Welcome to Oldcastle APG University
Masonry Best Practices

Chris Bettinger – Oldcastle APG
Architectural Product Specifications
• chris.bettinger@oldcastle.com
• Cell: (321) 302-4505

Lisa Pelham CSI CDT – Oldcastle APG
Architectural Product Specifications
• lisa.pelham@oldcastle.com
• Cell: (813) 255-4737
LEARNING OBJECTIVES

Course Learning Objectives:

• Review ASTM standards for clay brick

• Understand the quality protections built into the ASTM standards for clay brick

• Understand minimum code requirements and best practices for resilient masonry construction in Florida.

• Understand the best method for material sampling and selection insuring the design intent of a project.
AGENDA

1. Clay Brick Specification
   • ASTM Standards

2. Masonry Best Practices
   • Flashing
   • Weeps
   • Movement

3. Specification and sampling of Clay Brick
Masonry Best Practices

CLAY BRICK SPECIFICATION
ASTM C216
ASTM C652
SECTION 2103
MASONRY CONSTRUCTION MATERIALS

2103.1 Masonry units. Concrete masonry units, clay or shale masonry units, stone masonry units, glass unit masonry and AAC masonry units shall comply with Article 2.3 of TMS 602/ACI 503.1/ASCE 6. Architectural cast stone shall conform to ASTM C1364.

TMS 602 SPECIFICATION

2.3 B. Provide clay or shale masonry units that conform to ASTM C34, C56, C62, C126, C212, C216, C652, C1088, or C1405 or to ANSI A 137.1, as specified.
What is a Brick?
ASTM Definitions

Designation: ASTM C1232 – 12, 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.

facing brick, *n*—brick for general purposes where appearance properties such as color, texture, and chippage are important; see Specification C 216 and Specification C 652.
Designation: C216 – 13

Standard Specification 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.

¹This specification is under the jurisdiction of ASTM Committee C21 on Masonry Units and is the direct responsibility of Subcommittee C21.11 on Brick and Structural ClayTile. Current edition approved June 15, 2011. Published June 2012. Originally approved in 1917. Last previous edition approved in 2002 as C216 – 02. DOI: 10.1520/C216M.

This specification is under the jurisdiction of ASTM Committee C21 on Masonry Units and is the direct responsibility of Subcommittee C21.11 on Brick and Structural ClayTile. Current edition approved June 15, 2011. Published June 2012. Originally approved in 1917. Last previous edition approved in 2002 as C216 – 02. DOI: 10.1520/C216M.

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

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A Summary of Changes section appears at the end of this standard.
Designation: C652 – 13

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

This specification is under the jurisdiction of ASTM Committee C15 on Masonry and Mortar Test Methods, and by the direct responsibility of Subcommittee C15.12 on Brick and Structural Clay Tile. This report was approved Nov. 9, 2015. Published Nov. 2015. Originally approved in 1961. Previous editions approved in 1982 and C652-82(1990), D3961-82(1995) and D3961-13.

For information on whether this standard is available in other languages, please visit the ASTM website, www.astm.org.

This specification covers hollow masonry units consisting of structural clay brick made from a mixture of clay, shale, or other similar earth materials. This specification covers two classes of hollow masonry units, Class A and Class B. Class A units are intended for use in situations where mortar is used to bond the units to other units, and Class B units are intended for use in situations where mortar is not used to bond the units to other units.

The values stated in inch-pounds are to be regarded as the standard units of measurement. The SI values are given in parentheses.

Terminology

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

¹For information on whether this standard is available in other languages, please visit the ASTM website, www.astm.org.
4.1.1 Grade SW (Severe Weathering) — Brick intended for use where high resistance to damage caused by cyclic freezing is desired.
4.2.1 Type FBS—Brick for general use in masonry.

5. Ordering Information
5.1 Orders for facing brick under this specification shall include the following information:

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 FBS, specify grade (30%), uniform dimensions (Section 5), and a representative sample.

