AIA Florida

Provider #: A022

Advanced Florida Building Code – Masonry Changes and best Practices
CN17ABCMC

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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

This course informs the participant of the latest changes and how to incorporate them in their specification. These changes will be incorporated into the National Masonry Code for 2016. TMS 402/602 will also be reviewed.

Learning Objectives

At the end of the this course, participants will be able to:

1. Review ASTM standards for clay brick, and understand the quality protections built into the ASTM standards for clay brick
2. What is the MSJC code, who is responsible for it and how does the FL Building Code reference it? and learn what primary changes to the code have occurred between the 2008, 2011, 2013 and 2016 editions?
3. How is the allowable compressive design strength of masonry affected by the latest 2013 code? Learn how can you utilize the latest 2013 edition of the MSJC even though it is not the referenced standard in the 5th Edition Florida Building Code. What is the MSJC code, who is responsible for it and how does the FL Building Code reference it?
4. Explain minimum code requirements and best practices for resilient masonry construction in Florida. Learn the best method for material sampling and selection insuring the design intent of a project

Masonry Association of Florida

Advanced Masonry Code Changes & Best Practices

NATIONAL CONCRETE MASONRY ASSOCIATION
Sustainable Concrete Products for Structures and Hardscapes

BUILD YOUR CREDENTIALS. BUILD THE INDUSTRY.

MAF INFO

WHO WE ARE
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.

THE MAF OFFERS

- Professional Education (Architects, Engineers, Contractors & Building Inspectors
- Masonry Apprentice Training
- Technical Assistance through our Engineering Help Desk & Technical Library

- For more: www.floridamasonry.com

MAF 2016 ACCOMPLISHMENTS

1. Over 2000 CEU/PDH's awarded to Architects, Engineers & Contractors through 2016, through Masonry Certification, Lunch Presentations, AIA Convention and Spring & Fall Hot Topics courses.
2. Successfully completed an online Masonry Certification Course for Architects for through our partnership with AIA Florida
3. Created a masonry industry online education platform for engineers, contractors and masonry professionals to complete a "study-at-home" Masonry Certification (Level I).

MAF 2016 ACCOMPLISHMENTS

4. Sponsored and awarded the 8th Annual AIA Florida Caribbean Award for Excellence in Masonry.
5. Distributed the MAF Masonry Awards Publication to over 4200 AIA Florida Architect Members featuring the award-winning masonry projects of the 2016 MAF Masonry Excellence Awards Program.
6. Surveyed the design community regarding their preferences for building materials. Their thoughts on masonry versus other building systems, labor issues, their perceptions of the cost, resiliency and design flexibility of masonry.

SUMMARY, PROVIDER & CREDITS

SUMMARY

Course to review relevant changes to the 2014 Florida Building Code and referenced ASTM Standards and referenced TMS 402/602 National Masonry Standard.

Course to review all relevant changes to the 2014 Florida Building Code and the referenced National Masonry Code concerning masonry products and installation. This review is not limited to FBC Chapter 21 but covers multiple referenced codes effecting the use of masonry. Upon completion of this course, the attendee should have a good understanding of the relevant changes to State and referenced National Building Codes pertaining to masonry construction.

We will also review Masonry Best Practices for flashing, weeps and movement joints.

MAF PROVIDER INFORMATION

The Masonry Association of Florida/Masonry Education Foundation is a registered provider with…

- America Institute of Architects Continuing Education System (AIA Provider # G524)
- Construction Industry Licensing Board (CILB Provider# 4545)
- Florida Board of Professional Engineers (FBPE Provider #4507).

LEARNING OBJECTIVES

LEARNING OBJECTIVES

- Review 2014 FBC referenced ASTM standards for clay brick
- Understand the quality protections built into the referenced ASTM standards for clay brick
- Define the TMS 402/602 code, explain who is responsible for it and explain how it is referenced by the 2014 Florida Building Code.
- Review the primary changes between the 2010 FBC and the 2014 FBC and the referenced ASTM and TMS Standards.
- Understand how the allowable compressive design strength of masonry is affected by the latest FBC.
- Understand how to utilize the latest 2013 edition of the TMS 402/602 through Chapter One references in the 2014 FBC.
- Understand minimum 2014 FBC 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.

