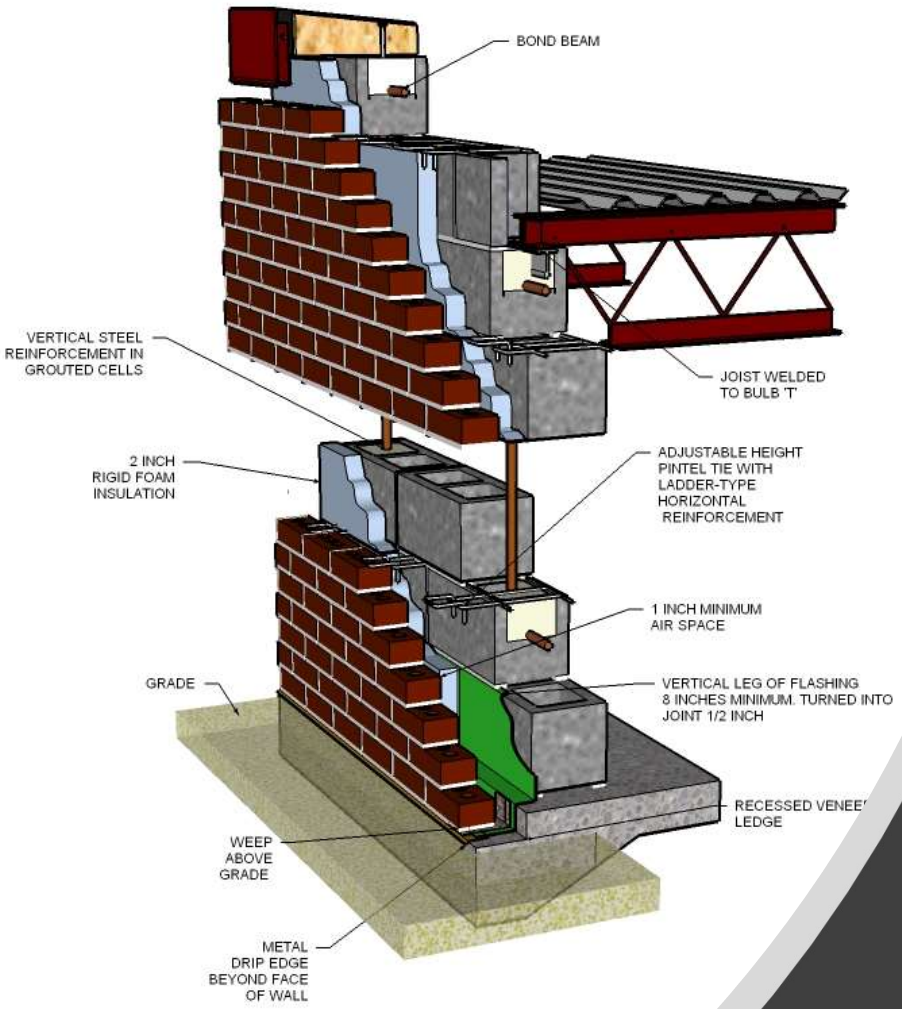
SIZE TOLERANCES

	<3”	3-4”	6-8”
FBX	±1/16	±3/32	±5/32
FBS (rough)	±3/32	±1/8	±1/4





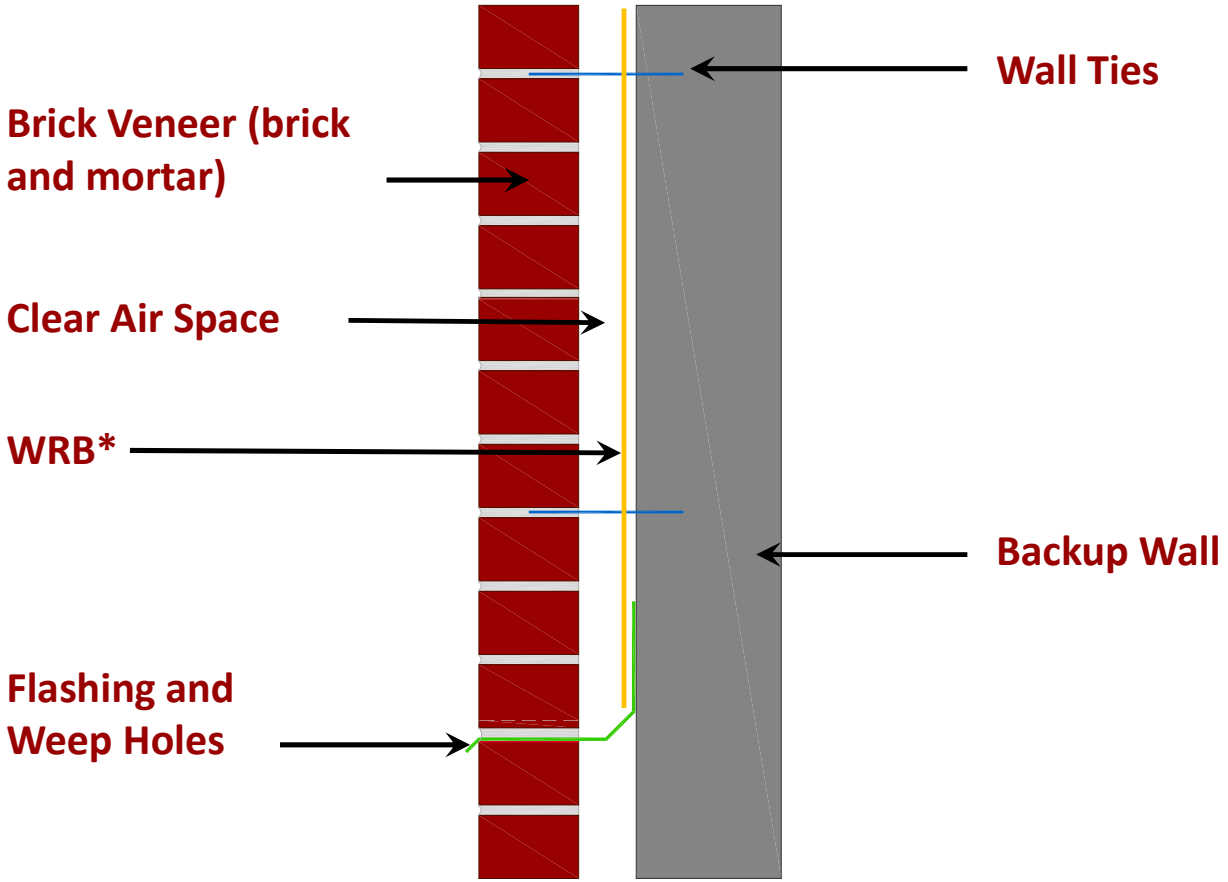
Drainage Wall System



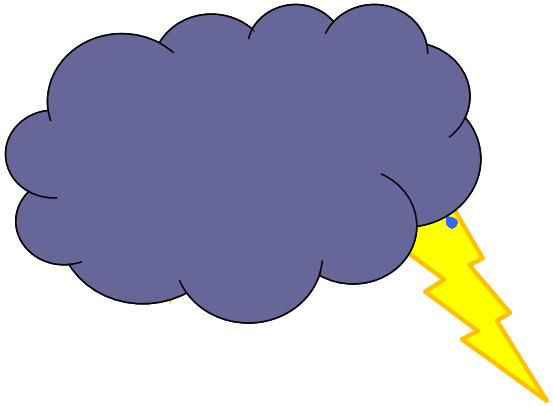
Double Wythe Cavity Wall System

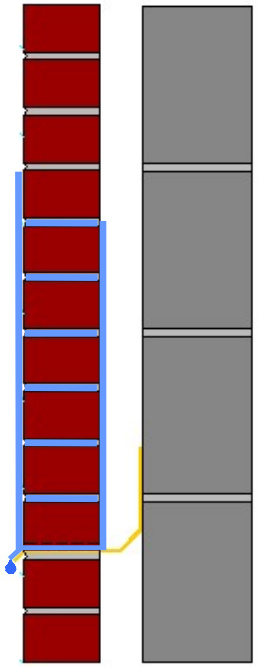
Worlds Best Wall System

DRAINAGE WALL COMPONENTS



DRAINAGE WALL CONCEPT

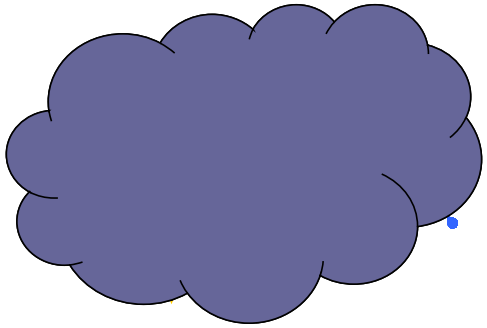




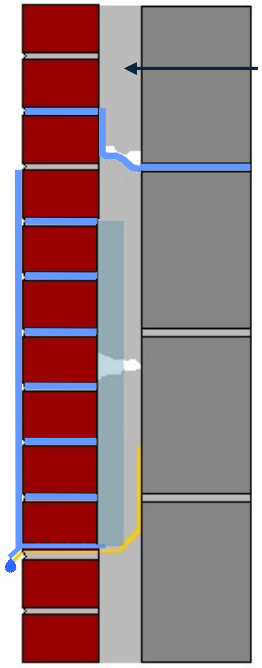
Water may penetrate brick masonry

Water runs down back of brick

Water exits wall at flashing at weep holes.



BARRIER WALL CONCEPT



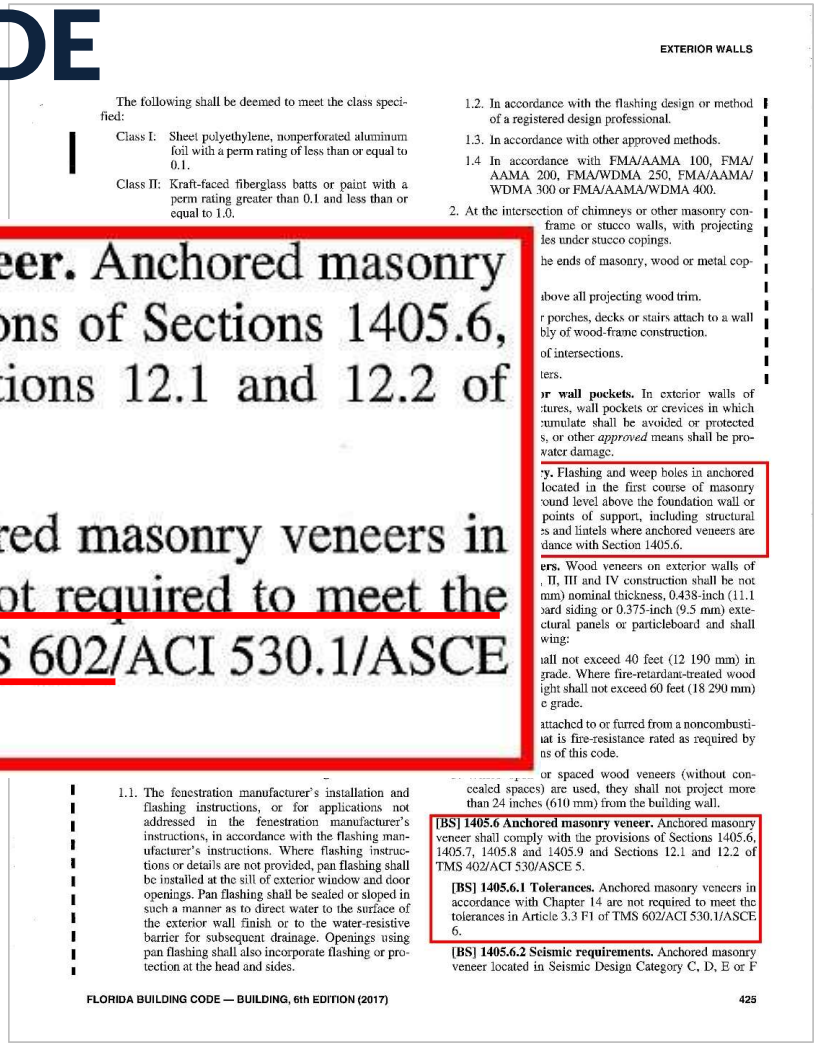
Collar joint must be completely filled

Water is absorbed by masonry or runs down to flashing and exits wall

FLORIDA BUILDING CODE

[BS] 1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections 12.1 and 12.2 of TMS 402/ACI 530/ASCE 5.

[BS] 1405.6.1 Tolerances. Anchored masonry veneers in accordance with Chapter 14 are not required to meet the tolerances in Article 3.3 F1 of TMS 602/ACI 530.1/ASCE 6.



EXTERIOR WALLS

The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, nonperforated aluminum foil with a perm rating of less than or equal to 0.1.

Class II: Kraft-faced fiberglass batts or paint with a perm rating greater than 0.1 and less than or equal to 1.0.

1.2. In accordance with the flashing design or method of a registered design professional.

1.3. In accordance with other approved methods.

1.4 In accordance with FMA/AAMA 100, FMA/AAMA 200, FMA/WDMA 250, FMA/AAMA/WDMA 300 or FMA/AAMA/WDMA 400.

2. At the intersection of chimneys or other masonry con- frame or stucco walls, with projecting les under stucco copings.

he ends of masonry, wood or metal cop-

above all projecting wood trim.

r porches, decks or stairs attach to a wall bly of wood-frame construction.

of intersections.

ters.

or wall pockets. In exterior walls of tures, wall pockets or crevices in which umulate shall be avoided or protected s, or other *approved* means shall be pro- water damage.

y. Flashing and weep holes in anchored located in the first course of masonry ound level above the foundation wall or points of support, including structural s and lintels where anchored veneers are dance with Section 1405.6.

ers. Wood veneers on exterior walls of , II, III and IV construction shall be not mm) nominal thickness, 0.438-inch (11.1 oard siding or 0.375-inch (9.5 mm) exte- ctural panels or particleboard and shall wing:

all not exceed 40 feet (12 190 mm) in grade. Where fire-retardant-treated wood ight shall not exceed 60 feet (18 290 mm) e grade.

attached to or furred from a noncombusti- at is fire-resistance rated as required by ns of this code.

or spaced wood veneers (without con- cealed spaces) are used, they shall not project more than 24 inches (610 mm) from the building wall.

[BS] 1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections 12.1 and 12.2 of TMS 402/ACI 530/ASCE 5.

[BS] 1405.6.1 Tolerances. Anchored masonry veneers in accordance with Chapter 14 are not required to meet the tolerances in Article 3.3 F1 of TMS 602/ACI 530.1/ASCE 6.

[BS] 1405.6.2 Seismic requirements. Anchored masonry veneer located in Seismic Design Category C, D, E or F

1.1. The fenestration manufacturer's installation and flashing instructions, or for applications not addressed in the fenestration manufacturer's instructions, in accordance with the flashing manufacturer's instructions. Where flashing instructions or details are not provided, pan flashing shall be installed at the sill of exterior window and door openings. Pan flashing shall be sealed or sloped in such a manner as to direct water to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Openings using pan flashing shall also incorporate flashing or protection at the head and sides.

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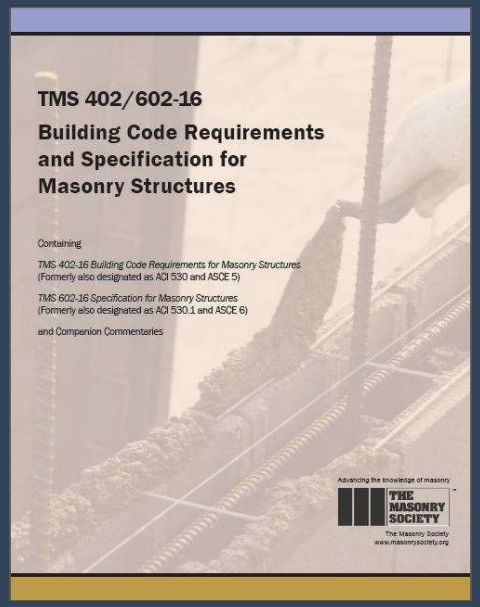
TMS 402/602-16



VENEER

Chapter 12

TMS 402

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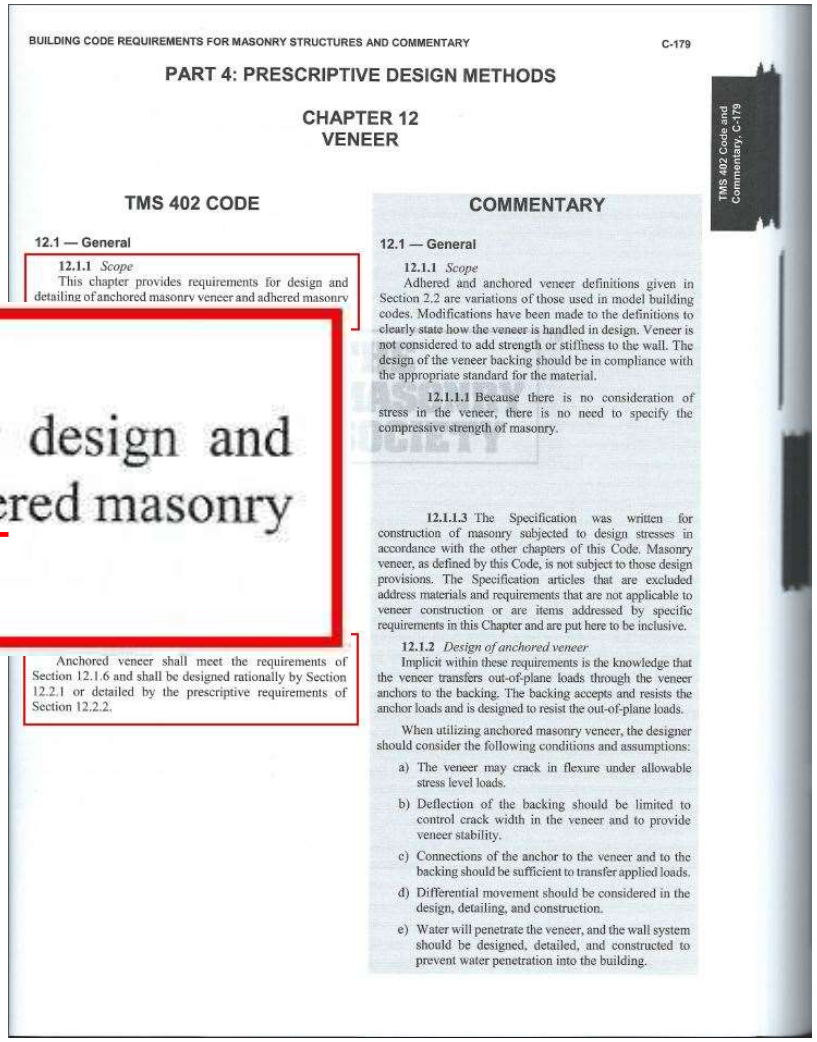

BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES AND COMMENTARY C-179

PART 4: PRESCRIPTIVE DESIGN METHODS

CHAPTER 12
VENEER

TMS 402 Code and Commentary, C-179

TMS 402 CODE

12.1 — General

12.1.1 *Scope*

This chapter provides requirements for design and detailing of anchored masonry veneer and adhered masonry

Anchored veneer shall meet the requirements of Section 12.1.6 and shall be designed rationally by Section 12.2.1 or detailed by the prescriptive requirements of Section 12.2.2.

COMMENTARY

12.1 — General

12.1.1 *Scope*

Adhered and anchored veneer definitions given in Section 2.2 are variations of those used in model building codes. Modifications have been made to the definitions to clearly state how the veneer is handled in design. Veneer is not considered to add strength or stiffness to the wall. The design of the veneer backing should be in compliance with the appropriate standard for the material.

12.1.1.1 Because there is no consideration of stress in the veneer, there is no need to specify the compressive strength of masonry.

12.1.1.3 The Specification was written for construction of masonry subjected to design stresses in accordance with the other chapters of this Code. Masonry veneer, as defined by this Code, is not subject to those design provisions. The Specification articles that are excluded address materials and requirements that are not applicable to veneer construction or are items addressed by specific requirements in this Chapter and are put here to be inclusive.

12.1.2 *Design of anchored veneer*

Implicit within these requirements is the knowledge that the veneer transfers out-of-plane loads through the veneer anchors to the backing. The backing accepts and resists the anchor loads and is designed to resist the out-of-plane loads.

When utilizing anchored masonry veneer, the designer should consider the following conditions and assumptions:

a) The veneer may crack in flexure under allowable stress level loads.

b) Deflection of the backing should be limited to control crack width in the veneer and to provide veneer stability.

c) Connections of the anchor to the veneer and to the backing should be sufficient to transfer applied loads.

d) Differential movement should be considered in the design, detailing, and construction.

e) Water will penetrate the veneer, and the wall system should be designed, detailed, and constructed to prevent water penetration into the building.