5.1.3 Color, color range, and texture (10%) by approved test methods.

5.2.1 Samples (3.2.1) shall be submittal samples of the type of brick ordered.

5.2 Sampling (3.2.2)—Samples to be of uniform dimensions for testing.

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

5.2.1 Strength (7.2)—Specify strength of above minimum compressive strength in Table 5.

5.3.3.1 Coloring (11.1.4)—Include only the shade of brick on the specification.

5.3.4.2 Grade of Test (Note 14)—Unusuallly specified by the manufacturer.

5.4 Materials and Composition

5.4.1 Composition—The materials used in the manufacture of the brick shall be such as will produce a product that will meet the requirements of this specification.

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6. Materials and Composition

5.4.1 Composition—The materials used in the manufacture of the brick shall be such as will produce a product that will meet the requirements of this specification.

6. Materials and Composition

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 flushing or stained by sanding, where the sand does not form a continuous coating, shall be considered as surface-coated brick for the purpose of this specification.

5.4.2.1 The materials used in the manufacture of the brick shall be such as will produce a product that will meet the requirements of this specification.

5.4.2.2 Grade of Test (Note 14)—Unusuallly specified by the manufacturer.

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

5.2.1 Strength (7.2)—Specify strength of above minimum compressive strength in Table 5.

5.3.3.1 Coloring (11.1.4)—Include only the shade of brick on the specification.

5.3.4.2 Grade of Test (Note 14)—Unusuallly specified by the manufacturer.
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
## Specifying Brick

<table>
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<tr>
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Specifying Brick - Characteristics to Consider

ASTM C216 & C652

Efflorescence – clay does not effloresce

Variable Characteristics

Chips
Racking
Defects & Distortion
Size and Consistency
Masonry Best Practices

Flashing | Weeps | Movement

TMS 402/ACI 530/ASCE 5 (MSJC)
As referenced in the Florida Building Code – 7th Edition
DRAINAGE WALL COMPONENTS

- Brick Veneer (brick and mortar)
- Clear Air Space
- WRB
- Flashing and Weep Holes
- Wall Ties
- Backup Wall
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
WEEP HOLES

BIA Suggested Spacings
Weep Holes @ 24” O.C., Wicks @ 16” O.C.

(MSJC – 33 inches O.C.)

TMS 602 Sect. 6.1.6.2 Requirements

Rope Wick  Weep Tube  Open Head Joint
REQUIRED FLASHING LOCATIONS

Parapets
PARAPET FLASHING

Prefinished Metal Coping
REQUIRED FLASHING LOCATIONS
SHELF ANGLE FLASHING

- Flashing
- Weep Holes
- Sealant & Backer Rod
REQUIRED FLASHING LOCATIONS
HEAD/LOOSE LINTEL FLASHING
WINDOW FLASHING

Through Wall Flashing w/ End Dams

Steel Lintel Angle
Weep Holes
Sealant

Flashing w/End Dams Installed Before Window

Sealant 15° or ¾ in.
Weep Holes

Window Head
Window Sill
Window Sills- ¾” Slope Minimum
REQUIRED FLASHING LOCATIONS
BASE WALL FLASHING

CMU Backup Wall
Through Wall Flashing

- Wall Tie
- Exterior Sheathing w/ Building Paper
- Flashing (1st Course above grade)
- Weep Holes
- Full Collar Joint
Accommodating Expansion of Brickwork

Abstract: Expansion joints are used in brickwork to accommodate movement and to avoid cracking. This Technical Note summarizes general movement joints used in brickwork construction and gives guidance regarding their placement. The theory and rationale for the guidelines 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 terms, and flexible anchorage.

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

SUMMARY OF RECOMMENDATIONS:

Vertical Expansion Joints in Brick Veneer:
- For brickwork without openings, space no more than 20 ft (6.1 m) o.c.
- For brickwork with multiple openings, consider vertical placement of expansion joints and reduced spacing of no more than 10 ft (3.1 m) o.c.
- When spacing between vertical expansion joints exceeds 20 ft (6.1 m) o.c., make expansion joints shallower than the top of the heel of the expansion joints.
- Place at all cornices.
- At close to sills.
- At change in wall height.
- At change in roof height.
- Where rise of brick veneer changes.
- Where wall function or detail changes.
- Extend to top of brickwork, including parapets.