SPEAKER INFORMATION

CHRIS BETTINGER – OLDCASTLE COASTAL

Chris Bettinger is the Masonry and Hardscapes Specification Manager for Oldcastle Coastal in Florida. Chris is a graduate of the University of Michigan School of Architecture. Starting his tenth year with Oldcastle in Florida he has served on the Masonry Associations Board since 2010. Since 2011 he has chaired the ProMasonry Committee.

CONTACT INFORMATION:

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SPEAKER INFORMATION

DON BEERS, PE, GC – MASONRY ASSOCIATION OF FLORIDA

Don Beers, P.E. is the staff engineer for the Masonry Association of Florida, Inc. Previous experience includes 35 years involvement in masonry industry activities including Management Services Engineer for CEMEX, Inc. Don is a graduate of the University of South Florida and is a licensed engineer in Florida, Georgia and General Contractor in Florida. He served as Chairman of the National Concrete Masonry Association's Codes Committee, Florida Concrete & Products Association's Block Committee and is a member of SBCCI, Florida Engineering Society and the Masonry Society.

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AGENDA

SECTIONS

1. Clay Brick Specification
2. FBC Masonry Code Changes
3. Masonry Best Practices
   - Flashing
   - Weeps
   - Movement

Masonry Association of Florida

SECTION 1

CLAY BRICK SPECIFICATION

ASTM C216
ASTM C652

BUILD YOUR CREDENTIALS. BUILD THE INDUSTRY.

2014 FBC Clay Brick Reference:

2103.2 Clay or shale masonry units. Clay or shale masonry units shall conform to the following standards: ASTM C 34 for structural clay *load-bearing wall* tile; ASTM C 56 for structural clay nonload-bearing wall tile; ASTM C 62 for building brick (solid masonry units made from clay or shale); ASTM C 1088 for solid units of thin veneer brick; ASTM C 126 for ceramic-glazed structural clay facing tile, facing brick and solid masonry units; ASTM C 212 for structural clay facing tile; ASTM C 216 for facing brick (solid masonry units made from clay or shale); ASTM C 652 for hollow brick (hollow masonry units made from clay or shale) or ASTM C 1405 for glazed brick (single-fired solid brick units).

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.

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 – 07a

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

Section IV :: CLAY BRICK MASONRY

Page 3

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: C652 – 09

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

Section IV :: CLAY BRICK MASONRY

Page 11

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 – 07a

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

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

Section IV :: CLAY BRICK MASONRY Page 3

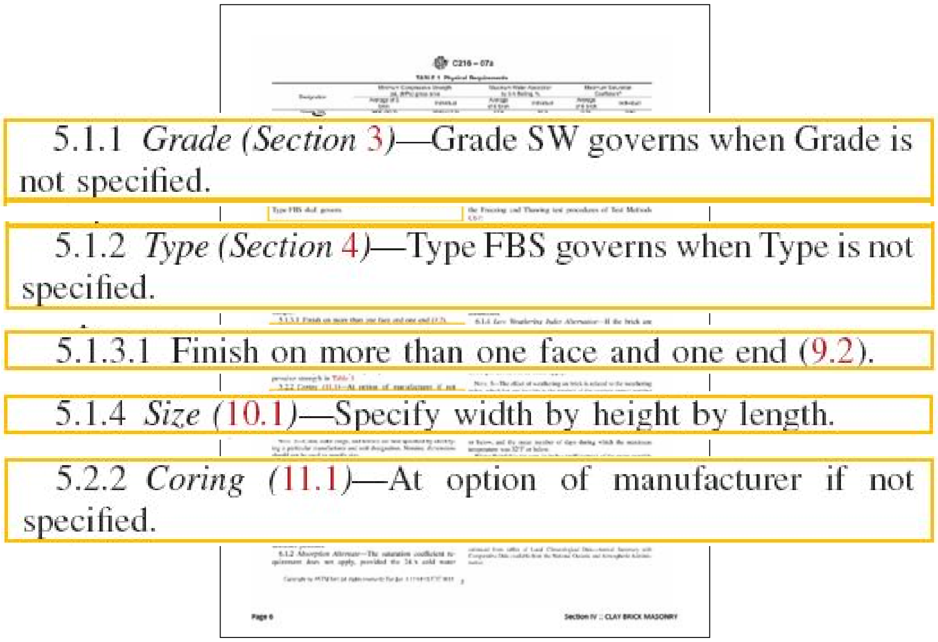
NOTICE: This standard has either been superseded and replaced by a new version or withdrawn. Contact ASTM International (www.astm.org) for the latest information.