12.1.1 *Scope*

This chapter provides requirements for design and detailing of anchored masonry veneer and adhered masonry veneer.

TMS 402

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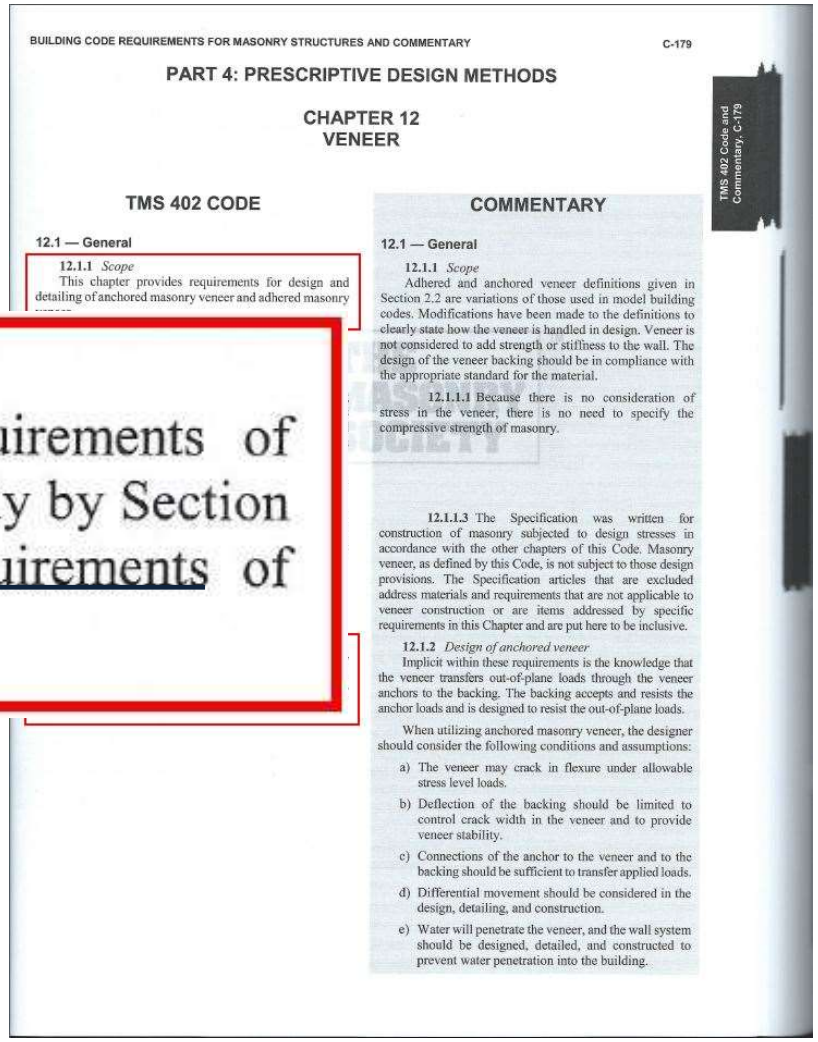
12.1.2 *Design of anchored veneer*

Anchored veneer shall meet the requirements of Section 12.1.6 and shall be designed rationally by Section 12.2.1 or detailed by the prescriptive requirements of Section 12.2.2.



BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES AND COMMENTARY C-179

PART 4: PRESCRIPTIVE DESIGN METHODS

CHAPTER 12
VENEER

TMS 402 Code and Commentary, C-179

TMS 402 CODE

12.1 — General

12.1.1 *Scope*
This chapter provides requirements for design and detailing of anchored masonry veneer and adhered masonry

COMMENTARY

12.1 — General

12.1.1 *Scope*
Adhered and anchored veneer definitions given in Section 2.2 are variations of those used in model building codes. Modifications have been made to the definitions to clearly state how the veneer is handled in design. Veneer is not considered to add strength or stiffness to the wall. The design of the veneer backing should be in compliance with the appropriate standard for the material.

12.1.1.1 Because there is no consideration of stress in the veneer, there is no need to specify the compressive strength of masonry.

12.1.1.3 The Specification was written for construction of masonry subjected to design stresses in accordance with the other chapters of this Code. Masonry veneer, as defined by this Code, is not subject to those design provisions. The Specification articles that are excluded address materials and requirements that are not applicable to veneer construction or are items addressed by specific requirements in this Chapter and are put here to be inclusive.

12.1.2 *Design of anchored veneer*
Implicit within these requirements is the knowledge that the veneer transfers out-of-plane loads through the veneer anchors to the backing. The backing accepts and resists the anchor loads and is designed to resist the out-of-plane loads.

When utilizing anchored masonry veneer, the designer should consider the following conditions and assumptions:

a) The veneer may crack in flexure under allowable stress level loads.

b) Deflection of the backing should be limited to control crack width in the veneer and to provide veneer stability.

c) Connections of the anchor to the veneer and to the backing should be sufficient to transfer applied loads.

d) Differential movement should be considered in the design, detailing, and construction.

e) Water will penetrate the veneer, and the wall system should be designed, detailed, and constructed to prevent water penetration into the building.

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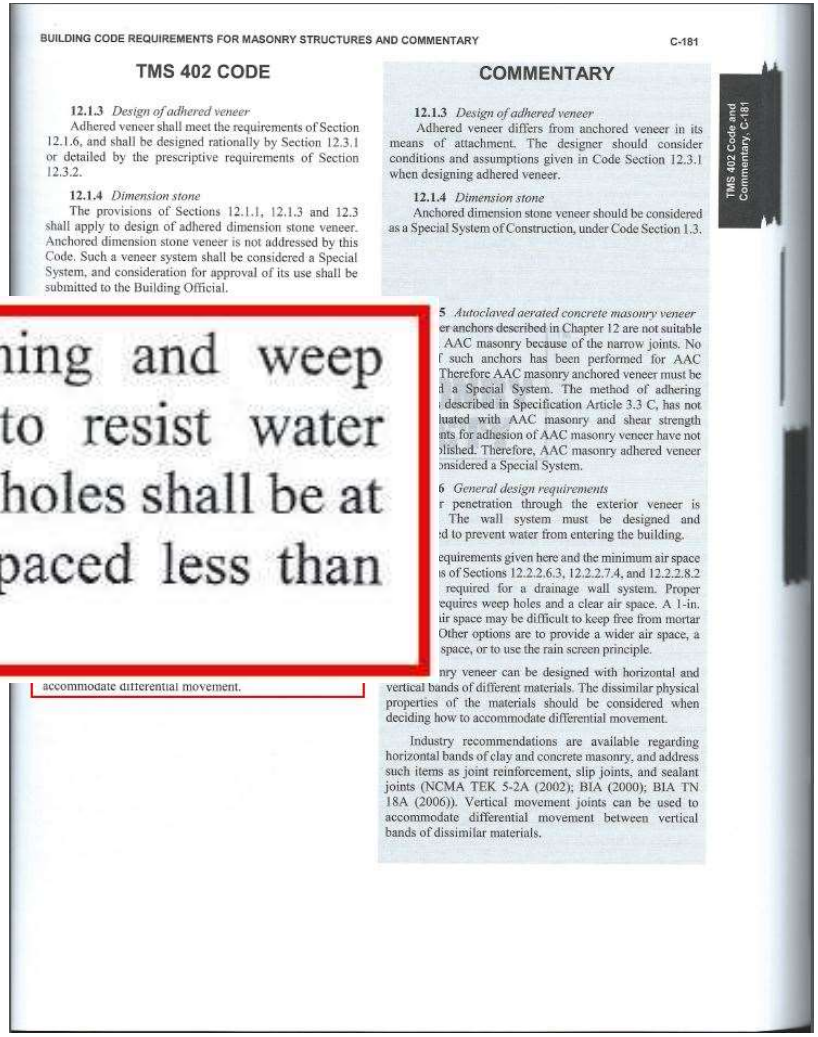

BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES AND COMMENTARY C-181

TMS 402 CODE

12.1.3 *Design of adhered veneer*
Adhered veneer shall meet the requirements of Section 12.1.6, and shall be designed rationally by Section 12.3.1 or detailed by the prescriptive requirements of Section 12.3.2.

12.1.4 *Dimension stone*
The provisions of Sections 12.1.1, 12.1.3 and 12.3 shall apply to design of adhered dimension stone veneer. Anchored dimension stone veneer is not addressed by this Code. Such a veneer system shall be considered a Special System, and consideration for approval of its use shall be submitted to the Building Official.

12.1.6.2 Design and detail flashing and weep holes in exterior veneer wall systems to resist water penetration into the building interior. Weepholes shall be at least $^{3}/_{16}$ in. (4.8 mm) in diameter and spaced less than 33 in. (838 mm) on center.

accommodate differential movement.

COMMENTARY

12.1.3 *Design of adhered veneer*
Adhered veneer differs from anchored veneer in its means of attachment. The designer should consider conditions and assumptions given in Code Section 12.3.1 when designing adhered veneer.

12.1.4 *Dimension stone*
Anchored dimension stone veneer should be considered as a Special System of Construction, under Code Section 1.3.

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5 *Autoclaved aerated concrete masonry veneer*
er anchors described in Chapter 12 are not suitable AAC masonry because of the narrow joints. No such anchors has been performed for AAC Therefore AAC masonry anchored veneer must be a Special System. The method of adhering described in Specification Article 3.3 C, has not luated with AAC masonry and shear strength nts for adhesion of AAC masonry veneer have not olished. Therefore, AAC masonry adhered veneer onsidered a Special System.

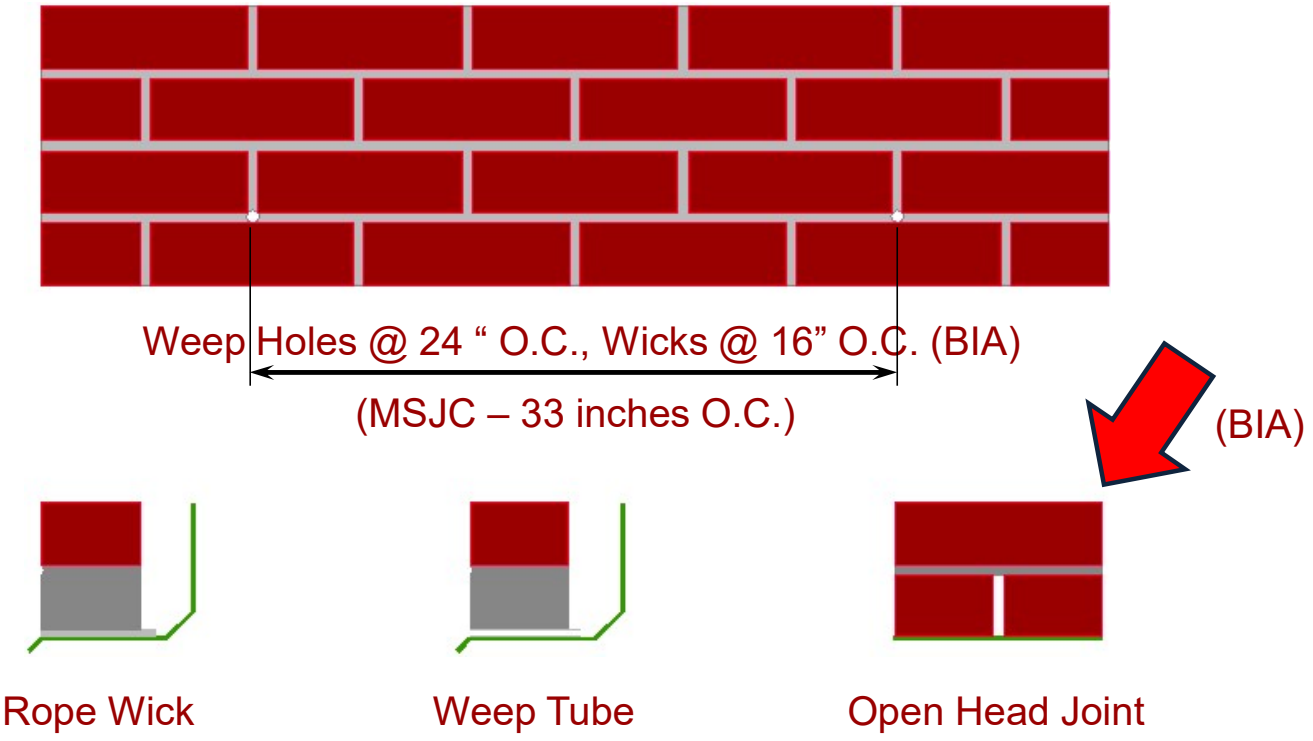
6 *General design requirements*
r penetration through the exterior veneer is The wall system must be designed and d to prevent water from entering the building.

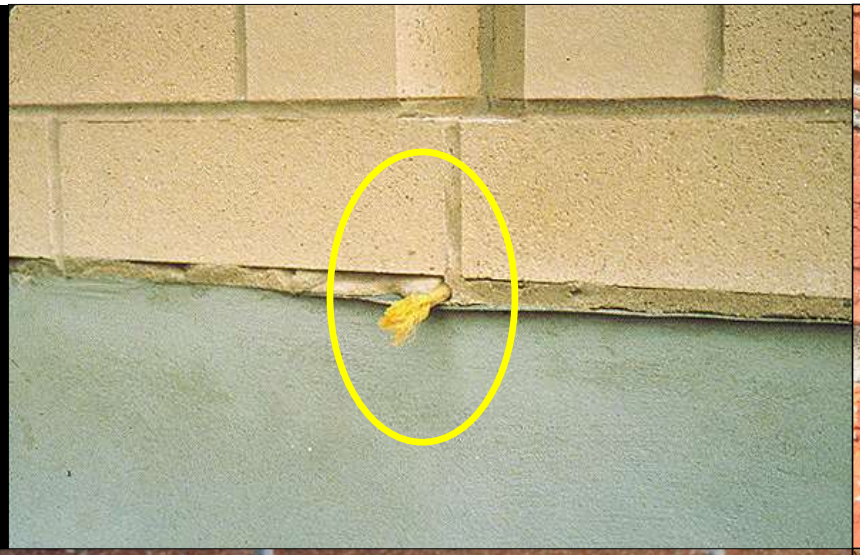
equirements given here and the minimum air space s of Sections 12.2.2.6.3, 12.2.2.7.4, and 12.2.2.8.2 required for a drainage wall system. Proper equires weep holes and a clear air space. A 1-in. ir space may be difficult to keep free from mortar Other options are to provide a wider air space, a space, or to use the rain screen principle.

nry veneer can be designed with horizontal and vertical bands of different materials. The dissimilar physical properties of the materials should be considered when deciding how to accommodate differential movement.

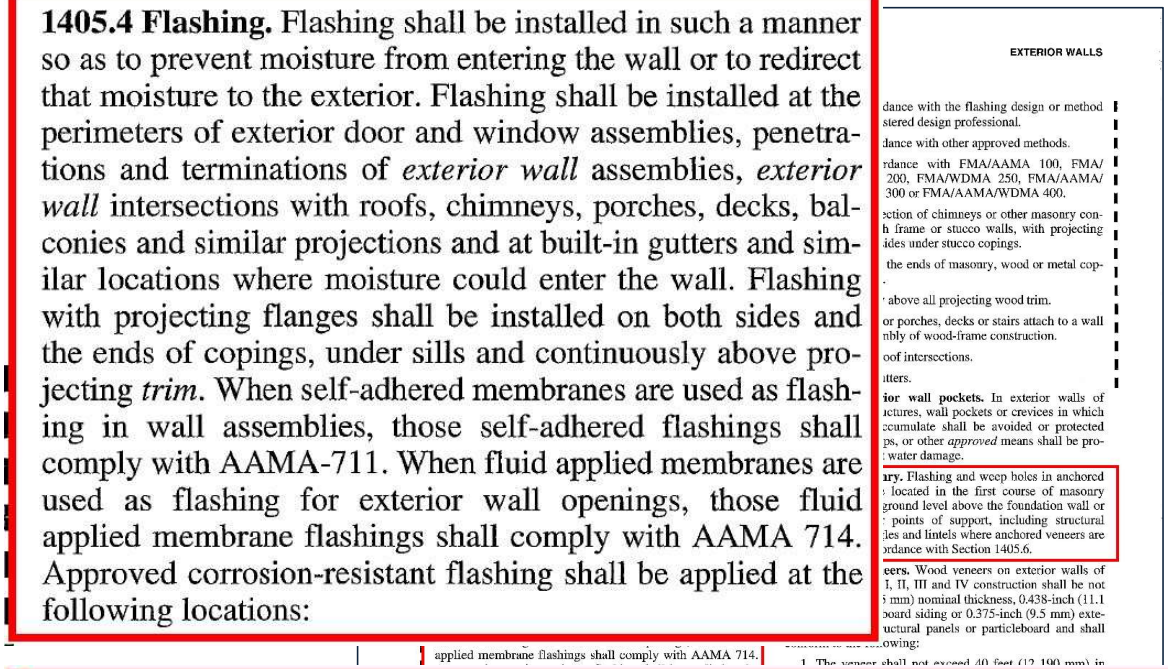
Industry recommendations are available regarding horizontal bands of clay and concrete masonry, and address such items as joint reinforcement, slip joints, and sealant joints (NCMA TEK 5-2A (2002); BIA (2000); BIA TN 18A (2006)). Vertical movement joints can be used to accommodate differential movement between vertical bands of dissimilar materials.

WEEP HOLES


Weep Holes @ 24 “ O.C., Wicks @ 16” O.C. (BIA)
(MSJC – 33 inches O.C.)
(BIA)
Rope Wick
Weep Tube
Open Head Joint



1405.4 Flashing. Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect that moisture to the exterior. Flashing shall be installed at the perimeters of exterior door and window assemblies, penetrations and terminations of *exterior wall* assemblies, *exterior wall* intersections with roofs, chimneys, porches, decks, balconies and similar projections and at built-in gutters and similar locations where moisture could enter the wall. Flashing with projecting flanges shall be installed on both sides and the ends of copings, under sills and continuously above projecting *trim*. When self-adhered membranes are used as flashing in wall assemblies, those self-adhered flashings shall comply with AAMA-711. When fluid applied membranes are used as flashing for exterior wall openings, those fluid applied membrane flashings shall comply with AAMA 714. Approved corrosion-resistant flashing shall be applied at the following locations:



EXTERIOR WALLS

dance with the flashing design or method
stered design professional.
dance with other approved methods.
rdance with FMA/AAMA 100, FMA/
200, FMA/WDMA 250, FMA/AAMA/
300 or FMA/AAMA/WDMA 400.
ection of chimneys or other masonry con-
h frame or stucco walls, with projecting
ides under stucco copings.
the ends of masonry, wood or metal cop-
above all projecting wood trim.
or porches, decks or stairs attach to a wall
nbly of wood-frame construction.
oof intersections.
itters.
ior wall pockets. In exterior walls of
ictures, wall pockets or crevices in which
ccumulate shall be avoided or protected
ps, or other *approved* means shall be pro-
water damage.
ry. Flashing and weep holes in anchored
located in the first course of masonry
ground level above the foundation wall or
points of support, including structural
les and lintels where anchored veneers are
ordance with Section 1405.6.
eers. Wood veneers on exterior walls of
I, II, III and IV construction shall be not
5 mm) nominal thickness, 0.438-inch (11.1
board siding or 0.375-inch (9.5 mm) exte-
uctural panels or particleboard and shall
owing:

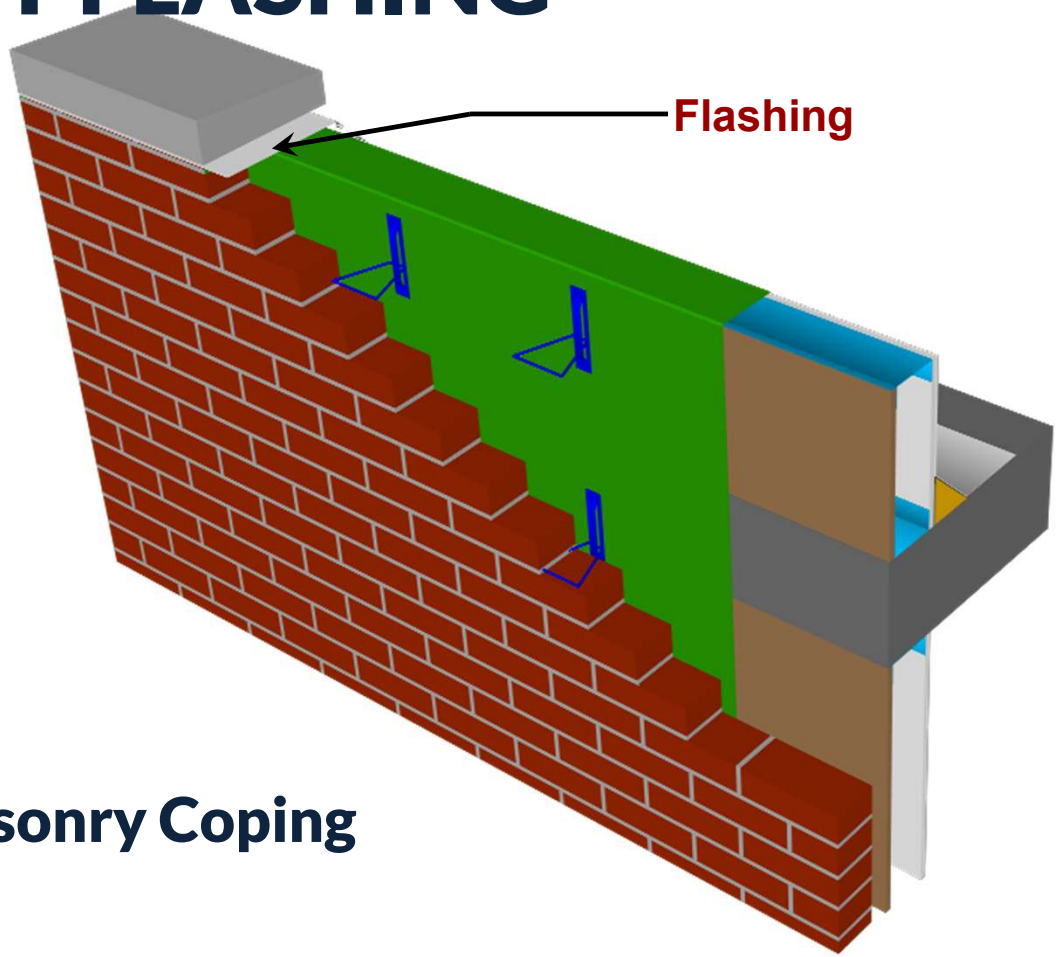
applied membrane flashings shall comply with AAMA 714.