Horizontal Expansion Joints in Brick Veneer:
- Insulate in plumbing or chases.
- Insulate in openings to control air leakage and prevent condensation.
- Insert isolation materials at the perimeter of the expansion joint.
- For brick inlays, place between the top of the brickwork and structural frame.
- Brickwork Without Shelf Angle:
  - Accommodate movement.
  - Place expansion joints around elements that are rigidly attached to the brick and project into the veneer, such as windows and door frames.
  - Install metal caps or spacers that allow independent vertical movement of spandrel masses.
  - Install joint receptors that allow independent movement of spandrel masses.
  - Install adjustable anchors or ties.

Expansion Joint Seals:
- Apply with ASTM C-230, Grade NS, Unit M.
- Use minimum unhardened neoprene, Class 35 (aliphatic).
- Consult sealant manufacturer’s literature for guidance regarding use of primer and bonding materials.

Cement Based:
- Use building paper or flashing to separate brickwork from chemically active materials, foundations, and walls.

Loudsounding Masonry:
- Use wood reinforcement to accommodate local sound concentrations, particularly in parapets, at applied topping joints and details.
- 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 types, 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 non-loadbearing 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 included 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?
Projected Moisture Expansion, Fired Brick vs. Time
EXPANSION JOINTS
Spacing of Vertical & Horizontal 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 (0.0003)
- \( k_f \): coefficient of freezing expansion (only if < -10°F and sat.)
- \( k_t \): coefficient of thermal expansion (0.000004/°F)
- \( \Delta T \): temperature change in brickwork
EXPANSION JOINTS
Spacing of Vertical & Horizontal Joints

30 & 4
EXPANSION JOINTS
Spacing of Vertical & Horizontal Joints

30’ Run Max
4’ From Corner Max
## MOVEMENT

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<tr>
<td>Permanent</td>
<td>0.05 %</td>
<td>- 0.035 %</td>
</tr>
<tr>
<td>Thermal</td>
<td>0.0004 %/°T</td>
<td>0.00045 %/°T</td>
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</table>

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

Permanent: \(100 \text{ ft} \times 12 \text{ in/ft} \times 0.0005 = 0.6 \text{ in.}\)

Thermal: \(100 \text{ ft} \times 12 \text{ in/ft} \times (100 - 40) \times 0.000004 = 0.288 \text{ in.}\)

TOTAL: 0.888 in \(\approx\) 7/8 in.
TYPICAL EXPANSION JOINT LOCATIONS

- Different Support Conditions
- Long walls
- Offsets
- Different Height Walls
- Corners
- Shelf Angles
HORIZONTAL EXPANSION JOINTS

Brick Veneer -> Concrete or CMU Structure

<arrow down>  <arrow up>
Above 30 FT, support required at each floor

Ht. at gable

8 FT

Ht. at plate

30 FT – No intermediate support required

30 FT

Noncombustible foundation

Veneer w/ steel studs
2.67 sq ft

24 or 16 in. o.c.

16 or 24 in. o.c.

Brick Anchors
NOT APPROVED BY CODE FOR COMMERCIAL PROPERTIES
...at least 5/8 in. (15.9 mm) mortar cover to the outside face.
# Minimum Air Space

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<tr>
<td>Steel Stud</td>
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<td>2”</td>
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<td>2”</td>
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</table>

*Recommended
Masonry Best Practices

Sampling & Mock-ups
Mini Panels – Qualifying color texture and scale (no older than 6 months)
   Mortar sample - Color

   Recent Run Sample – Natural material, can vary from run to run
   Submittal Package – Test Reports and Letter of Certification
   Budget $$ reviewed

   Selection has been made & Project Bid

   Jobsite Mock-up to establish product and workmanship standards using run
   sample of material
SAMPLING & MOCK-UPS

Jobsite Mock-up to establish product and workmanship standards

POTENTIAL PROBLEMS

1. Mock-up disappears – needs to stay up till project is finished
2. Mock-up not built to production standards...
   - Too perfect
   - Not Cleaned as specified
   - Special conditions not shown
     - Shapes
     - Windows and doors
3. Cleaned incorrectly
   - Clean to the weakest link
Masonry Best Practices

Questions
Masonry Best Practices

Thank you!