Designation: C216 – 07a

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

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

Section IV :: CLAY BRICK MASONRY Page 3



5.1.1 *Grade (Section 3)*—Grade SW governs when Grade is not specified.

5.1.2 *Type (Section 4)*—Type FBS governs when Type is not specified.

5.1.3.1 Finish on more than one face and one end (9.2).

5.1.4 *Size (10.1)*—Specify width by height by length.

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

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

Specifying Brick - Characteristics to Consider

ASTM C216 & C652

Efflorescence – clay does not effloresce

Variable Characteristics

Chips
Racking
Defects & Distortion
Size and Consistency

Masonry Association of Florida

SECTION 2

FBC MASONRY CODE CHANGES

TMS 402/602 (National Masonry Code)
As referenced by the 2014 Florida Building Code

BUILD YOUR CREDENTIALS. BUILD THE INDUSTRY.

2014 FBC CMU Reference:

SECTION 2104
CONSTRUCTION

2104.1 Masonry construction. Masonry construction shall comply with the requirements of Sections 2104.1.1 through 2104.4 and with TMS 602/ACI 530.1/ASCE 6.

SECTION 2107
ALLOWABLE STRESS DESIGN

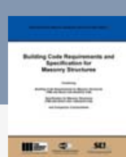
2107.1 General. The design of masonry structures using *allowable stress design* shall comply with Section 2106 and the requirements of Chapters 1 and 2 of TMS 402/ACI 530/ ASCE 5 except as modified by Sections 2107.2 through 2107.4.

SECTION 2108
STRENGTH DESIGN OF MASONRY

2108.1 General. The design of masonry structures using strength design shall comply with Section 2106 and the requirements of Chapters 1 and 3 of TMS 402/ACI 530/ ASCE 5, except as modified by Sections 2108.2 through 2108.3.

TRANSITIONING

2008 MSJC



2009 IBC

2010 FBC

2011 MSJC

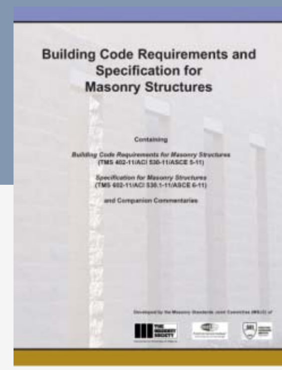
2012 IBC

5th Edition FBC

2013 MSJC

2015 IBC

THE MSJC COMMITTEE

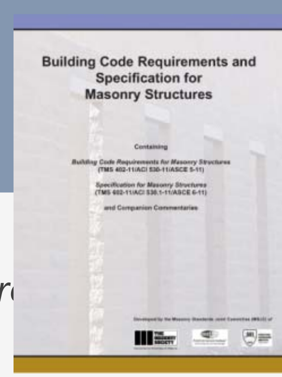


Joint Committee with:

- The Masonry Society (TMS)
- American Concrete Institute (ACI)
- Structural Engineering Institute of the American Society of Civil Engineers (ASCE-SEI)

MSJC – Masonry Standards Joint Committee

MSJC DOCUMENTS



- TMS 402/ACI 530/ASCE 5
  Building Code Requirements for Masonry Structures
- TMS 602/ACI 530.1/ASCE 6
  Specification for Masonry Structures
- Commentary for each *Non-mandatory*

2008 – 2011 SUMMARY OF CHANGES

2011 MSJC REFERENCES 2010 ASCE 7

2008

6.2.2.11 *Requirements in areas of high winds* — The following requirements apply in areas where the basic wind speed exceeds 110 mph (177 km/hr) but does not exceed 130 mph (209 km/hr) and the building's mean roof height is less than or equal to 60 ft (18.3 m):

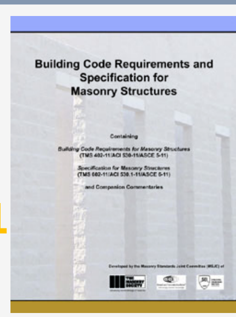
2011

6.2.2.11 *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):

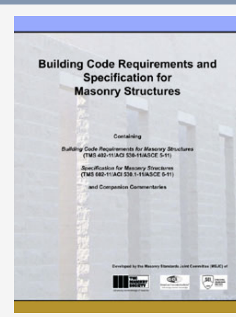
2011-2013 SUMMARY OF CHANGES

- 2013 MSJC references 2010 ASCE 7 (No Significant Change)

2011



2013



2008-2011 SUMMARY OF CHANGES

RECALIBRATION OF ALLOWABLE STRESS DESIGN

Historically masonry design permitted allowable design stresses to be increased by one-third when subjected to wind or seismic loads.