1405.4.2 Masonry. Flashing and weep holes in anchored veneer shall be located in the first course of masonry above finished ground level above the foundation wall or slab, and other points of support, including structural floors, shelf angles and lintels where anchored veneers are designed in accordance with Section 1405.6.

Florida Building Code

REQUIRED FLASHING LOCATIONS

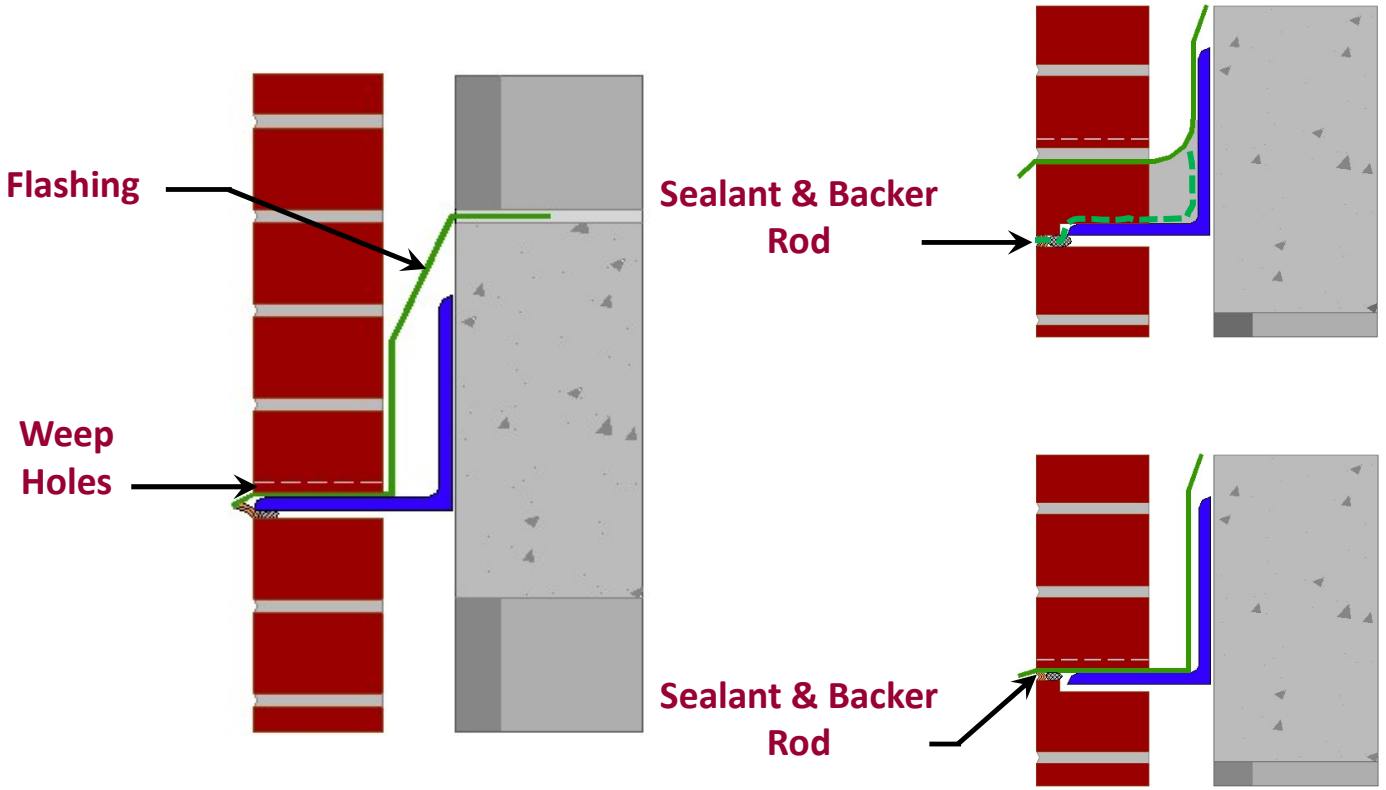
PARAPET FLASHING



Masonry Coping

REQUIRED FLASHING LOCATIONS

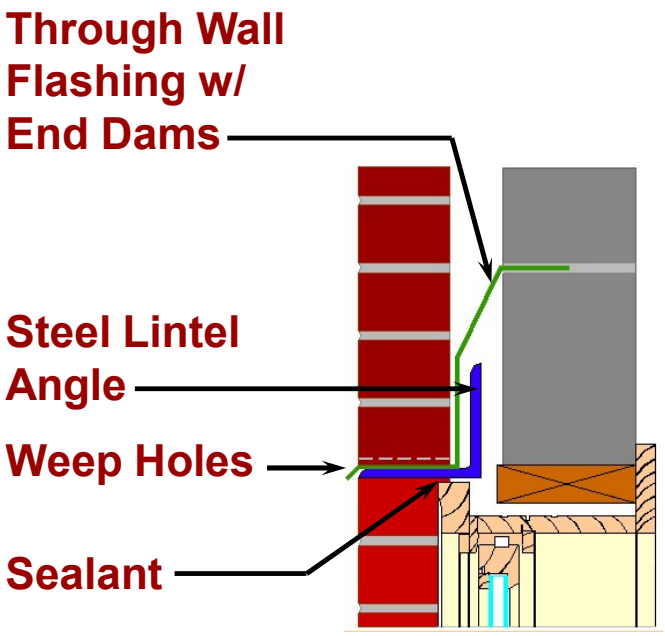
SHELF ANGLE FLASHING



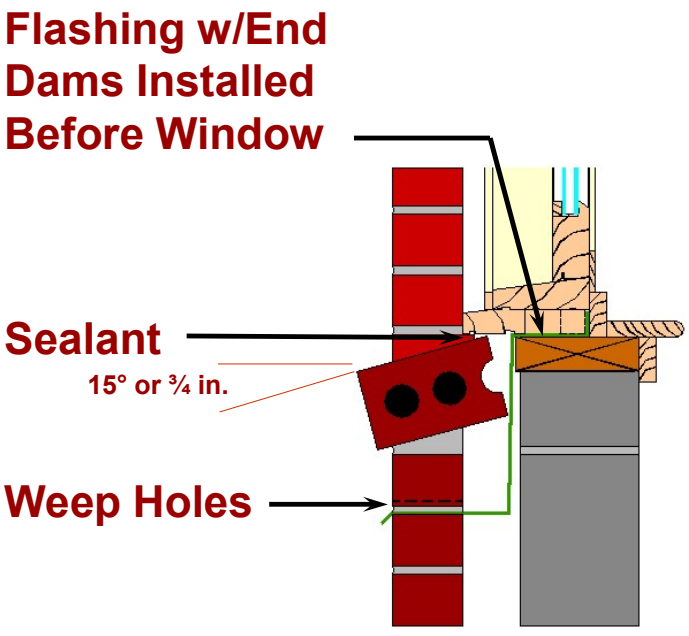
SHELF ANGLE FLASHING

REQUIRED FLASHING LOCATIONS

WINDOW FLASHING



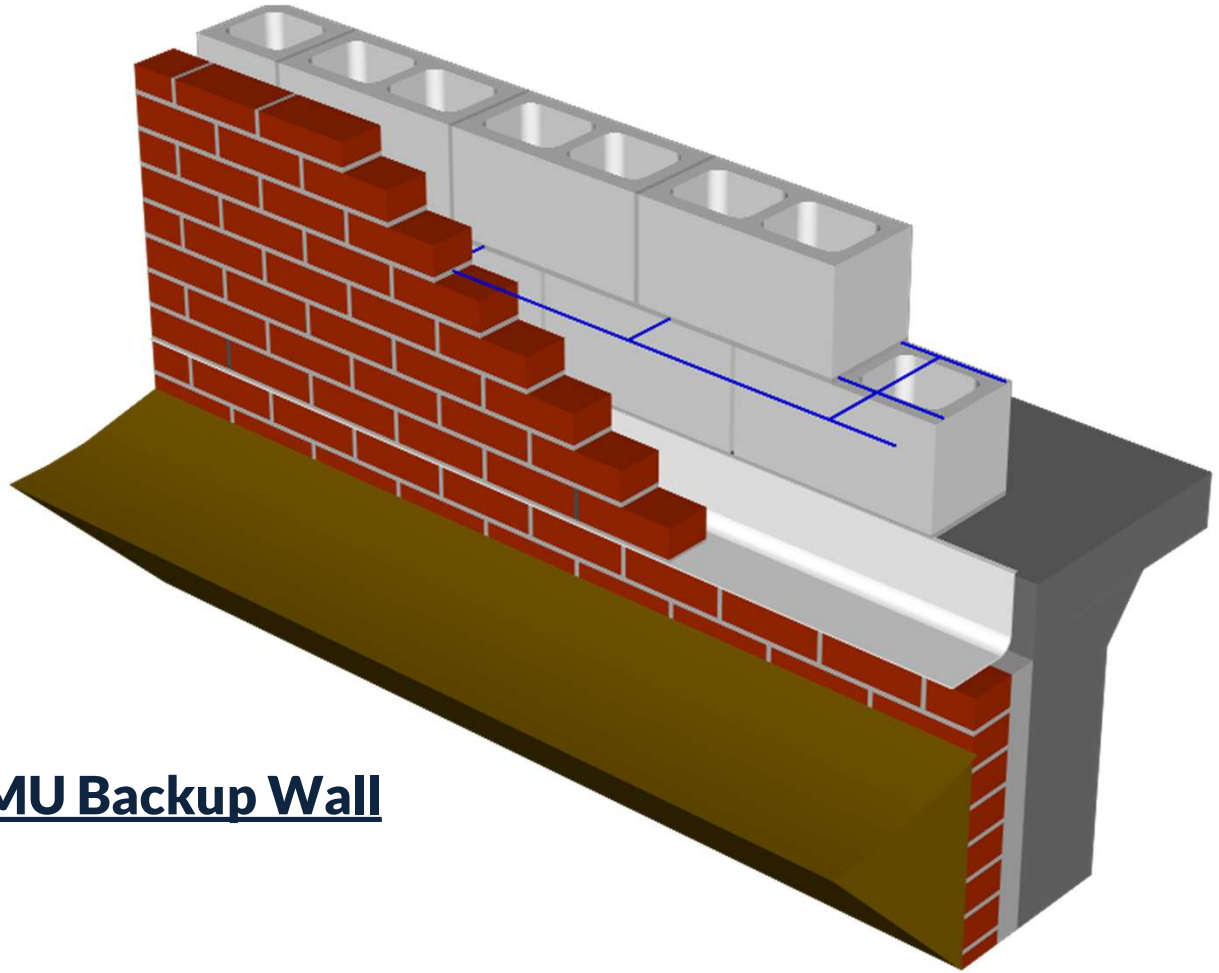
Window Head



Window Sill

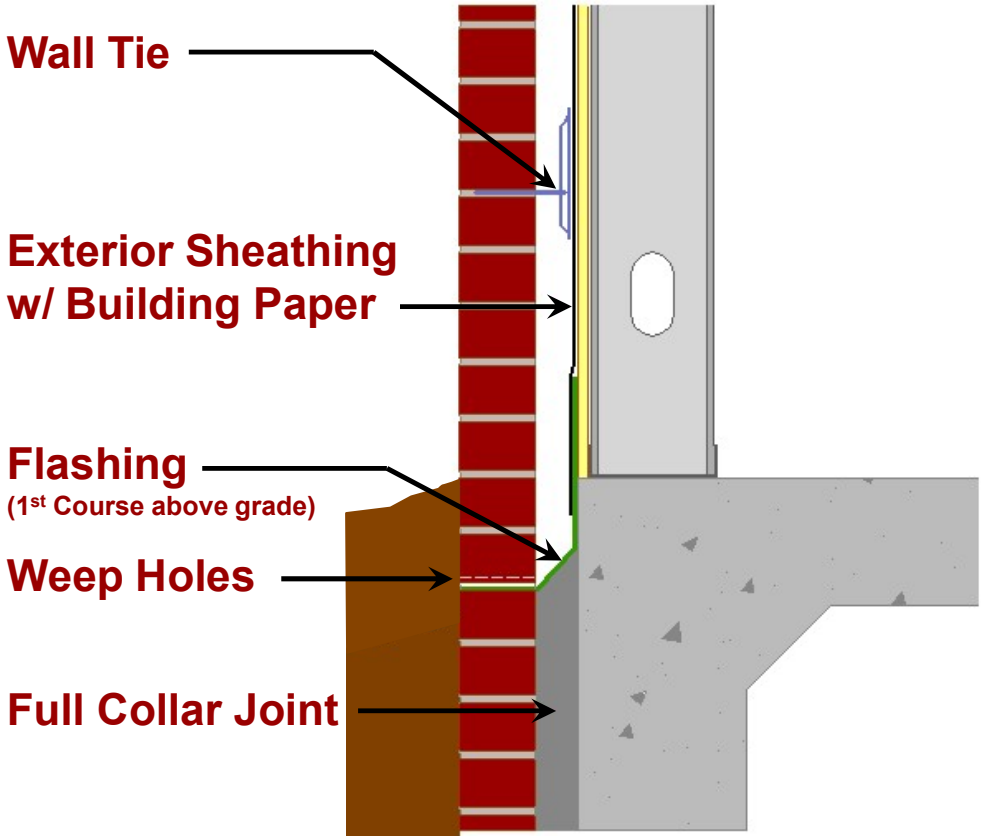
REQUIRED FLASHING LOCATIONS

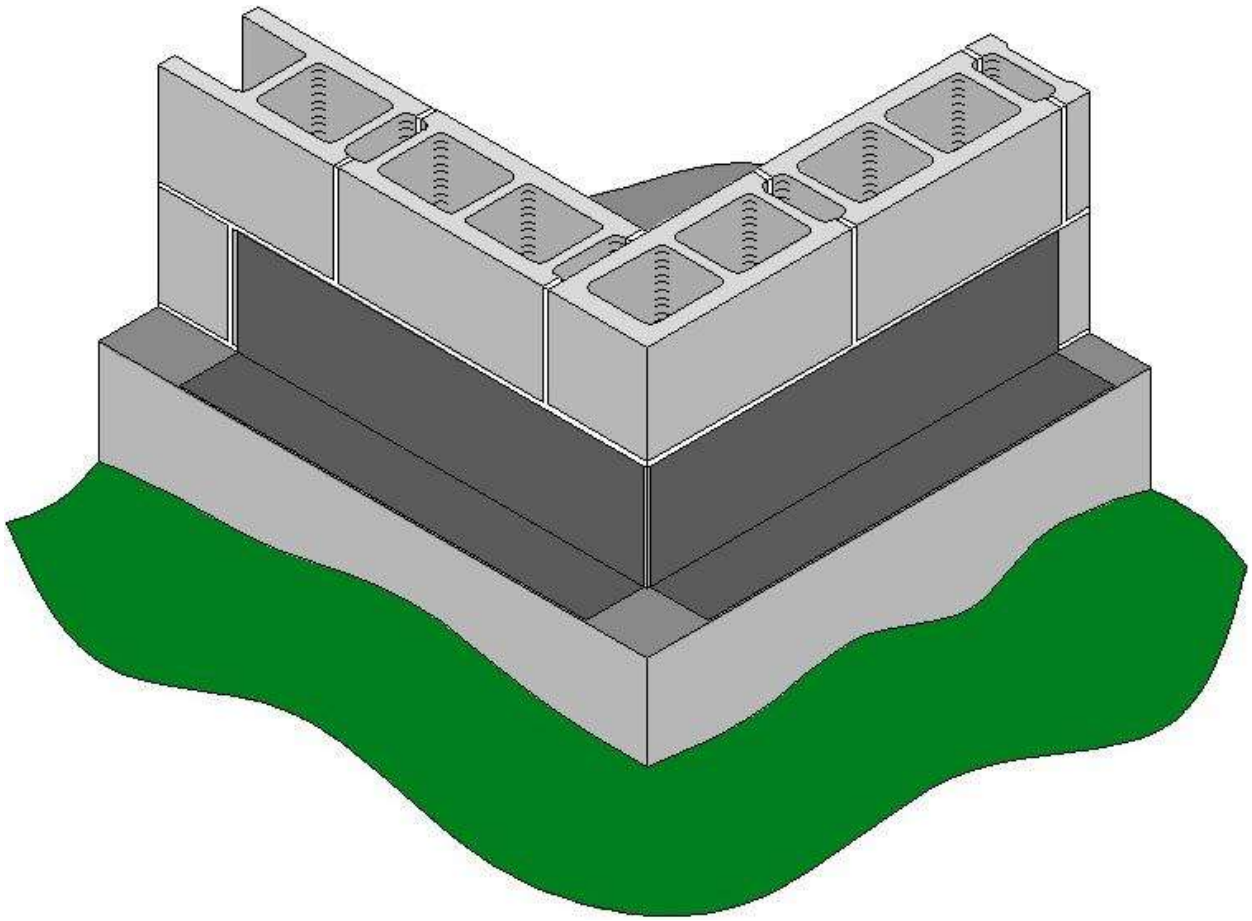
BASE WALL FLASHING

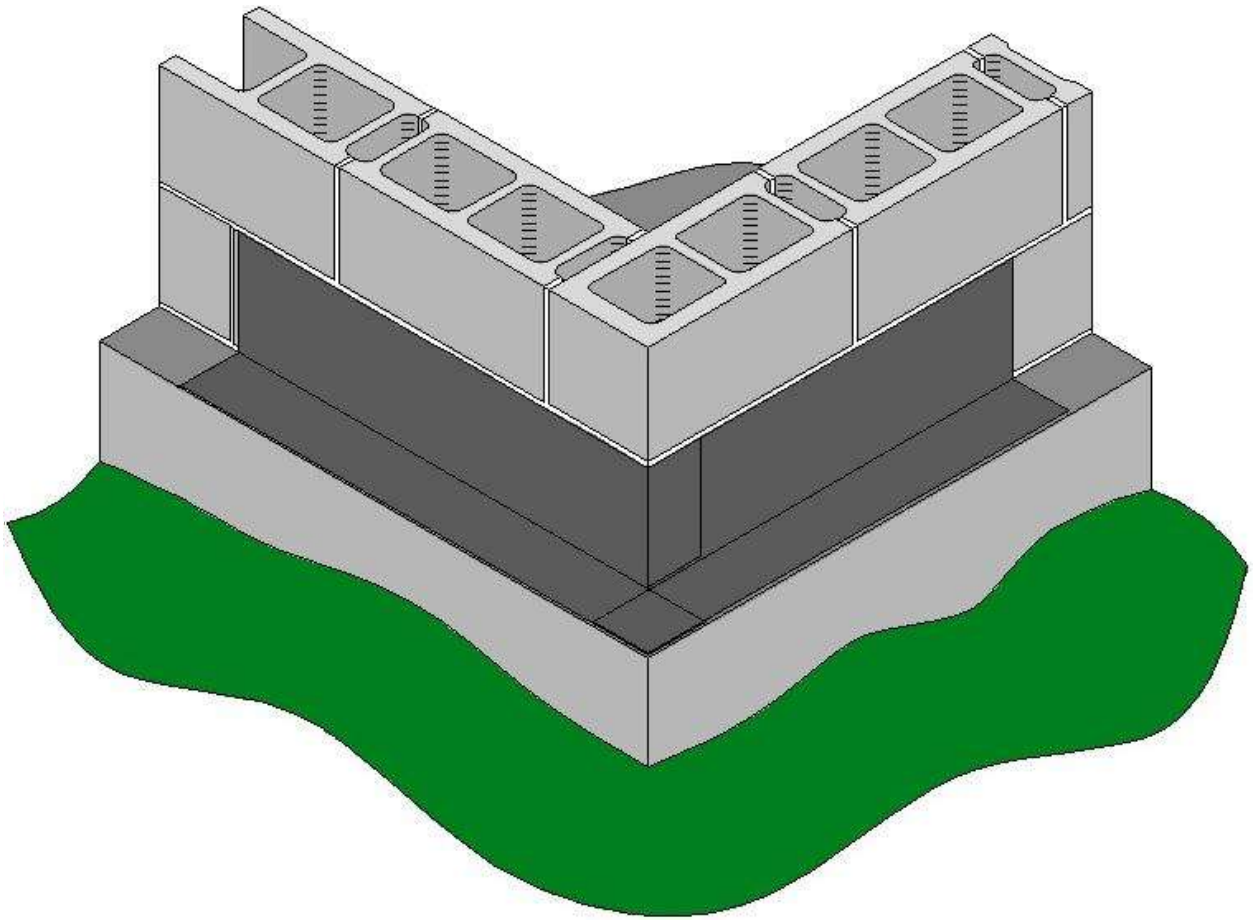


CMU Backup Wall

THROUGH WALL FLASHING







TMS 402 VENEER

Chapter 12

TMS 402

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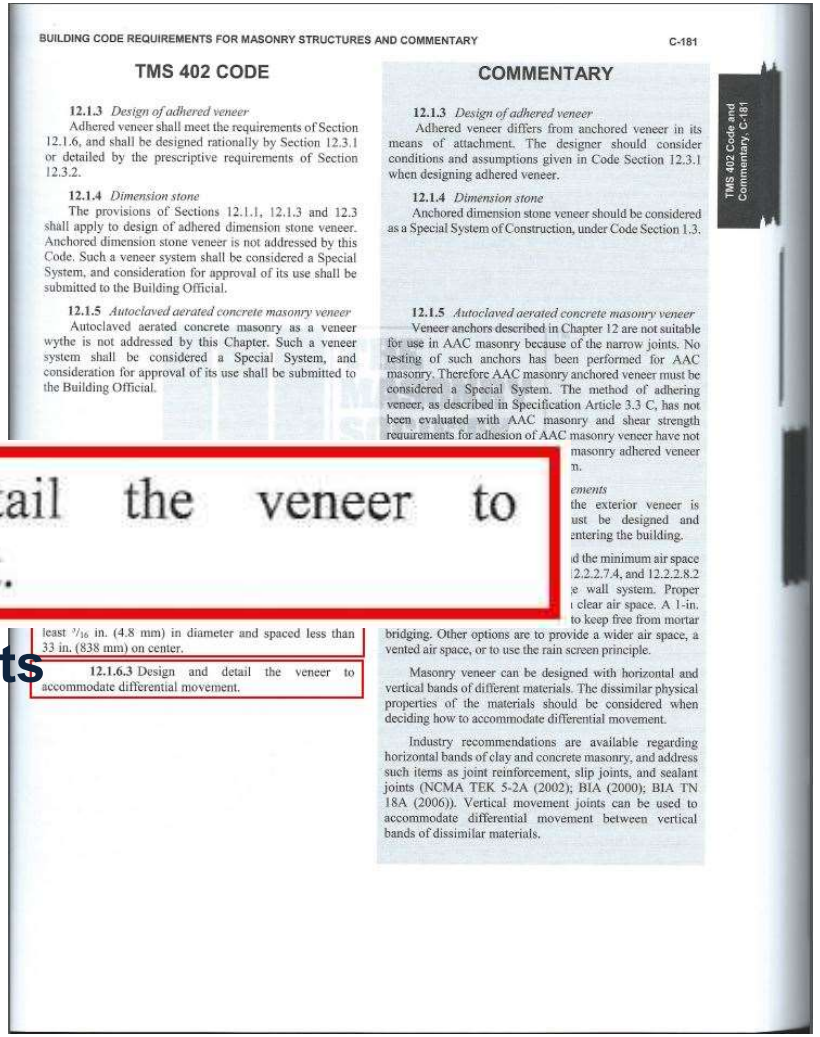

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TMS 402 CODE

12.1.3 *Design of adhered veneer*
Adhered veneer shall meet the requirements of Section 12.1.6, and shall be designed rationally by Section 12.3.1 or detailed by the prescriptive requirements of Section 12.3.2.

12.1.4 *Dimension stone*
The provisions of Sections 12.1.1, 12.1.3 and 12.3 shall apply to design of adhered dimension stone veneer. Anchored dimension stone veneer is not addressed by this Code. Such a veneer system shall be considered a Special System, and consideration for approval of its use shall be submitted to the Building Official.

12.1.5 *Autoclaved aerated concrete masonry veneer*
Autoclaved aerated concrete masonry as a veneer wythe is not addressed by this Chapter. Such a veneer system shall be considered a Special System, and consideration for approval of its use shall be submitted to the Building Official.

least 7/16 in. (4.8 mm) in diameter and spaced less than 33 in. (838 mm) on center.

12.1.6.3 Design and detail the veneer to accommodate differential movement.

COMMENTARY

12.1.3 *Design of adhered veneer*
Adhered veneer differs from anchored veneer in its means of attachment. The designer should consider conditions and assumptions given in Code Section 12.3.1 when designing adhered veneer.

12.1.4 *Dimension stone*
Anchored dimension stone veneer should be considered as a Special System of Construction, under Code Section 1.3.

12.1.5 *Autoclaved aerated concrete masonry veneer*
Veneer anchors described in Chapter 12 are not suitable for use in AAC masonry because of the narrow joints. No testing of such anchors has been performed for AAC masonry. Therefore AAC masonry anchored veneer must be considered a Special System. The method of adhering veneer, as described in Specification Article 3.3 C, has not been evaluated with AAC masonry and shear strength requirements for adhesion of AAC masonry veneer have not

masonry adhered veneer
n.

ements
the exterior veneer is
ust be designed and
entering the building.

d the minimum air space
2.2.2.7.4, and 12.2.2.8.2
e wall system. Proper
clear air space. A 1-in.
to keep free from mortar

bridging. Other options are to provide a wider air space, a vented air space, or to use the rain screen principle.

Masonry veneer can be designed with horizontal and vertical bands of different materials. The dissimilar physical properties of the materials should be considered when deciding how to accommodate differential movement.

Industry recommendations are available regarding horizontal bands of clay and concrete masonry, and address such items as joint reinforcement, slip joints, and sealant joints (NCMA TEK 5-2A (2002); BIA (2000); BIA TN 18A (2006)). Vertical movement joints can be used to accommodate differential movement between vertical bands of dissimilar materials.

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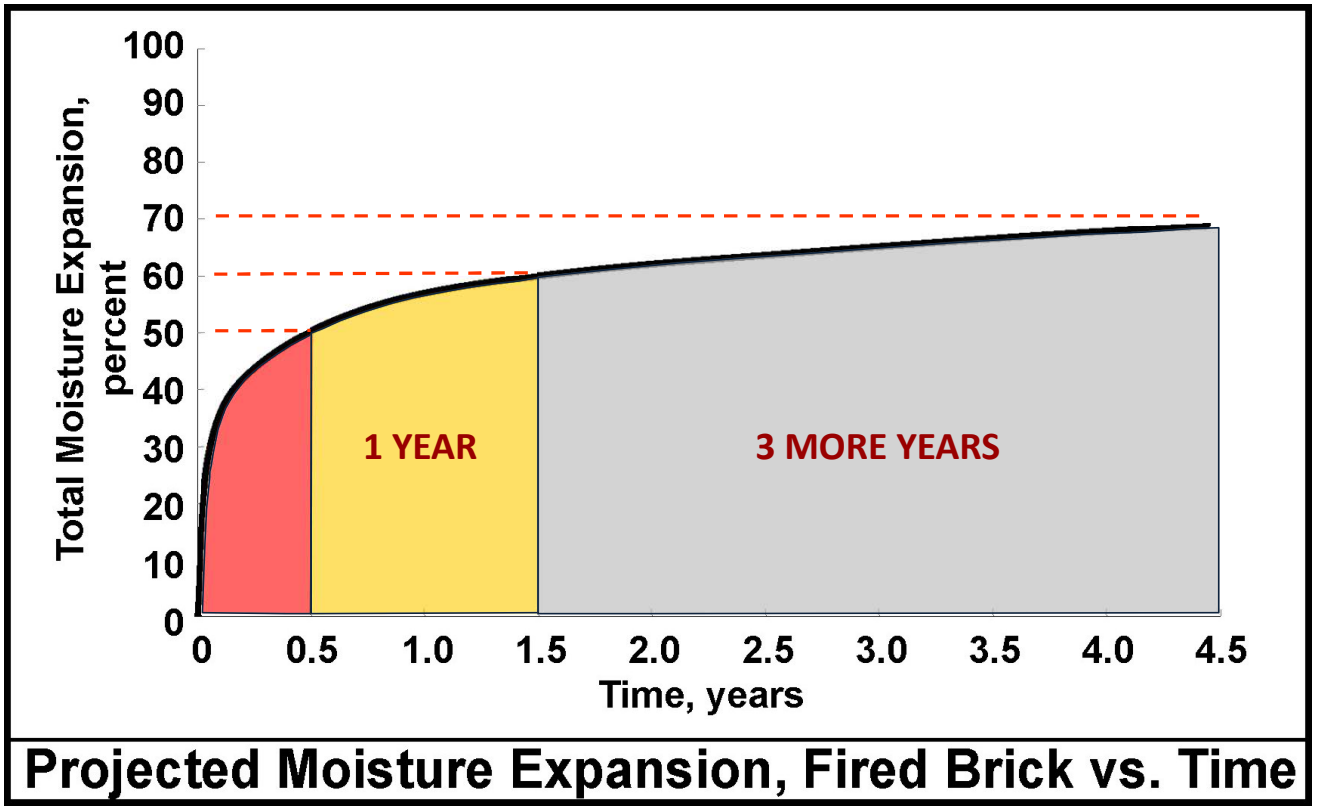
12.1.6.3 Design and detail the veneer to accommodate differential movement.

Expansion Joints



Projected Moisture Expansion, Fired Brick vs. Time

EXPANSION JOINT DESIGN

BRICK INDUSTRY ASSOCIATION | TECHNICAL NOTES on Brick Construction | 18A

1850 Centennial Park Drive, Reston, Virginia 20191 | www.gobrick.com | 703-620-0010 | November 2006

Accommodating Expansion of Brickwork