2.1.2.3 Unless prohibited by the legally adopted building code, allowable stresses and allowable loads in Chapters 2 and 4 shall be permitted to be increased by one-third when considering Load Combination (c), (d), or (e) of Section 2.1.2.1.

2008-2011 SUMMARY OF CHANGES

RECALIBRATION OF ALLOWABLE STRESS DESIGN

Beginning with 2011, the transient load increase was removed and the ASD design provisions recalibrated.

2008

2.3.3.2.2 The compressive stress in masonry due to flexure or due to flexure in combination with axial load shall not exceed $(^1/_3)\ f'_m$ provided the calculated compressive stress due to the axial load component, f_a, does not exceed the allowable stress, F_a, in Section 2.2.3.1.

2011

2.3.4.2.2 The compressive stress in masonry due to flexure or due to flexure in combination with axial load shall not exceed $0.45\ f'_m$ provided that the calculated compressive stress due to the axial load component, f_a, does not exceed the allowable stress, F_a, in Section 2.2.3.1.

2008-2011 SUMMARY OF CHANGES

Recalibration of Allowable Stress Design

This was *not* an across-the-board 1/3 stress increase. Each design value was independently considered.

TMS 402 Sect. 2.3.2.1

2008

(a) Grade 40 or Grade 50 reinforcement ....20,000 psi (137.9 MPa)

(b) Grade 60 reinforcement ....24,000 psi (165.5 MPa)

2011

(a) Grade 40 or Grade 50 reinforcement: 20,000 psi (137.9 MPa)

(b) Grade 60 reinforcement: 32,000 psi (220.7 MPa)

2008-2011 SUMMARY OF CHANGES

Recalibration of Allowable Stress Design

The net result was an increase of allowable design stresses that varied from 0% to approximately 35%.

2011-2013 SUMMARY OF CHANGES

Recalibration of Allowable Stress Design

No analogous, broad-based changes to the allowable stress design provisions in the 2013 edition…but minor tweaks and revisions to reflect recent research and testing.

2008-2011 SUMMARY OF CHANGES

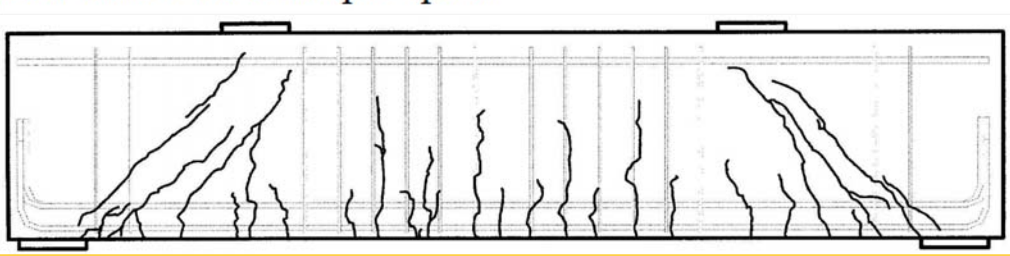
New masonry infill design provisions have been added. Located in Appendix B.

TMS 402
Appendix B

2008-2011 SUMMARY OF CHANGES

- Design provisions for deep beams have been added.

Deep beam — A beam that has an effective span-to-depth ratio, l_{eff}/d_v, less than 3 for a continuous span and less than 2 for a simple span.



Please Note 2011-2013: *No significant revisions to the deep beam design provisions between 2011 and 2013 MSJC.*

2008-2011 SUMMARY OF CHANGES

Lap Splices and Development Length 2011 MSJC Provisions…
The addition of a confinement factor:

TMS 402
Sect 2.1.9.3
Eq (2-12)

$$\xi = 1.0 - \frac{2.3A_{sc}}{d_b^{2.5}}$$

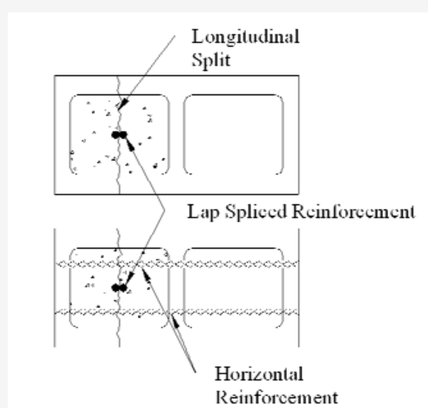
$$\text{Where}: \frac{2.3A_{sc}}{d_b^{2.5}} \leq 1.0$$

$$l_d = \left(\frac{0.13 d_b^{\ 2} f_y \gamma}{K \sqrt{f'_m}} \right) \xi$$

A_{sc} is the area of the transervse bars at each end of the lap splice and shall not be taken greater than 0.35 in^2 (226 mm^2).

2008-2011 SUMMARY OF CHANGES

- Lap Splices and Development Length



2008-2011 SUMMARY OF CHANGES

Lap Splices and Development Length

A_{sc} < 0.35 in.^{2}

Transverse Offset $\leq$ 1.5 in.

Longitudinal Offset $\leq$ 8 in.

Lap Splice $\geq$ $36d_b$

2008-2011 SUMMARY OF CHANGES

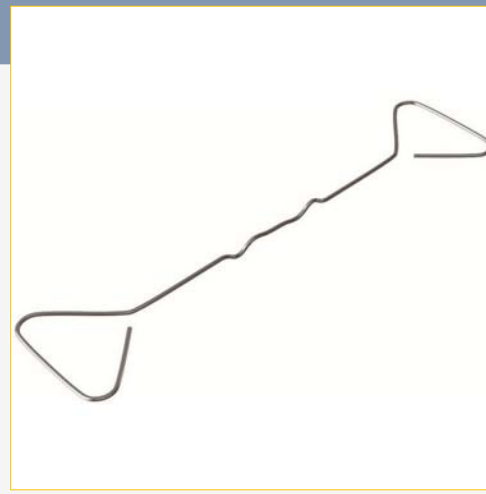
Typical 8 inch Concrete Masonry Unit Lap Lengths

Bar Size	MSJC Lap Length, No Confinement (in.)	MSJC Lap Length, With No. 5 Confinement (in.)
No. 3	12.0	13.5
No. 4	14.1	18.0
No. 5	22.5	22.5
No. 6	42.8	27.0
No. 7	59.4	31.5
No. 8	91.2	36.0
No. 9	118.3*	55.5*

Please Note 2011-2013:
No significant revisions to the lap splice and development length design provisions between 2011 and 2013 MSJC.

2008-2011 SUMMARY OF CHANGES

- Veneer ties with drips no longer permitted.



2008-2011 SUMMARY OF CHANGES

- Grout lift heights are now modular.

TMS 402
Sect. 1.19.1
Table 1.19.1

Grout type[1]	Maximum grout pour height, ft (m)
Fine	1 (0.30)
Fine	5.33 (1.63)
Fine	12.67 (3.86)
Fine	24 (7.32)
Coarse	1 (0.30)
Coarse	5.33 (1.63)
Coarse	12.67 (3.86)
Coarse	24 (7.32)

2008-2011 SUMMARY OF CHANGES

- Quality Assurance provisions reorganized and clarified.

TMS 402
Sect. 1.19

Inspection Task	Frequency [a]	
	Continuous	Periodic
1. Verify compliance with the approved submittals		X
2. As masonry construction begins, verify that the following are in compliance:		
a. Proportions of site-prepared mortar		X
b. Construction of mortar joints		X
c. Grade and size of prestressing tendons and anchorages		X
d. Location of reinforcement, connectors, and prestressing tendons and anchorages		X
e. Prestressing technique		X

This Section of TMS 402 Exempted Out of the 2014 FBC in Section 2107.1

MANDATORY INSPECTIONS FROM TMS 402

TMS 402-13 SECT 3.1

Mod 5973 provides an exception to inspections required by TMS 402/ACI 530/ASCE 5 Chapter 1 Section 1.19 and TMS 602/ ACI 530.1/ASCE 6 Section 1.6 where inspections are provided by a building department. The architect, engineer, or the building official is permitted to require the inspections specified by TMS (Strength Design Method).

2008-2011 SUMMARY OF CHANGES

ASTM C90 REVISIONS:

Beginning in 2011, ASTM C90 (specification for loadbearing concrete masonry units) was substantially revised to permit alternative unit configurations.