Abstract: Expansion joints are used in brickwork to accommodate movement and to avoid cracking. This *Technical Note* describes typical movement joints used in building construction and gives guidance regarding their placement. The theory and rationale for the guidelines are presented. Examples are given showing proper placement of expansion joints to avoid cracking of brickwork and methods to improve the aesthetic impact of expansion joints. Also included is information about bond breaks, bond beams and flexible anchorage.

Key Words: differential movement, expansion joints, flexible anchorage, movement, sealants.

SUMMARY OF RECOMMENDATIONS:

Vertical Expansion Joints in Brick Veneer:
- For brickwork without openings, space no more than 25 ft (7.6 m) o.c.
- For brickwork with multiple openings, consider symmetrical placement of expansion joints and reduced spacing of no more than 20 ft (6.1 m) o.c.
- When spacing between vertical expansion joints in parapets is more than 15 ft (4.6 m), make expansion joints wider or place additional expansion joints halfway between full-height expansion joints
- Place as follows:
  - at or near corners
  - at offsets and setbacks
  - at wall intersections
  - at changes in wall height
  - where wall backing system changes
  - where support of brick veneer changes
  - where wall function or climatic exposure changes
- Extend to top of brickwork, including parapets

Horizontal Expansion Joints in Brick Veneer:
- Locate immediately below shelf angles
- Minimum ¼ in. (6.4 mm) space or compressible material recommended below shelf angle
- For brick infill, place between the top of brickwork and structural frame

Brickwork Without Shelf Angles:
- Accommodate brickwork movement by:
  - placing expansion joints around elements that are rigidly attached to the frame and project into the veneer, such as windows and door frames
  - installing metal caps or copings that allow independent vertical movement of wythes
  - installing jamb receptors that allow independent movement between the brick and window frame
  - installing adjustable anchors or ties

Expansion Joint Sealants:
- Comply with ASTM C 920, Grade NS, Use M
- Class 50 minimum extensibility recommended; Class 25 alternate
- Consult sealant manufacturer's literature for guidance regarding use of primer and backing materials

Bond Breaks:
- Use building paper or flashing to separate brickwork from dissimilar materials, foundations and slabs

Loadbearing Masonry:
- Use reinforcement to accommodate stress concentrations, particularly in parapets, at applied loading points and around openings
- Consider effect of vertical expansion joints on brickwork stability

INTRODUCTION

A system of movement joints is necessary to accommodate the changes in volume that all building materials experience. Failure to permit the movements caused by these changes may result in cracks in brickwork, as discussed in *Technical Note* 18. The type, size and placement of movement joints are critical to the proper performance of a building. This *Technical Note* defines the types of movement joints and discusses the proper design of expansion joints within brickwork. Details of expansion joints are provided for loadbearing and nonloadbearing applications. While most examples are for commercial structures, movement joints, although rare, also must be considered for residential structures.

TYPES OF MOVEMENT JOINTS

The primary type of movement joint used in brick construction is the expansion joint. Other types of movement joints in buildings that may be needed include control joints, building expansion joints and construction joints. Each of these is designed to perform a specific task, and they should not be used interchangeably.

Q: *Where should I put the expansion joints on my building?*

EXPANSION JOINTS
Spacing of Vertical Joints

$$S_e = \frac{w_j e_j}{(k_e + k_f + k_t \Delta T)\, 100}$$

S_e = spacing between expansion joints

w_j = width of expansion joint

e_j = extensibility of expansion joint material (~ 50%)

k_e = coefficient of moisture expansion (0.0005) **(BIA)**
(TMS 402/ACI 530/ASCE 5 = 0.0003)

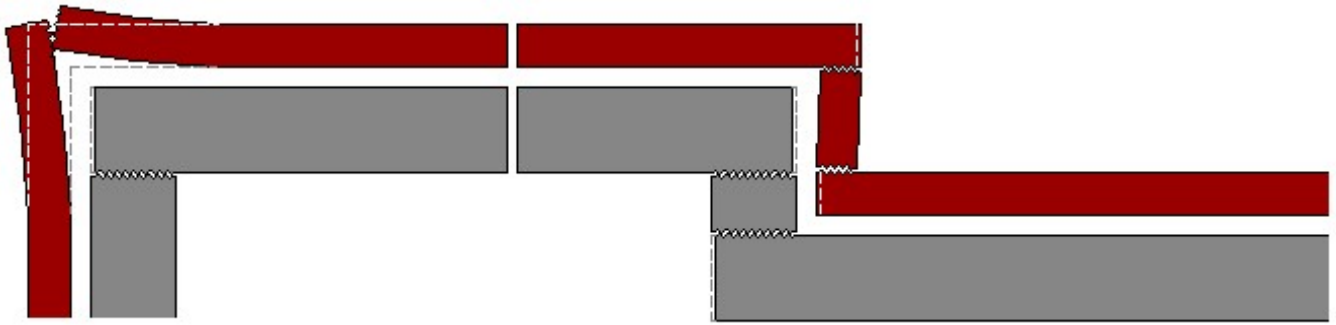
k_f = coefficient of freezing expansion (only if < -10°F and sat.)

k_t = coefficient of thermal expansion (0.000004/°F)

ΔT = temperature change in brickwork

Brick Expansion

	Brick	CMU
Permanent	0.05 %	- 0.035 %
Thermal	0.0004 %/°T	0.00045 %/°T



Example: 100 ft brick wall, 100°F Summer, 40°F Winter

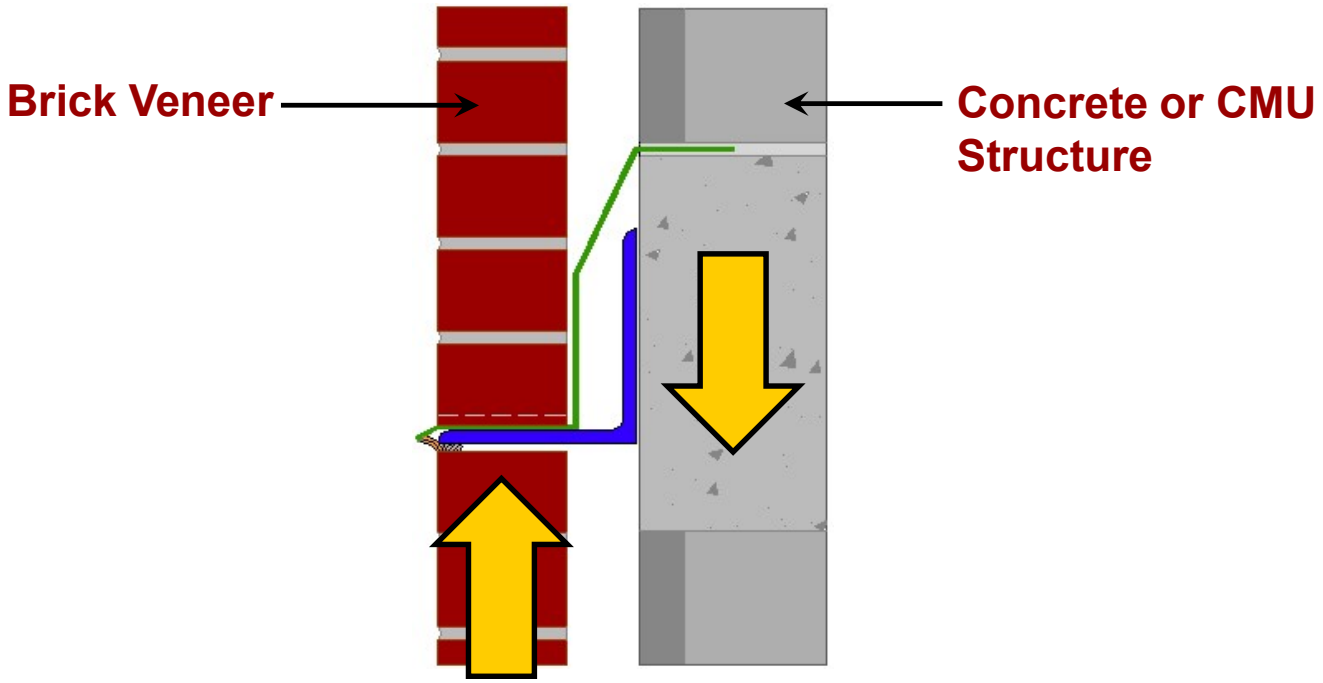
Permanent	100 ft x 12 in/ft x .0005 =	0.6 in.
Thermal	100 ft x 12 in/ft x (100 - 40) x .000004 =	0.288 in.
TOTAL		0.888 in ≈ 7/8 in.

Brick Expansion

- Actual expansion
- over approx. 70’
- of wall.