Transition Overview of Masonry Design Standards

2014 FBC CMU Referenced Standards:

SECTION 2103
MASONRY CONSTRUCTION MATERIALS

2103.1 Concrete masonry units. Concrete masonry units shall conform to the following standards: ASTM C 55 for concrete brick; ASTM C 73 for calcium silicate face brick; ASTM C 90 for load-bearing concrete masonry units or ASTM C 744 for prefaced concrete and calcium silicate masonry units.

2014 FBC Referenced Standard:

35.8 FLORIDA BUILDING CODE

INTERNATIONAL CODE COUNCIL®

ASTM—continued

C 56—05	Specification for Structural Clay Nonload Bearing Tile . . . .
C 59/C 59M—00 (2006)	Specification for Gypsum Casting and Molding Plaster . . . .
C 61/C 61M—00 (2006)	Specification for Gypsum Keene's Cement. . . . .
C 62—08	Specification for Building Brick (Solid Masonry Units Made from Clay or Shale) . . . .
C 67—08	Test Methods of Sampling and Testing Brick and Structural Clay
C 73—05	Specification for Calcium Silicate Face Brick (Sand-lime Brick). .
C 90—11b	Specification for Loadbearing Concrete Masonry Units . . . . .T
C 91—05	Specification for Masonry Cement . . . .

ASTM C90-11b CHANGES (Table 1)

For 70 years, the configuration of concrete masonry units has been standardized to fit a specific configuration.

TABLE 1 Minimum Thickness of Face Shells and Webs[A]

Nominal Width (W) of Units, in. (mm)	Face Shell Thickness (t_{fs}), min, in. (mm)[B,C]	Web Thickness (t_w) Webs[B,D,C] min, in. (mm)	Web Thickness (t_w) Equivalent Web Thickness, min, in./linear ft[E] (mm/linear m)
3 (76.2) and 4 (102)	¾ (19)	¾ (19)	1⅝ (136)
6 (152)	1 (25)	1 (25)	2¼ (188)
8 (203)	1¼ (32)	1 (25)	2¼ (188)
10 (254) and greater	1¼ (32)	1⅛ (29)	2½ (209)

Older Version of C90 Table 1

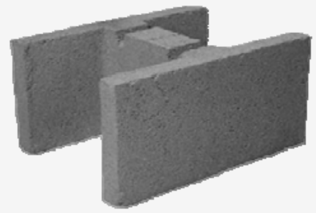
ASTM C90-11b CHANGES (Table 1)

1930s Building Solution

2010s Building Solution

ASTM C90-11b CHANGES (Table 1)

- The marketplace, however, has evolved well beyond ASTM C90.



ASTM C90-11b CHANGES (Table 1)

ASTM C90 now permits different unit configurations using alternative web configurations.

ells and Web Requirements[A]

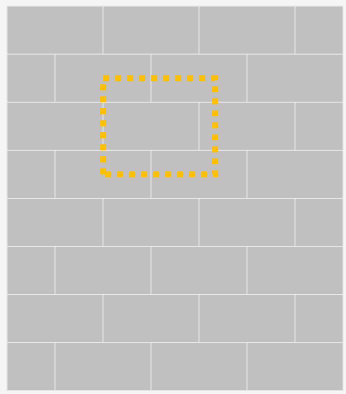
Webs	
Web Thickness[C] (t_w), min, in. (mm)	Normalized Web Area (A_{nw}), min, in.^{2}/ft^2 (mm^2/m^2)[D]
¾ (19)	6.5 (45, 140)
¾ (19)	6.5 (45, 140)
¾ (19)	6.5 (45, 140)

ed in Test Methods C140.
of the split surface is permitted to have thickness less than those shown, but not less
ot apply and Footnote C establishes a thickness requirement for the entire faceshell.
shall be not less than ⅝ in. (16 mm).
ed with grout. The length of that portion shall be deducted from the overall length of

New Table 1

ASTM C90-11b CHANGES (Table 1)

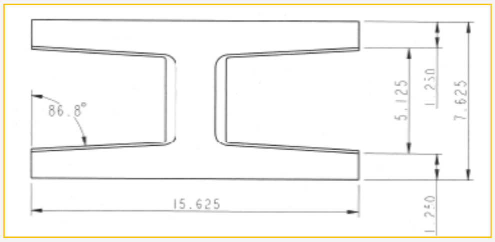
Literally, this new requirement means that for every square foot of wall surface, no less than 6.5 in.^{2} of web must connect the front and back face shells, with no web measuring less than 0.75 in. in thickness.

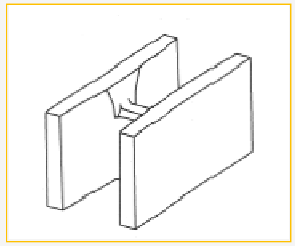


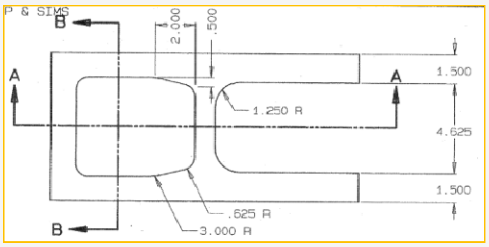
ASTM C90-11b CHANGES (Table 1)

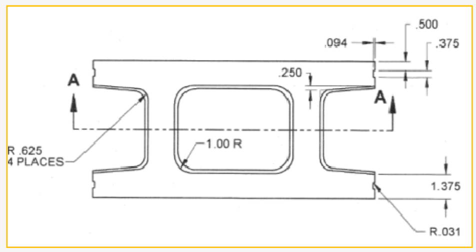
These revisions do not require any changes to be made to current practices. Instead, they offer more flexibility for designers/owners to meet evolving building code requirements (energy efficiency, sustainability, structural, ease of construction, etc.).

ASTM C90-11b CHANGES (Table 1)



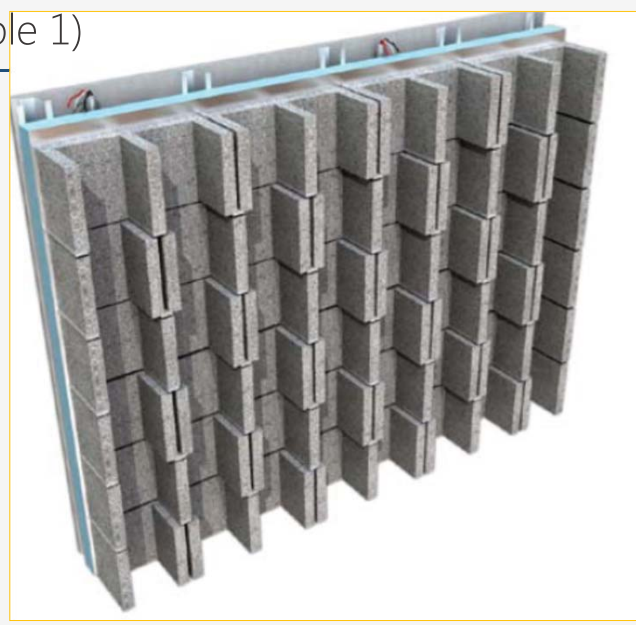






ASTM C90 CHANGES (Table 1)

- 3-Web Unit Configuration

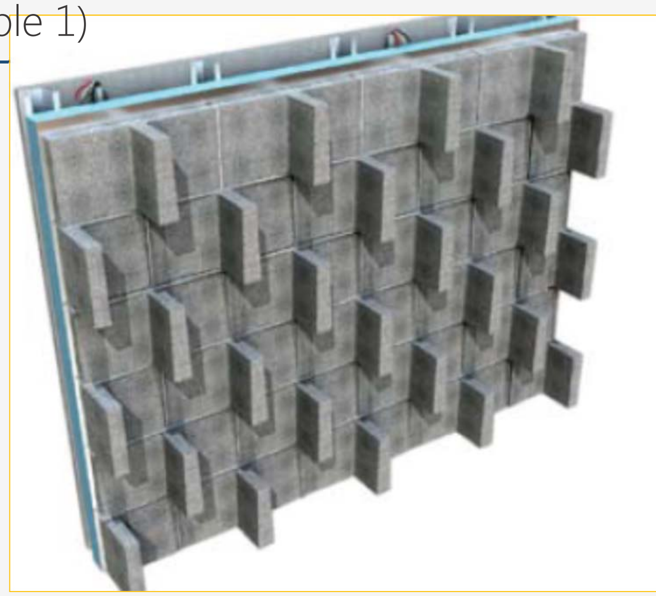


ASTM C90 CHANGES (Table 1)