TYPICAL EXPANSION JOINT LOCATIONS

HORIZONTAL EXPANSION JOINTS



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12.2.2 Prescriptive requirements for anchored masonry veneer

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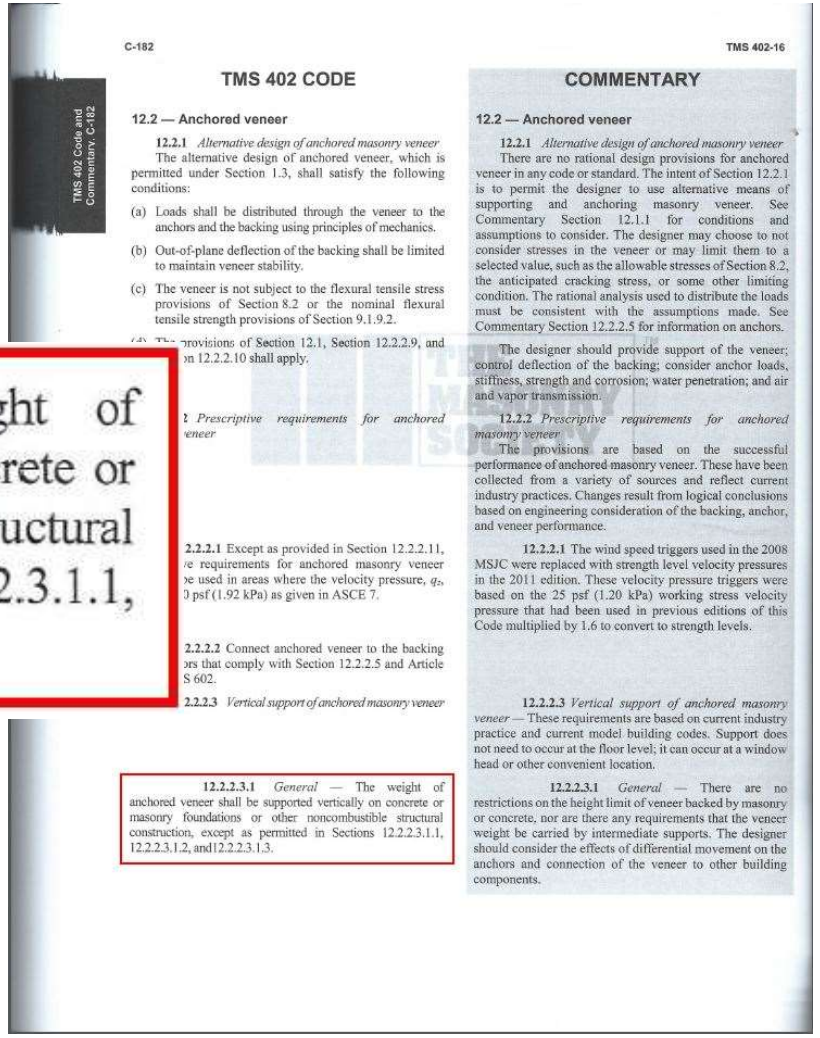
12.2.2.3.1 *General* — The weight of anchored veneer shall be supported vertically on concrete or masonry foundations or other noncombustible structural construction, except as permitted in Sections 12.2.2.3.1.1, 12.2.2.3.1.2, and12.2.2.3.1.3.



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12.2 — Anchored veneer

12.2.1 *Alternative design of anchored masonry veneer*
The alternative design of anchored veneer, which is permitted under Section 1.3, shall satisfy the following conditions:

(a) Loads shall be distributed through the veneer to the anchors and the backing using principles of mechanics.

(b) Out-of-plane deflection of the backing shall be limited to maintain veneer stability.

(c) The veneer is not subject to the flexural tensile stress provisions of Section 8.2 or the nominal flexural tensile strength provisions of Section 9.1.9.2.

(d) The provisions of Section 12.1, Section 12.2.2.9, and Section 12.2.2.10 shall apply.

12.2.2 *Prescriptive requirements for anchored masonry veneer*

12.2.2.1 Except as provided in Section 12.2.2.11, the requirements for anchored masonry veneer shall be used in areas where the velocity pressure, q_z, is 30 psf (1.92 kPa) as given in ASCE 7.

12.2.2.2 Connect anchored veneer to the backing with ties that comply with Section 12.2.2.5 and Article 6.1.6.3 of TMS 602.

12.2.2.3 *Vertical support of anchored masonry veneer*

12.2.2.3.1 *General* — The weight of anchored veneer shall be supported vertically on concrete or masonry foundations or other noncombustible structural construction, except as permitted in Sections 12.2.2.3.1.1, 12.2.2.3.1.2, and12.2.2.3.1.3.

COMMENTARY

12.2 — Anchored veneer

12.2.1 *Alternative design of anchored masonry veneer*
There are no rational design provisions for anchored veneer in any code or standard. The intent of Section 12.2.1 is to permit the designer to use alternative means of supporting and anchoring masonry veneer. See Commentary Section 12.1.1 for conditions and assumptions to consider. The designer may choose to not consider stresses in the veneer or may limit them to a selected value, such as the allowable stresses of Section 8.2, the anticipated cracking stress, or some other limiting condition. The rational analysis used to distribute the loads must be consistent with the assumptions made. See Commentary Section 12.2.2.5 for information on anchors.

The designer should provide support of the veneer; control deflection of the backing; consider anchor loads, stiffness, strength and corrosion; water penetration; and air and vapor transmission.

12.2.2 *Prescriptive requirements for anchored masonry veneer*
The provisions are based on the successful performance of anchored masonry veneer. These have been collected from a variety of sources and reflect current industry practices. Changes result from logical conclusions based on engineering consideration of the backing, anchor, and veneer performance.

12.2.2.1 The wind speed triggers used in the 2008 MSJC were replaced with strength level velocity pressures in the 2011 edition. These velocity pressure triggers were based on the 25 psf (1.20 kPa) working stress velocity pressure that had been used in previous editions of this Code multiplied by 1.6 to convert to strength levels.

12.2.2.3 *Vertical support of anchored masonry veneer* — These requirements are based on current industry practice and current model building codes. Support does not need to occur at the floor level; it can occur at a window head or other convenient location.

12.2.2.3.1 *General* — There are no restrictions on the height limit of veneer backed by masonry or concrete, nor are there any requirements that the veneer weight be carried by intermediate supports. The designer should consider the effects of differential movement on the anchors and connection of the veneer to other building components.

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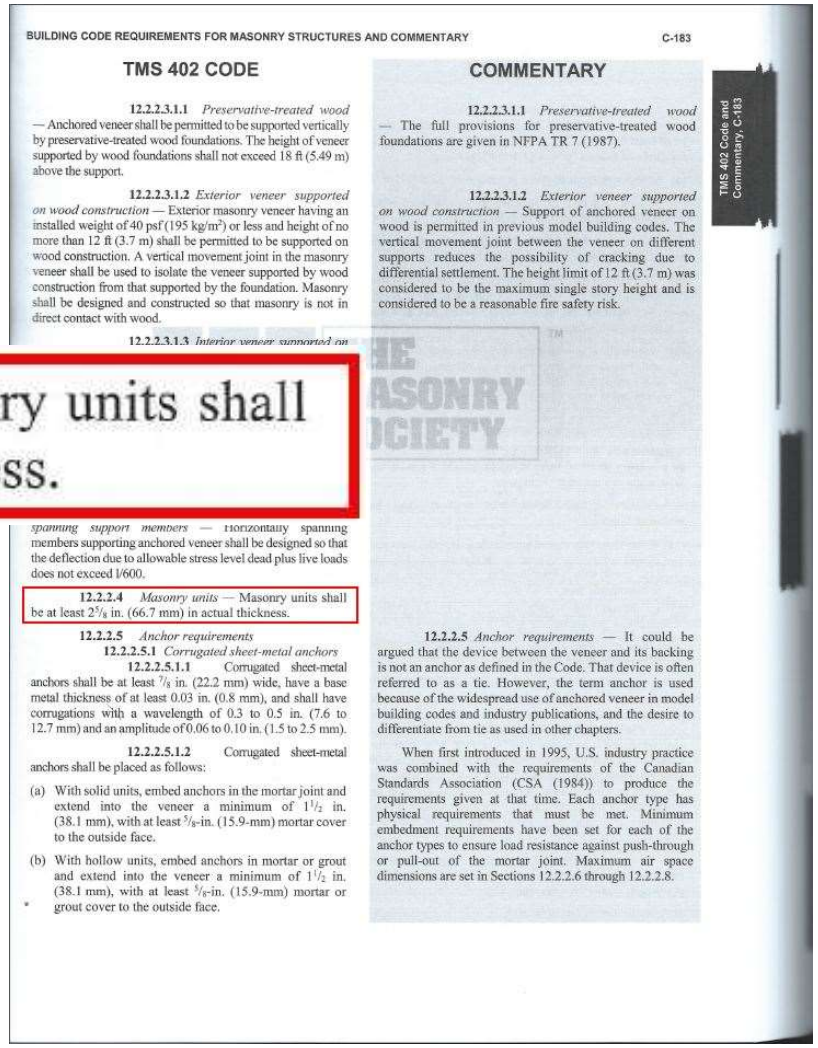
12.2.2.4 *Masonry units* — Masonry units shall be at least $2^5/_8$ in. (66.7 mm) in actual thickness.



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TMS 402 CODE

12.2.2.3.1.1 *Preservative-treated wood* — Anchored veneer shall be permitted to be supported vertically by preservative-treated wood foundations. The height of veneer supported by wood foundations shall not exceed 18 ft (5.49 m) above the support.

12.2.2.3.1.2 *Exterior veneer supported on wood construction* — Exterior masonry veneer having an installed weight of 40 psf (195 kg/m²) or less and height of no more than 12 ft (3.7 m) shall be permitted to be supported on wood construction. A vertical movement joint in the masonry veneer shall be used to isolate the veneer supported by wood construction from that supported by the foundation. Masonry shall be designed and constructed so that masonry is not in direct contact with wood.

12.2.2.3.1.3 *Interior veneer supported on*

spanning support members — Horizontally spanning members supporting anchored veneer shall be designed so that the deflection due to allowable stress level dead plus live loads does not exceed l/600.

12.2.2.4 *Masonry units* — Masonry units shall be at least $2^5/_8$ in. (66.7 mm) in actual thickness.

12.2.2.5 *Anchor requirements*

12.2.2.5.1 *Corrugated sheet-metal anchors*

12.2.2.5.1.1 Corrugated sheet-metal anchors shall be at least $^7/_8$ in. (22.2 mm) wide, have a base metal thickness of at least 0.03 in. (0.8 mm), and shall have corrugations with a wavelength of 0.3 to 0.5 in. (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 in. (1.5 to 2.5 mm).

12.2.2.5.1.2 Corrugated sheet-metal anchors shall be placed as follows:

(a) With solid units, embed anchors in the mortar joint and extend into the veneer a minimum of $1^1/_2$ in. (38.1 mm), with at least $^5/_8$-in. (15.9-mm) mortar cover to the outside face.

(b) With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of $1^1/_2$ in. (38.1 mm), with at least $^5/_8$-in. (15.9-mm) mortar or grout cover to the outside face.

COMMENTARY

12.2.2.3.1.1 *Preservative-treated wood* — The full provisions for preservative-treated wood foundations are given in NFPA TR 7 (1987).

12.2.2.3.1.2 *Exterior veneer supported on wood construction* — Support of anchored veneer on wood is permitted in previous model building codes. The vertical movement joint between the veneer on different supports reduces the possibility of cracking due to differential settlement. The height limit of 12 ft (3.7 m) was considered to be the maximum single story height and is considered to be a reasonable fire safety risk.

12.2.2.5 *Anchor requirements* — It could be argued that the device between the veneer and its backing is not an anchor as defined in the Code. That device is often referred to as a tie. However, the term anchor is used because of the widespread use of anchored veneer in model building codes and industry publications, and the desire to differentiate from tie as used in other chapters.

When first introduced in 1995, U.S. industry practice was combined with the requirements of the Canadian Standards Association (CSA (1984)) to produce the requirements given at that time. Each anchor type has physical requirements that must be met. Minimum embedment requirements have been set for each of the anchor types to ensure load resistance against push-through or pull-out of the mortar joint. Maximum air space dimensions are set in Sections 12.2.2.6 through 12.2.2.8.

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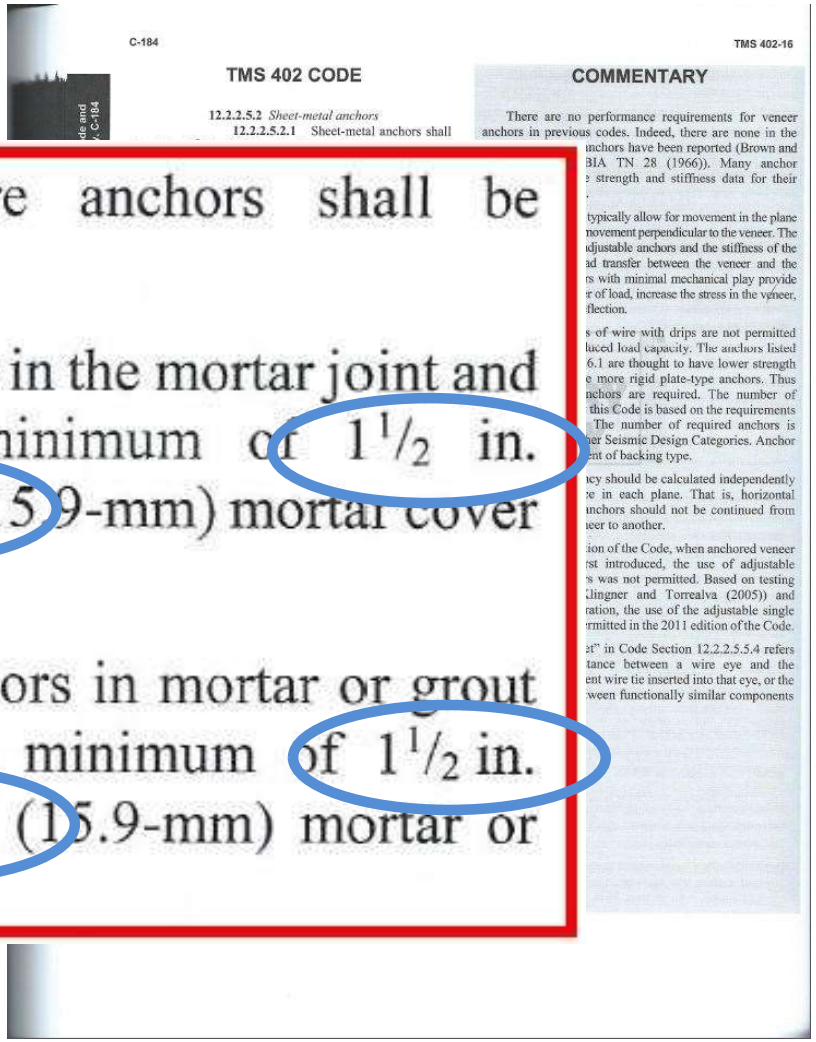

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12.2.2.5.2 *Sheet-metal anchors*

12.2.2.5.2.1 Sheet-metal anchors shall

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COMMENTARY

There are no performance requirements for veneer anchors in previous codes. Indeed, there are none in the

nchors have been reported (Brown and

BIA TN 28 (1966)). Many anchor

e strength and stiffness data for their

typically allow for movement in the plane

novement perpendicular to the veneer. The

djustable anchors and the stiffness of the

d transfer between the veneer and the

s with minimal mechanical play provide

r of load, increase the stress in the veneer,

flection.

s of wire with drips are not permitted

luced load capacity. The anchors listed

6.1 are thought to have lower strength

e more rigid plate-type anchors. Thus

nchors are required. The number of

this Code is based on the requirements

The number of required anchors is

her Seismic Design Categories. Anchor

ent of backing type.

ncy should be calculated independently

e in each plane. That is, horizontal

nchors should not be continued from

eer to another.

ion of the Code, when anchored veneer

st introduced, the use of adjustable

s was not permitted. Based on testing

Klingner and Torrealva (2005)) and

ration, the use of the adjustable single

rmitted in the 2011 edition of the Code.

et" in Code Section 12.2.2.5.5.4 refers

tance between a wire eye and the

ent wire tie inserted into that eye, or the

ween functionally similar components

12.2.2.5.3.2 Wire anchors shall be placed as follows:

(a) With solid units, embed anchors in the mortar joint and extend into the veneer a minimum of $1^1/_2$ in. (38.1 mm), with at least $^5/_8$-in. (15.9-mm) mortar cover to the outside face.

(b) With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of $1^1/_2$ in. (38.1 mm), with at least $^5/_8$-in. (15.9-mm) mortar or grout cover to the outside face.

1½ IN. MINIMUM ANCHOR EMBEDMENT

AT LEAST 5/8 IN. (15.9 MM) MORTAR COVER TO THE OUTSIDE FACE.

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12.2.2.5.5.4 Pintle anchors shall have one or more pintle legs of wire size W2.8 (MW18) and shall have an offset not exceeding $1^1/_4$ in. (31.8 mm).

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12.2.2.5.5 *Adjustable anchors*

12.2.2.5.5.1 Sheet-metal and wire components of adjustable anchors shall conform to the requirements of Section 12.2.2.5.2 or 12.2.2.5.3. Adjustable anchors with joint reinforcement shall also meet the requirements of Section 12.2.2.5.4.

12.2.2.5.5.2 Maximum clearance between connecting parts of the tie shall be $^1/_{16}$ in. (1.6 mm).

12.2.2.5.5.3 Adjustable anchors shall be detailed to prevent disengagement.

12.2.2.5.5.4 Pintle anchors shall have one or more pintle legs of wire size W2.8 (MW18) and shall have an offset not exceeding $1^1/_4$ in. (31.8 mm).

12.2.2.5.5.5 When the distance between the inside face of the veneer and the backing exceeds $4^5/_8$ in. (117 mm), adjustable anchors shall also conform to the

2.2.5.5.2.

The adjustable more wires of m the inside face part shall be a

Part of anchor here backing is the part of the el anchor with a); or a plate or ick and $1^1/_4$ in. the part of the el anchor with a minimum outside diameter of $^1/_4$ in. (6.4 mm); or a plate or prong anchor at least 0.074 in. (1.88 mm) thick and $1^1/_4$ in. (31.8 mm) wide; or a tab or two ends of minimum size W2.8 (MW18) wire welded to joint reinforcement

12.2.2.5.5.6 Adjustable anchors of equivalent strength and stiffness to those specified in Sections 12.2.2.5.5.1 through 12.2.2.5.5.5 are permitted.

12.2.2.5.6 *Anchor spacing*

12.2.2.5.6.1 For adjustable two-piece anchors, anchors of wire size W1.7 (MW11), and 22 gage (0.8 mm) corrugated sheet-metal anchors, provide at least one anchor for each 2.67 ft² (0.25 m²) of wall area.

12.2.2.5.6.2 For other anchors, provide at least one anchor for each 3.5 ft² (0.33 m²) of wall area.

12.2.2.5.6.3 Space anchors at a maximum of 32 in. (813 mm) horizontally and 25 in. (635 mm) vertically, but not to exceed the applicable requirements of Section 12.2.2.5.6.1 or 12.2.2.5.6.2.

12.2.2.5.6.4 Provide additional anchors around openings larger than 16 in. (406 mm) in either dimension. Space anchors around perimeter of

COMMENTARY

12.2.2.5.5.5 For distances that exceed $4^5/_8$ in. (117 mm) between the inside face of the veneer and the backing, adjustable anchors must meet additional requirements. A cross section through a wall with such an anchor is shown in Figure CC-12.2-1. The distance from the inside face of the veneer to the end of the adjustable part is limited to 2 in. (51 mm).

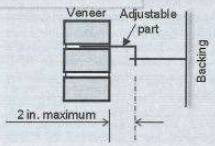

Figure CC-12.2-1 — Adjustable anchor for distances that exceed $4^5/_8$ in. (117 mm) between the inside face of

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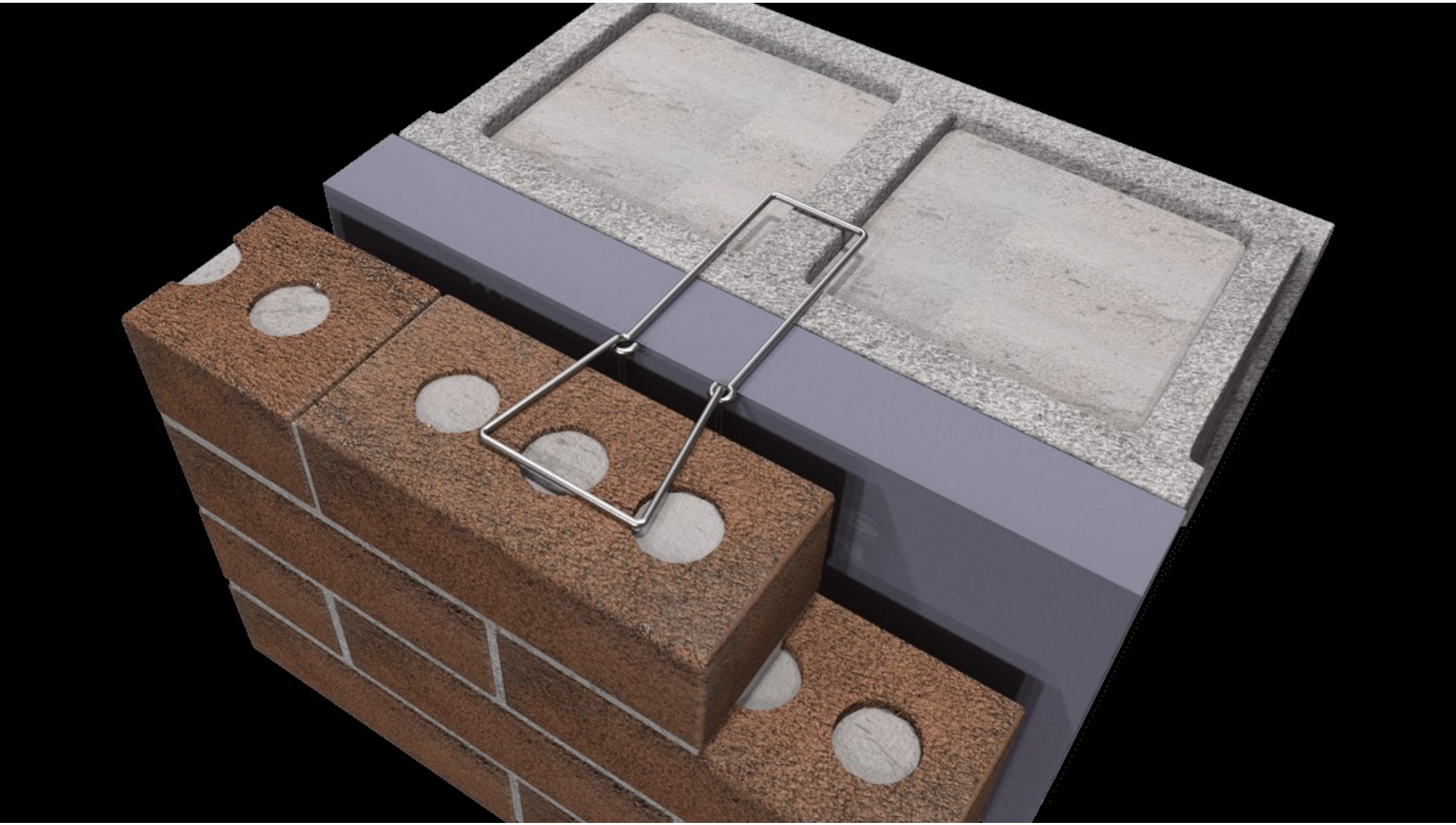
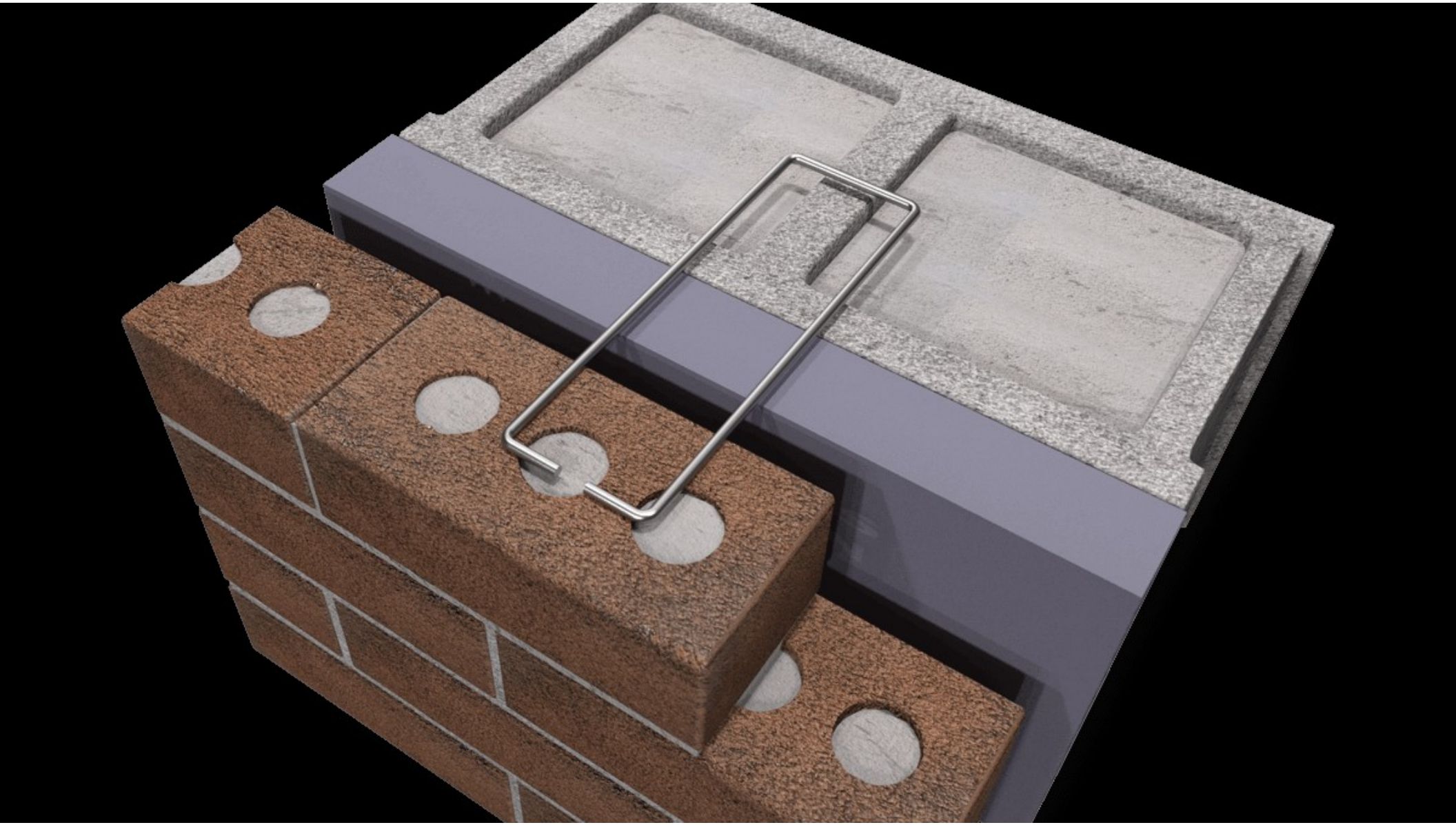
(W2.8 ≈ 3/16 dia.)





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12.2.2.5.6.3 Space anchors at a maximum of 32 in. (813 mm) horizontally and 25 in. (635 mm) vertically, but not to exceed the applicable requirements of Section 12.2.2.5.6.1 or 12.2.2.5.6.2.

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12.2.2.5 *Adjustable anchors*

12.2.2.5.1 Sheet-metal and wire components of adjustable anchors shall conform to the requirements of Section 12.2.2.5.2 or 12.2.2.5.3. Adjustable anchors with joint reinforcement shall also meet the requirements of Section 12.2.2.5.4.

12.2.2.5.2 Maximum clearance between connecting parts of the tie shall be $^1/_{16}$ in. (1.6 mm).

12.2.2.5.3 Adjustable anchors shall be detailed to prevent disengagement.

12.2.2.5.4 Pintle anchors shall have one or more pintle legs of wire size W2.8 (MW18) and shall

prong anchor at least 0.074 in. (1.88 mm) thick and 1¼ in. (31.8 mm) wide; or a tab or two eyes formed of minimum size W2.8 (MW18) wire welded to joint reinforcement.

12.2.2.5.6 Adjustable anchors of equivalent strength and stiffness to those specified in Sections 12.2.2.5.5.1 through 12.2.2.5.5.5 are permitted.

12.2.2.5.6 *Anchor spacing*

12.2.2.5.6.1 For adjustable two-piece anchors, anchors of wire size W1.7 (MW11), and 22 gage (0.8 mm) corrugated sheet-metal anchors, provide at least one anchor for each 2.67 ft² (0.25 m²) of wall area.

12.2.2.5.6.2 For other anchors, provide at least one anchor for each 3.5 ft² (0.33 m²) of wall area.

12.2.2.5.6.3 Space anchors at a maximum of 32 in. (813 mm) horizontally and 25 in. (635 mm) vertically, but not to exceed the applicable requirements of Section 12.2.2.5.6.1 or 12.2.2.5.6.2.

12.2.2.5.6.4 Provide additional anchors around openings larger than 16 in. (406 mm) in either dimension. Space anchors around perimeter of

COMMENTARY

12.2.2.5.5 For distances that exceed 4⅝ in. (117 mm) between the inside face of the veneer and the backing, adjustable anchors must meet additional requirements. A cross section through a wall with such an anchor is shown in Figure CC-12.2-1. The distance from the inside face of the veneer to the end of the adjustable part is limited to 2 in. (51 mm).

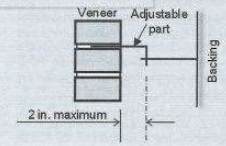

Figure CC-12.2-1 — Adjustable anchor for distances that exceed 4⅝ in. (117 mm) between the inside face of the veneer and the backing

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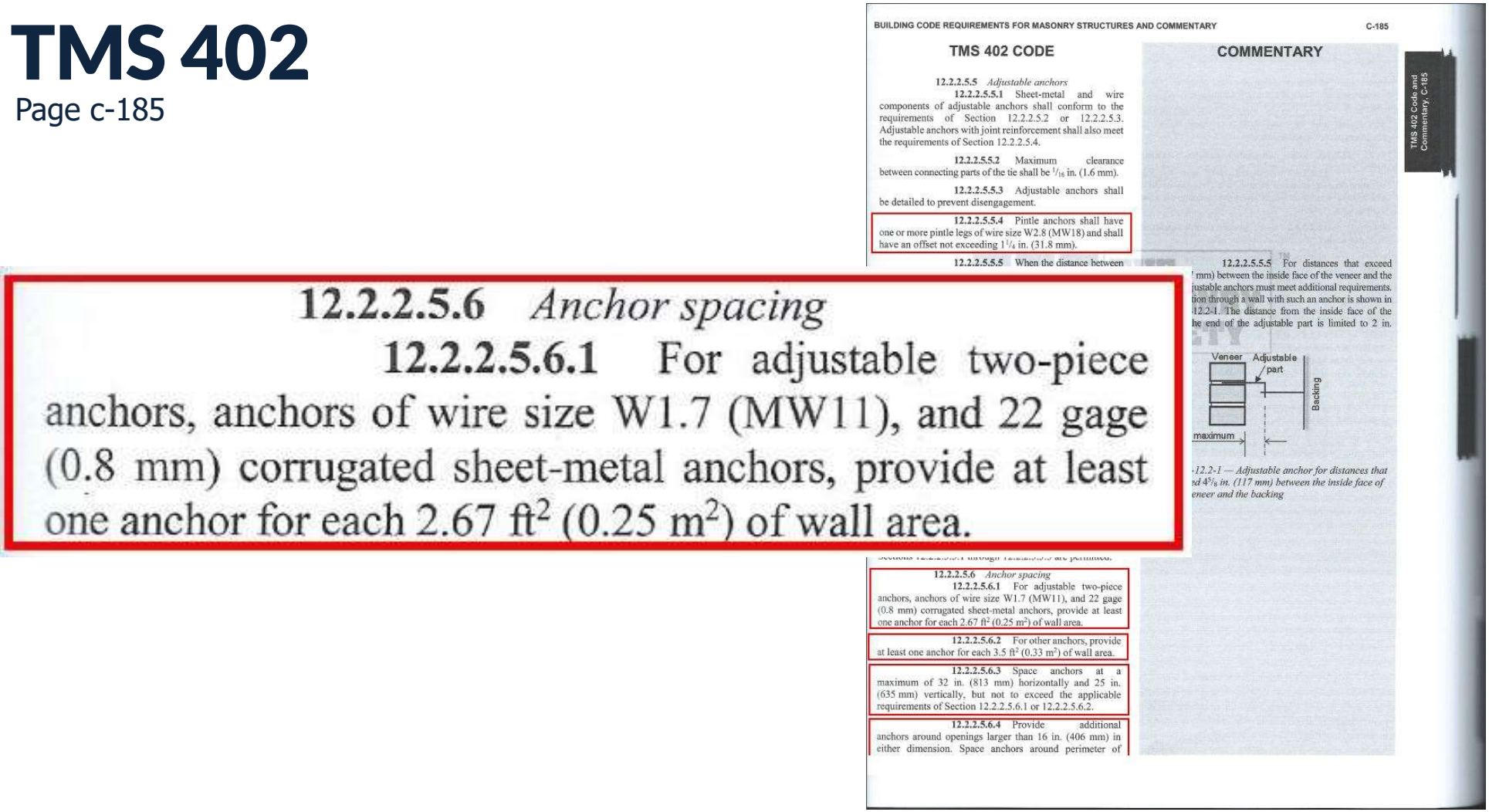

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COMMENTARY

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12.2.2.5 *Adjustable anchors*

12.2.2.5.1 Sheet-metal and wire components of adjustable anchors shall conform to the requirements of Section 12.2.2.5.2 or 12.2.2.5.3. Adjustable anchors with joint reinforcement shall also meet the requirements of Section 12.2.2.5.4.

12.2.2.5.2 Maximum clearance between connecting parts of the tie shall be 1/16 in. (1.6 mm).

12.2.2.5.3 Adjustable anchors shall be detailed to prevent disengagement.

12.2.2.5.4 Pintle anchors shall have one or more pintle legs of wire size W2.8 (MW18) and shall have an offset not exceeding 1 1/4 in. (31.8 mm).

12.2.2.5.5 When the distance between

12.2.2.5.5 For distances that exceed mm) between the inside face of the veneer and the justable anchors must meet additional requirements. tion through a wall with such an anchor is shown in 12.2-1. The distance from the inside face of the he end of the adjustable part is limited to 2 in.

Veneer Adjustable part Backing maximum

12.2-1 — Adjustable anchor for distances that ed 4 5/8 in. (117 mm) between the inside face of eneer and the backing

12.2.2.5.6 *Anchor spacing*

12.2.2.5.6.1 For adjustable two-piece anchors, anchors of wire size W1.7 (MW11), and 22 gage (0.8 mm) corrugated sheet-metal anchors, provide at least one anchor for each 2.67 ft^2 (0.25 m^2) of wall area.

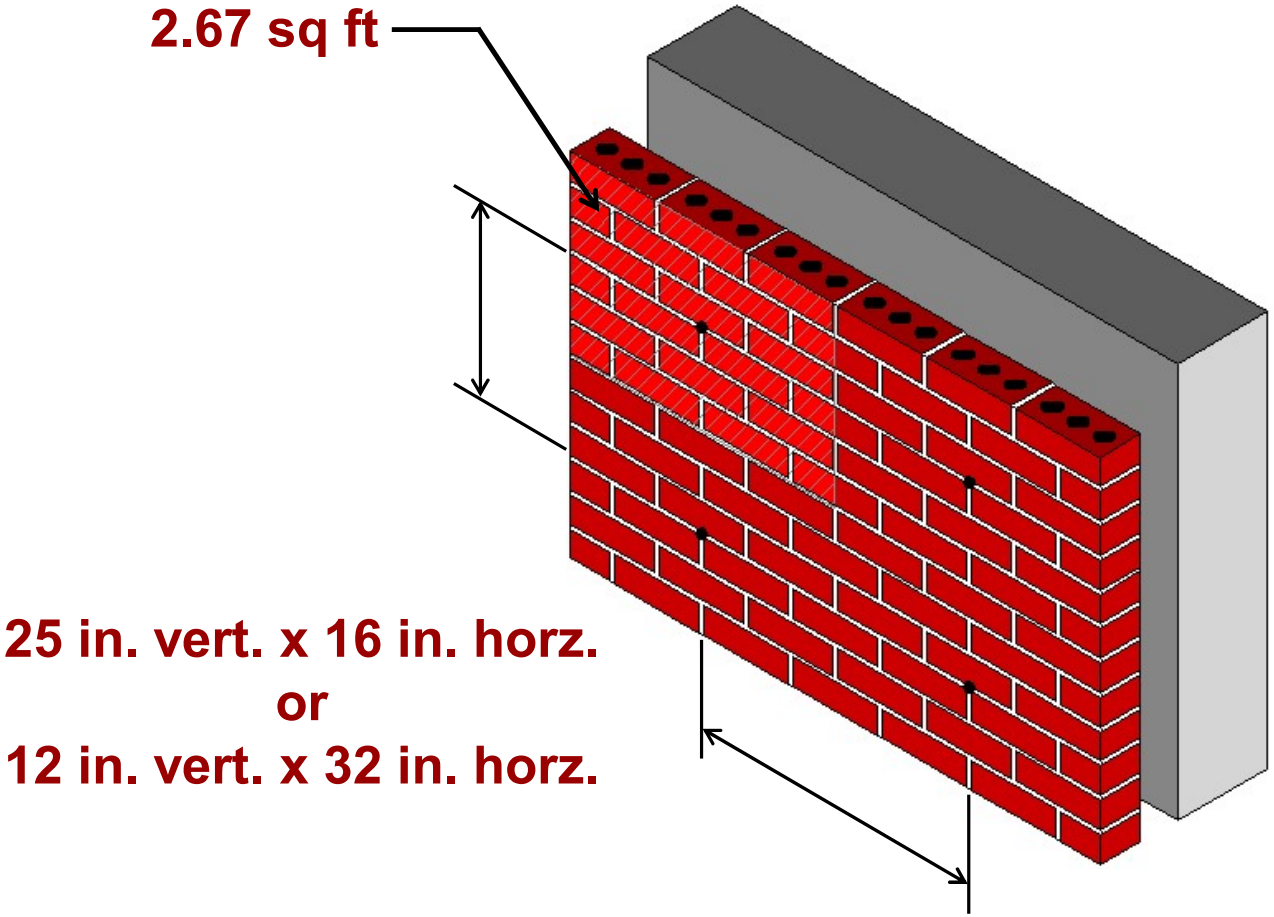
12.2.2.5.6.2 For other anchors, provide at least one anchor for each 3.5 ft^2 (0.33 m^2) of wall area.

12.2.2.5.6.3 Space anchors at a maximum of 32 in. (813 mm) horizontally and 25 in. (635 mm) vertically, but not to exceed the applicable requirements of Section 12.2.2.5.6.1 or 12.2.2.5.6.2.

12.2.2.5.6.4 Provide additional anchors around openings larger than 16 in. (406 mm) in either dimension. Space anchors around perimeter of

12.2.2.5.6 *Anchor spacing*

12.2.2.5.6.1 For adjustable two-piece anchors, anchors of wire size W1.7 (MW11), and 22 gage (0.8 mm) corrugated sheet-metal anchors, provide at least one anchor for each 2.67 ft^2 (0.25 m^2) of wall area.


2.67 sq ft
25 in. vert. x 16 in. horz.
or
12 in. vert. x 32 in. horz.

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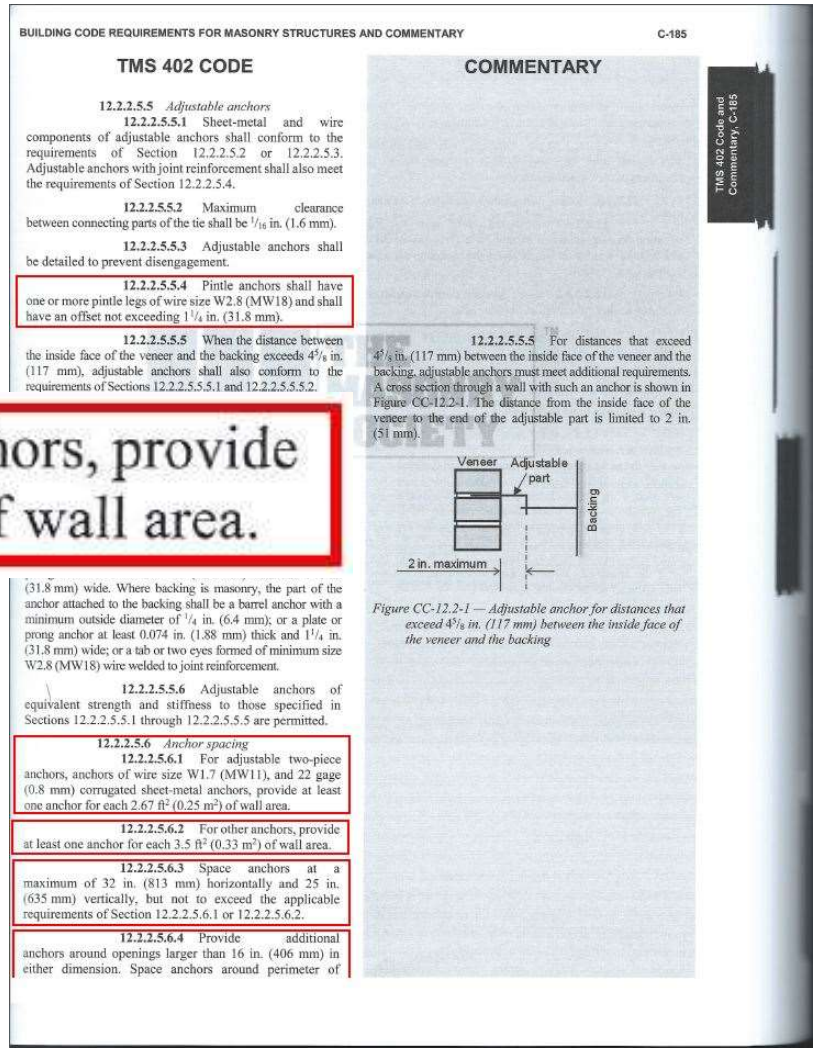
12.2.2.5.6.2 For other anchors, provide at least one anchor for each 3.5 ft^2 (0.33 m^2) of wall area.

HEAVIER GAUGE ANCHORS



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COMMENTARY

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12.2.2.5.5 *Adjustable anchors*

12.2.2.5.5.1 Sheet-metal and wire components of adjustable anchors shall conform to the requirements of Section 12.2.2.5.2 or 12.2.2.5.3. Adjustable anchors with joint reinforcement shall also meet the requirements of Section 12.2.2.5.4.

12.2.2.5.5.2 Maximum clearance between connecting parts of the tie shall be 1/16 in. (1.6 mm).

12.2.2.5.5.3 Adjustable anchors shall be detailed to prevent disengagement.

12.2.2.5.5.4 Pintle anchors shall have one or more pintle legs of wire size W2.8 (MW18) and shall have an offset not exceeding 1 1/4 in. (31.8 mm).

12.2.2.5.5.5 When the distance between the inside face of the veneer and the backing exceeds 4 5/8 in. (117 mm), adjustable anchors shall also conform to the requirements of Sections 12.2.2.5.5.5.1 and 12.2.2.5.5.5.2.

(31.8 mm) wide. Where backing is masonry, the part of the anchor attached to the backing shall be a barrel anchor with a minimum outside diameter of 1/4 in. (6.4 mm); or a plate or prong anchor at least 0.074 in. (1.88 mm) thick and 1 1/4 in. (31.8 mm) wide; or a tab or two eyes formed of minimum size W2.8 (MW18) wire welded to joint reinforcement.

12.2.2.5.5.6 Adjustable anchors of equivalent strength and stiffness to those specified in Sections 12.2.2.5.5.1 through 12.2.2.5.5.5 are permitted.

12.2.2.5.6 *Anchor spacing*

12.2.2.5.6.1 For adjustable two-piece anchors, anchors of wire size W1.7 (MW11), and 22 gage (0.8 mm) corrugated sheet-metal anchors, provide at least one anchor for each 2.67 ft^2 (0.25 m^2) of wall area.

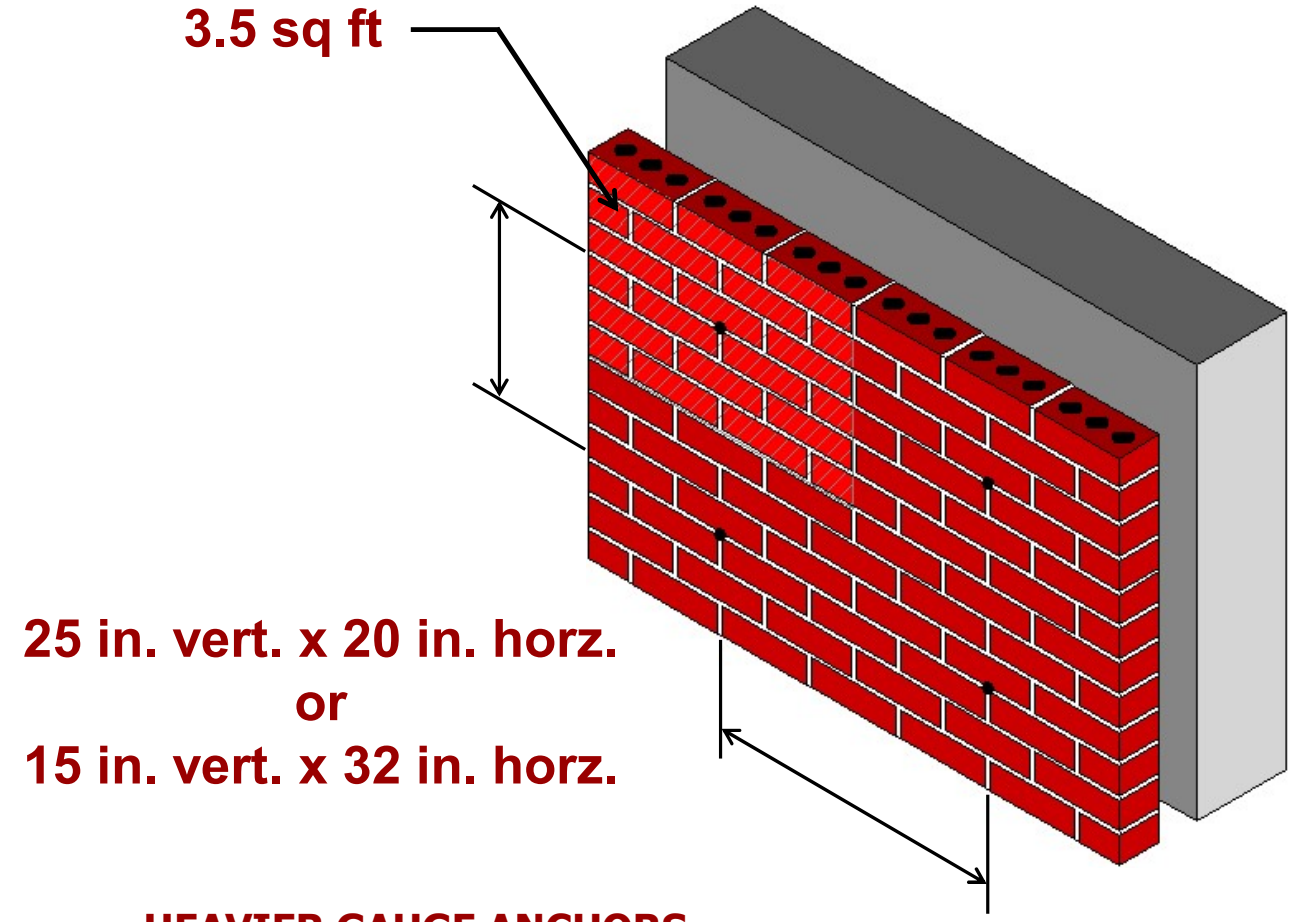
12.2.2.5.6.2 For other anchors, provide at least one anchor for each 3.5 ft^2 (0.33 m^2) of wall area.

12.2.2.5.6.3 Space anchors at a maximum of 32 in. (813 mm) horizontally and 25 in. (635 mm) vertically, but not to exceed the applicable requirements of Section 12.2.2.5.6.1 or 12.2.2.5.6.2.

12.2.2.5.6.4 Provide additional anchors around openings larger than 16 in. (406 mm) in either dimension. Space anchors around perimeter of

12.2.2.5.5.5 For distances that exceed 4 5/8 in. (117 mm) between the inside face of the veneer and the backing, adjustable anchors must meet additional requirements. A cross section through a wall with such an anchor is shown in Figure CC-12.2-1. The distance from the inside face of the veneer to the end of the adjustable part is limited to 2 in. (51 mm).

Figure CC-12.2-1 — Adjustable anchor for distances that exceed 4 5/8 in. (117 mm) between the inside face of the veneer and the backing



HEAVIER GAUGE ANCHORS

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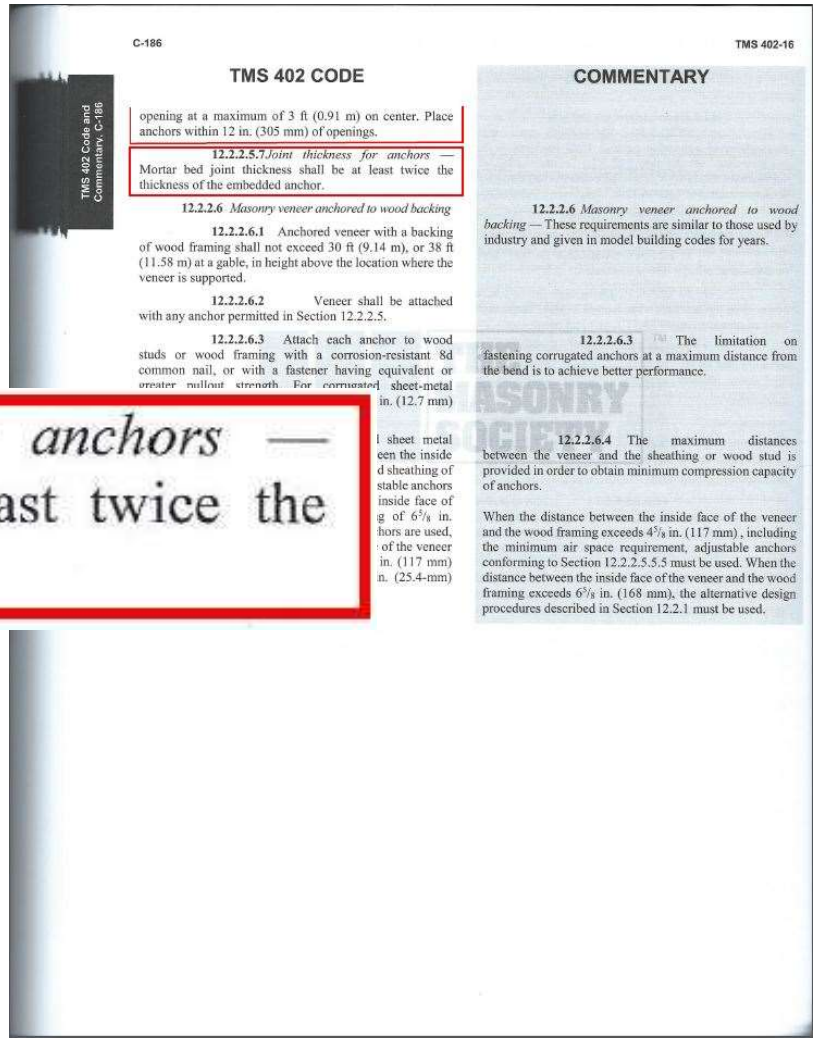

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opening at a maximum of 3 ft (0.91 m) on center. Place anchors within 12 in. (305 mm) of openings.

12.2.2.5.7 *Joint thickness for anchors* — Mortar bed joint thickness shall be at least twice the thickness of the embedded anchor.

12.2.2.6 *Masonry veneer anchored to wood backing*

12.2.2.6.1 Anchored veneer with a backing of wood framing shall not exceed 30 ft (9.14 m), or 38 ft (11.58 m) at a gable, in height above the location where the veneer is supported.

12.2.2.6.2 Veneer shall be attached with any anchor permitted in Section 12.2.2.5.

12.2.2.6.3 Attach each anchor to wood studs or wood framing with a corrosion-resistant 8d common nail, or with a fastener having equivalent or greater pullout strength. For corrugated sheet-metal

in. (12.7 mm)

l sheet metal
een the inside
d sheathing of
stable anchors
inside face of
g of $6^5/_8$ in.
hors are used,
of the veneer
in. (117 mm)
n. (25.4-mm)

COMMENTARY

12.2.2.6 *Masonry veneer anchored to wood backing* — These requirements are similar to those used by industry and given in model building codes for years.

12.2.2.6.3 The limitation on fastening corrugated anchors at a maximum distance from the bend is to achieve better performance.

12.2.2.6.4 The maximum distances between the veneer and the sheathing or wood stud is provided in order to obtain minimum compression capacity of anchors.

When the distance between the inside face of the veneer and the wood framing exceeds $4^5/_8$ in. (117 mm), including the minimum air space requirement, adjustable anchors conforming to Section 12.2.2.5.5.5 must be used. When the distance between the inside face of the veneer and the wood framing exceeds $6^5/_8$ in. (168 mm), the alternative design procedures described in Section 12.2.1 must be used.

12.2.2.5.7 *Joint thickness for anchors* — Mortar bed joint thickness shall be at least twice the thickness of the embedded anchor.

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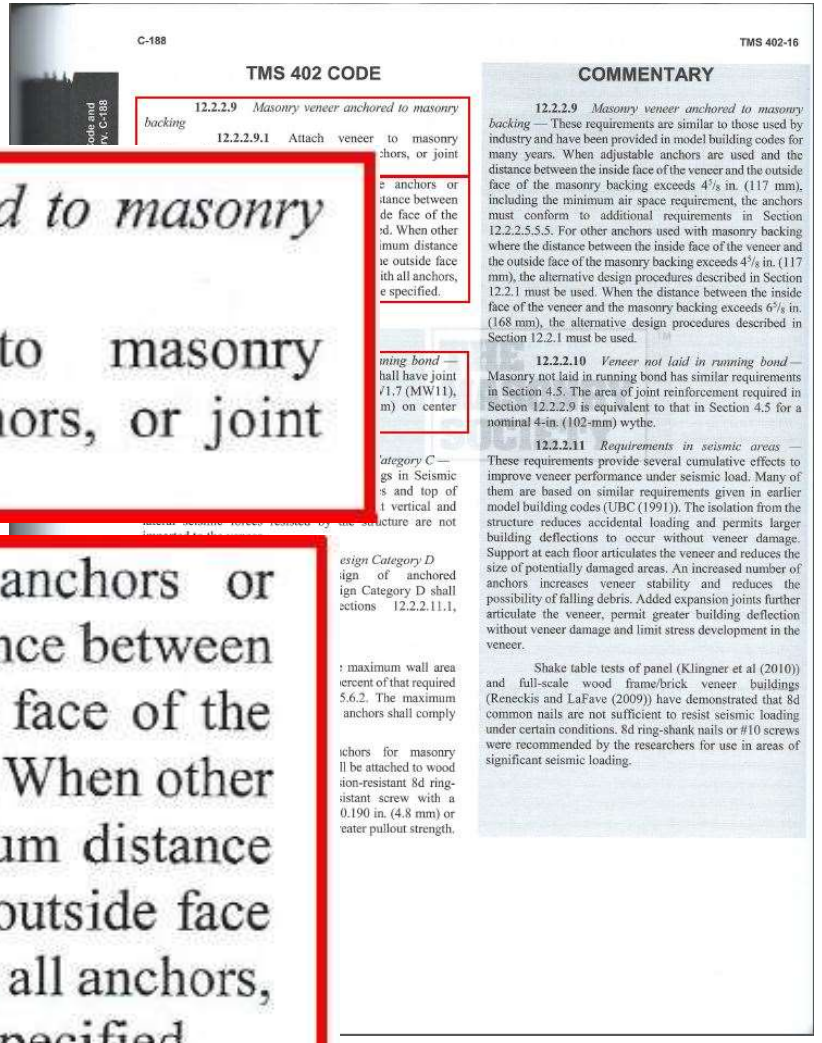

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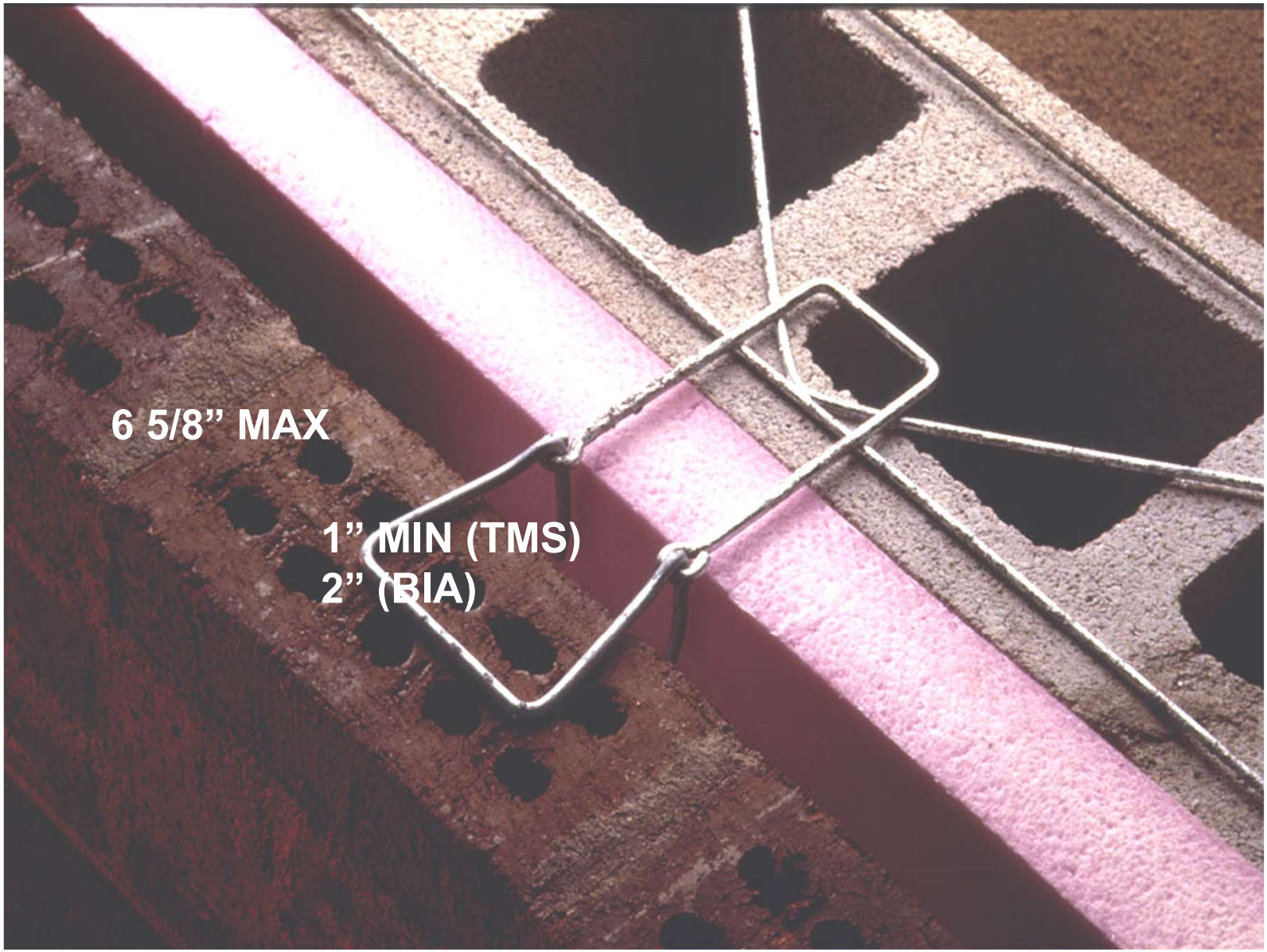
COMMENTARY

12.2.2.9 *Masonry veneer anchored to masonry backing*

12.2.2.9.1 Attach veneer to masonry backing with wire anchors, adjustable anchors, or joint reinforcement.

12.2.2.9.2 When adjustable anchors or joint reinforcement are used, a maximum distance between the inside face of the veneer and the outside face of the backing of $6^5/_8$ in. (168 mm) shall be specified. When other anchors are used, a $4^5/_8$ in. (117 mm) maximum distance between the inside face of the veneer and the outside face of the masonry backing shall be specified. With all anchors, a 1 in. (25.4 mm) minimum air space shall be specified.


6 5/8” MAX
1” MIN (TMS)
2” (BIA)

MINIMUM AIR SPACE

	FBC, Res	FBC, Bldg	TMS 402	BIA*
Wood Stud	1”		1”	1”
Steel Stud	1”		1”	2”
Concrete/ Masonry	1”		1”	2”

*Recommended


2
3

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12.2.2.9 *Masonry veneer anchored to masonry backing*

12.2.2.9.1 Attach veneer to masonry backing with wire anchors, adjustable anchors, or joint reinforcement.

12.2.2.9.2 When adjustable anchors or joint reinforcement are used, a maximum distance between the inside face of the veneer and the outside face of the backing of $6^5/_8$ in. (168 mm) shall be specified. When other anchors are used, a $4^5/_8$ in. (117 mm) maximum distance between the inside face of the veneer and the outside face of the masonry backing shall be specified. With all anchors, a 1 in. (25.4 mm) minimum air space shall be specified.

d in running bond —
g bond shall have joint
of size W1.7 (MW11),
(457 mm) on center

ments
Design Category C —
buildings in Seismic
the sides and top of
e so that vertical and
the structure are not

Design Category D
sign of anchored
sign Category D shall
ections 12.2.2.11.1,

e maximum wall area
percent of that required
in Sections 12.2.2.5.6.1 and 12.2.2.5.6.2. The maximum horizontal and vertical space between anchors shall comply with Section 12.2.2.5.6.3.

12.2.2.11.2.3 Anchors for masonry veneer anchored to wood backing shall be attached to wood studs or wood framing with a corrosion-resistant 8d ring-shank nail, a No. 10 corrosion-resistant screw with a minimum nominal shank diameter of 0.190 in. (4.8 mm) or with a fastener having equivalent or greater pullout strength.

COMMENTARY

12.2.2.9 *Masonry veneer anchored to masonry backing* — These requirements are similar to those used by industry and have been provided in model building codes for many years. When adjustable anchors are used and the distance between the inside face of the veneer and the outside face of the masonry backing exceeds $4^5/_8$ in. (117 mm), including the minimum air space requirement, the anchors must conform to additional requirements in Section 12.2.2.5.5.5. For other anchors used with masonry backing where the distance between the inside face of the veneer and the outside face of the masonry backing exceeds $4^5/_8$ in. (117 mm), the alternative design procedures described in Section 12.2.1 must be used. When the distance between the inside face of the veneer and the masonry backing exceeds $6^5/_8$ in. (168 mm), the alternative design procedures described in Section 12.2.1 must be used.

12.2.2.10 *Veneer not laid in running bond* — Masonry not laid in running bond has similar requirements in Section 4.5. The area of joint reinforcement required in Section 12.2.2.9 is equivalent to that in Section 4.5 for a nominal 4-in. (102-mm) wythe.

12.2.2.11 *Requirements in seismic areas* — These requirements provide several cumulative effects to improve veneer performance under seismic load. Many of them are based on similar requirements given in earlier model building codes (UBC (1991)). The isolation from the structure reduces accidental loading and permits larger building deflections to occur without veneer damage. Support at each floor articulates the veneer and reduces the size of potentially damaged areas. An increased number of anchors increases veneer stability and reduces the possibility of falling debris. Added expansion joints further articulate the veneer, permit greater building deflection without veneer damage and limit stress development in the veneer.

Shake table tests of panel (Klingner et al (2010)) and full-scale wood frame/brick veneer buildings (Reneckis and LaFave (2009)) have demonstrated that 8d common nails are not sufficient to resist seismic loading under certain conditions. 8d ring-shank nails or #10 screws were recommended by the researchers for use in areas of significant seismic loading.

12.2.2.10 *Veneer not laid in running bond* — Anchored veneer not laid in running bond shall have joint reinforcement of at least one wire, of size W1.7 (MW11), spaced at a maximum of 18 in. (457 mm) on center vertically.

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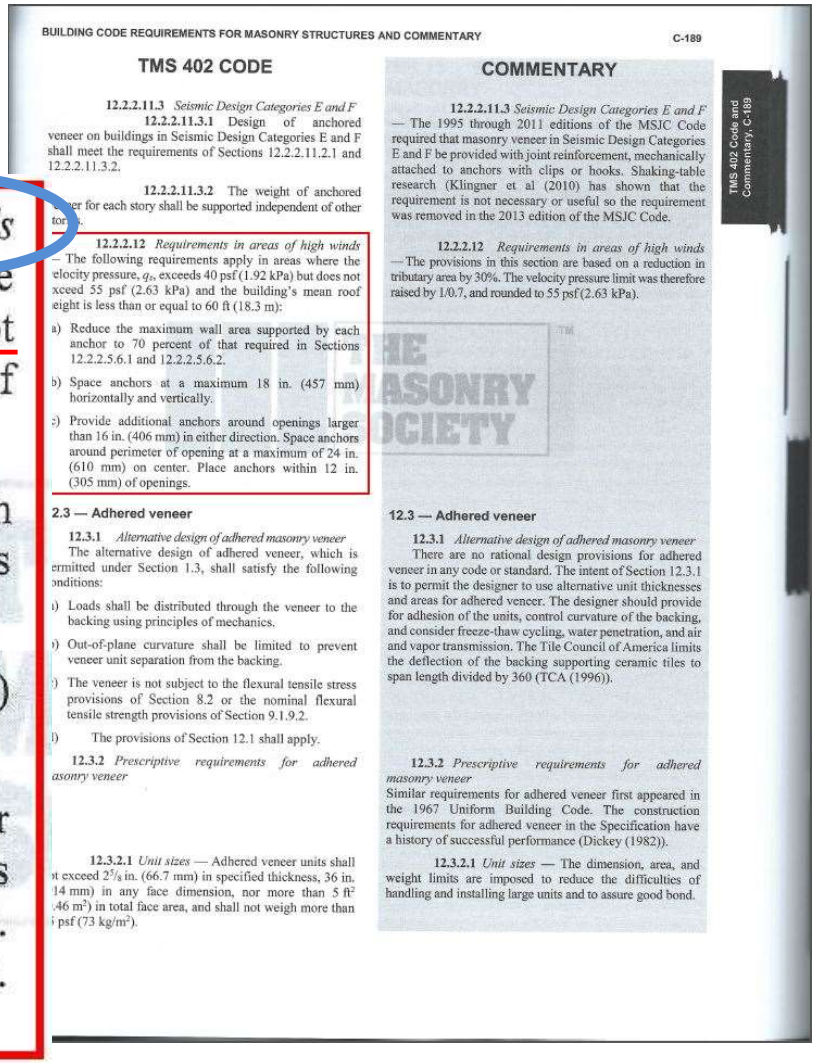
12.2.2.12 *Requirements in areas of high winds* — The following requirements apply in areas where the velocity pressure, q_z, exceeds 40 psf (1.92 kPa) but does not exceed 55 psf (2.63 kPa) and the building's mean roof height is less than or equal to 60 ft (18.3 m):

(a) Reduce the maximum wall area supported by each anchor to 70 percent of that required in Sections 12.2.2.5.6.1 and 12.2.2.5.6.2.

(b) Space anchors at a maximum 18 in. (457 mm) horizontally and vertically.

(c) Provide additional anchors around openings larger than 16 in. (406 mm) in either direction. Space anchors around perimeter of opening at a maximum of 24 in. (610 mm) on center. Place anchors within 12 in. (305 mm) of openings.



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TMS 402 CODE

12.2.2.11.3 *Seismic Design Categories E and F*

12.2.2.11.3.1 Design of anchored veneer on buildings in Seismic Design Categories E and F shall meet the requirements of Sections 12.2.2.11.2.1 and 12.2.2.11.3.2.

12.2.2.11.3.2 The weight of anchored ...er for each story shall be supported independent of other ...tor...

12.2.2.12 *Requirements in areas of high winds* — The following requirements apply in areas where the velocity pressure, q_z, exceeds 40 psf (1.92 kPa) but does not exceed 55 psf (2.63 kPa) and the building's mean roof height is less than or equal to 60 ft (18.3 m):

a) Reduce the maximum wall area supported by each anchor to 70 percent of that required in Sections 12.2.2.5.6.1 and 12.2.2.5.6.2.

b) Space anchors at a maximum 18 in. (457 mm) horizontally and vertically.

c) Provide additional anchors around openings larger than 16 in. (406 mm) in either direction. Space anchors around perimeter of opening at a maximum of 24 in. (610 mm) on center. Place anchors within 12 in. (305 mm) of openings.

2.3 — Adhered veneer

12.3.1 *Alternative design of adhered masonry veneer*

The alternative design of adhered veneer, which is ...ermitted under Section 1.3, shall satisfy the following ...onditions:

...) Loads shall be distributed through the veneer to the backing using principles of mechanics.

...) Out-of-plane curvature shall be limited to prevent veneer unit separation from the backing.

...) The veneer is not subject to the flexural tensile stress provisions of Section 8.2 or the nominal flexural tensile strength provisions of Section 9.1.9.2.

...) The provisions of Section 12.1 shall apply.

12.3.2 *Prescriptive requirements for adhered ...asonry veneer*

12.3.2.1 *Unit sizes* — Adhered veneer units shall ...t exceed 2⅝ in. (66.7 mm) in specified thickness, 36 in. (14 mm) in any face dimension, nor more than 5 ft² (.46 m²) in total face area, and shall not weigh more than ... psf (73 kg/m²).

COMMENTARY

12.2.2.11.3 *Seismic Design Categories E and F* — The 1995 through 2011 editions of the MSJC Code required that masonry veneer in Seismic Design Categories E and F be provided with joint reinforcement, mechanically attached to anchors with clips or hooks. Shaking-table research (Klingner et al (2010) has shown that the requirement is not necessary or useful so the requirement was removed in the 2013 edition of the MSJC Code.

12.2.2.12 *Requirements in areas of high winds* — The provisions in this section are based on a reduction in tributary area by 30%. The velocity pressure limit was therefore raised by 1/0.7, and rounded to 55 psf (2.63 kPa).

12.3 — Adhered veneer

12.3.1 *Alternative design of adhered masonry veneer*

There are no rational design provisions for adhered veneer in any code or standard. The intent of Section 12.3.1 is to permit the designer to use alternative unit thicknesses and areas for adhered veneer. The designer should provide for adhesion of the units, control curvature of the backing, and consider freeze-thaw cycling, water penetration, and air and vapor transmission. The Tile Council of America limits the deflection of the backing supporting ceramic tiles to span length divided by 360 (TCA (1996)).

12.3.2 *Prescriptive requirements for adhered masonry veneer*

Similar requirements for adhered veneer first appeared in the 1967 Uniform Building Code. The construction requirements for adhered veneer in the Specification have a history of successful performance (Dickey (1982)).

12.3.2.1 *Unit sizes* — The dimension, area, and weight limits are imposed to reduce the difficulties of handling and installing large units and to assure good bond.

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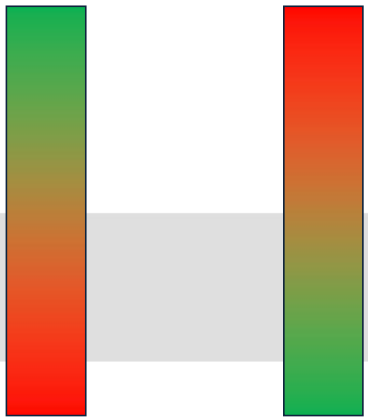
Mortar

MORTAR PROPERTIES

	Type	Use	Strength
	M	Below Grade	2500
	S	Structural	1800
Veneers →	N	General	750
	O	Partitions	350



- Use the lowest strength mortar which does the job

Important Related Issues

Installation

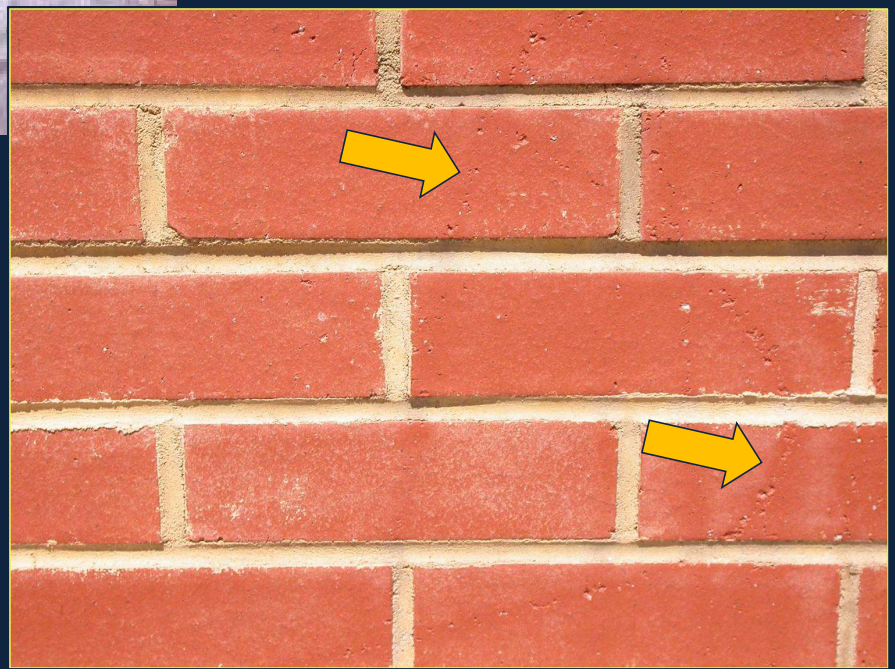
Full Head Joints

Results of partially filled Joints

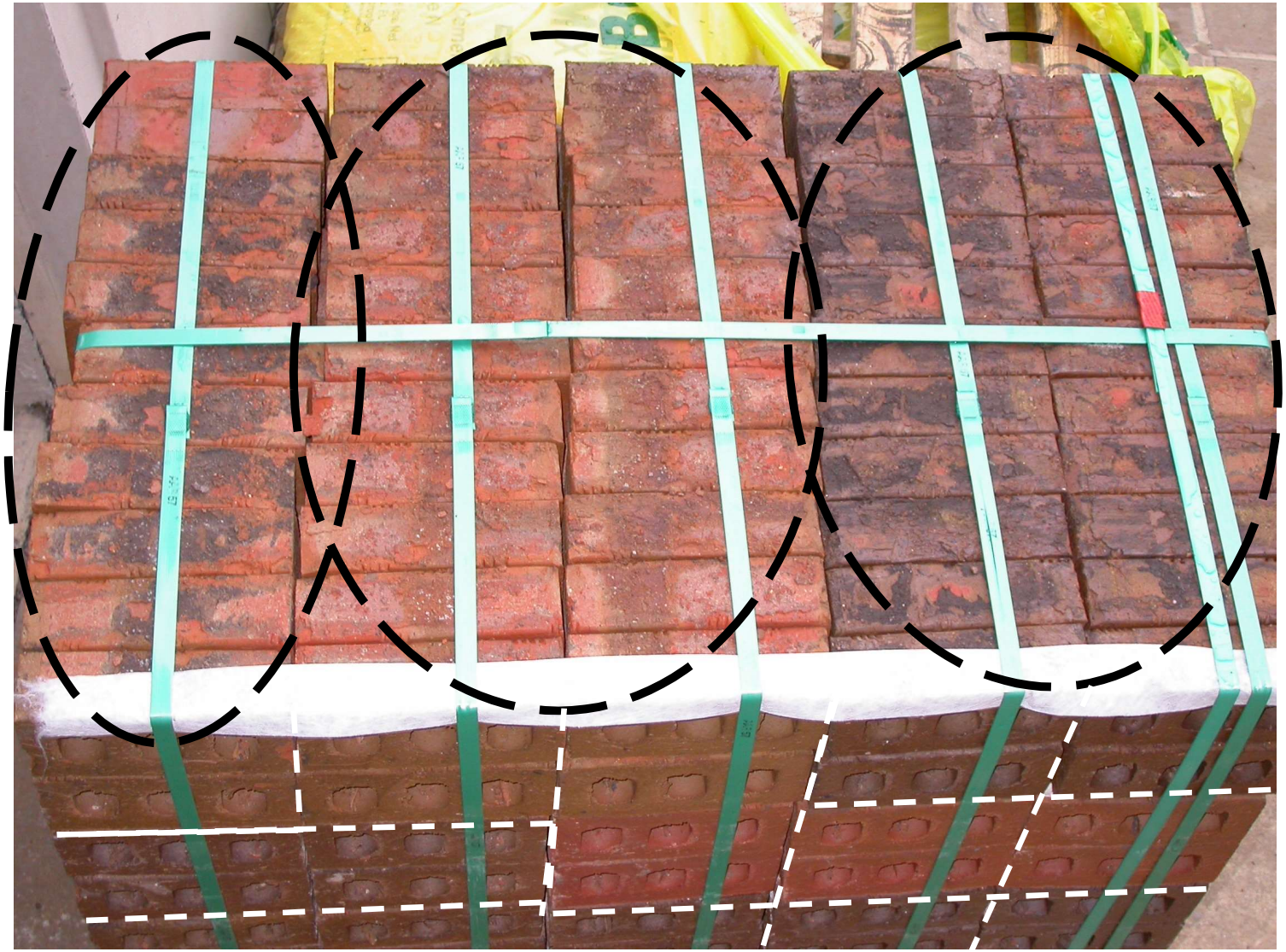
Efflorescence

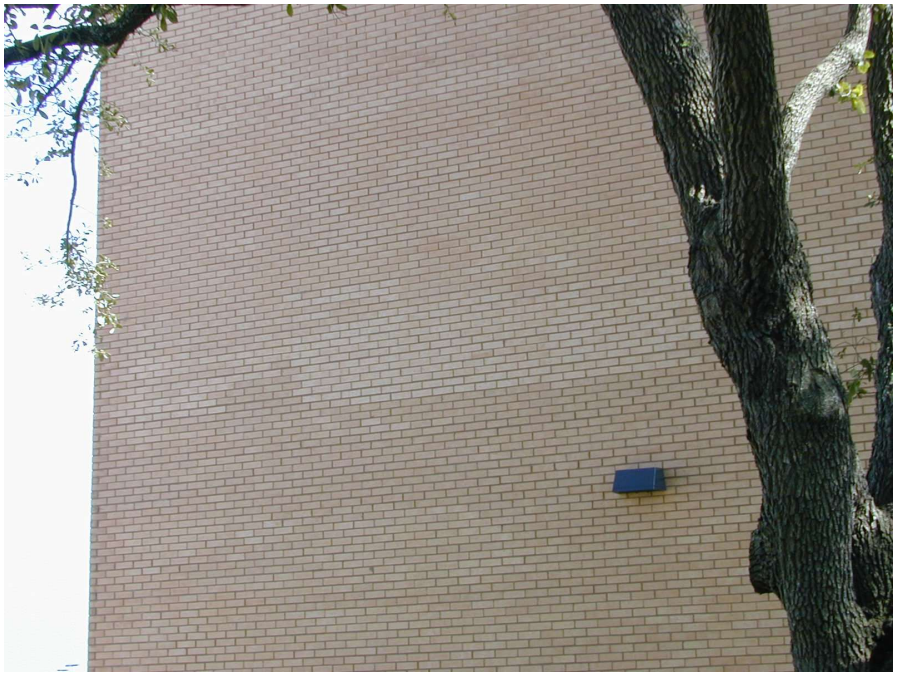

RESTRICTED
PARKING
MOTORCYCLES

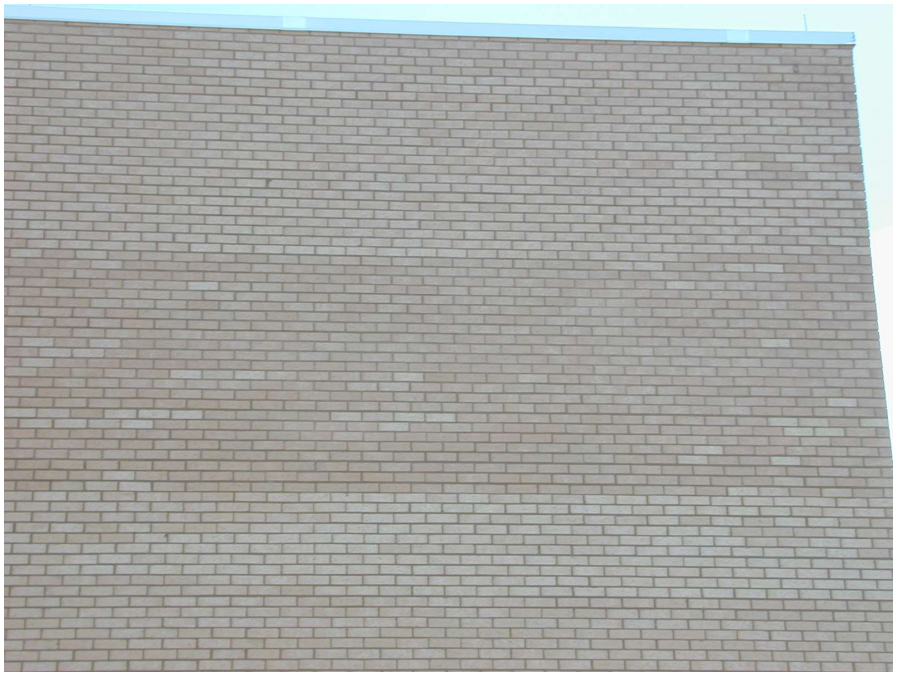
Cleaning



Blending & Color







Should a "Sealer" be Specified on New Brick Work?

- **Generally, NO – Properly designed/detailed and constructed brick veneer wall systems should not require a WATER REPELLANT.**

Should a "Sealer" be Specified on New Brick Work?

- Generally, NO – Properly designed/detailed and constructed brick veneer wall systems should not require a WATER REPELLANT.
- However, in certain situations a water repellant may be helpful in reducing the adverse effects of water penetration. Should it be determined that a water repellant is warranted, it should be a silane or siloxane based product.

REVIEW

- Solid facing brick are defined in ASTM ?.
- A solid facing brick is permitted to contain core holes up to ?%.
- Grade ? (durability) governs if grade is not specified
- If not specified, Type ? shall govern for face brick
- According to ASTM C216 how many brick are permitted to have a chip in the face?
- Always specify the size a brick unit by dimensions, not its name
- With modular units and 3/8 in. joints, how much of the wall surface is mortar?
- For brick veneer use the ? mortar that satisfies the project requirements.
- Which wall type offers the best protection from water penetration into a building?
- The brick industry recommends the use of a ? inch air space for drainage walls.

Are there any questions?