- 2-Web Unit Configuration

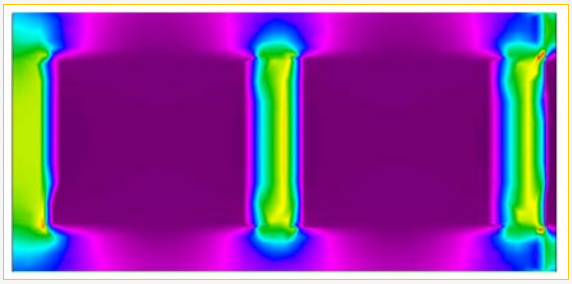
ASTM C90 CHANGES (Table 1)

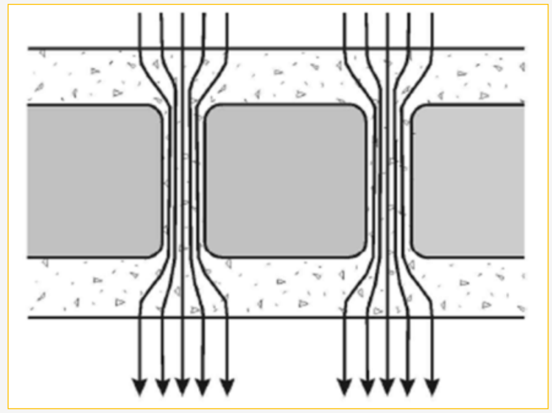
- 1-Web Unit Configuration



ASTM C90 CHANGES (Table 1)

- While there are several advantages, the primary reason for the change was energy efficiency.
- The basic premise = heat flows through the webs.





ASTM C90 CHANGES (Table 1)

- R-Value Examples – 8 in. CMU with foam-in-place Insulation at non-grouted cells

Lightly Reinforced Walls (Grout at 48 in.)			
Density (lb/ft^3)	3 Web Units	2 Web Units	Minimum Webs
105	4.18	5.76	7.99
		38% increase	91% increase
115	3.70	5.27	7.42
		42% increase	100% increase
125	3.27	4.81	6.89
		47% increase	111% increase

ASTM C90 CHANGES (Table 1) DESIGN IMPLICATIONS

Design of alternative web configurations is exactly the same, except if designing unreinforced masonry – which requires a supplemental check of the web shear stresses.

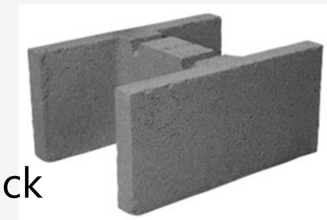
$$f_v = \frac{VQ}{I_n b} \leq 1.5\sqrt{f'_m}$$

ASTM C90 CHANGES (Table 1) DESIGN IMPLICATIONS

- For grouted masonry, the addition of grout (even lightly grouted/reinforced assemblies) more than compensates for reduced webs to transfer shear between face shells.

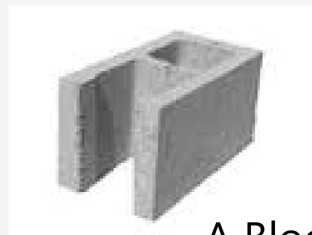
- For un-grouted masonry, the 6.5 $in.^2/ft^2$ web area limit was back-calculated as the lower bound before web shear controlled the design under extreme loading scenarios.

ASTM C90 CHANGES (Table 1) DESIGN IMPLICATIONS


H Block


Corner Unit


Stretcher Unit


A Block

ASTM C90 CHANGES (Table 1) DESIGN IMPLICATIONS

- Section properties vary slightly, but within the range of 'conventional' units.

		Three-Web Corner Unit	Three-Web Stretcher Unit	A-Block	H-Block
Face Shell Bedding Only	Net Area (An)	30.0	30.0	30.0	30.0
	Net MOI (In)	308.7	308.7	308.7	308.7
Full Mortar Bedding	Net Area (An)	38.6	38.6	35.8	32.9
	Net MOI (In)	327.6	327.6	321.4	315.1
Solid Grouted	Net Area (An)	90.1	84.3	91.5	91.5
	Net MOI (In)	440.2	427.5	443.3	443.3
Grout @ 16 in.	Net Area (An)	61.5	58.6	65.8	NA
	Net MOI (In)	383.9	371.3	387.0	NA
Grout @ 120 in.	Net Area (An)	34.2	33.8	34.8	NA
	Net MOI (In)	317.9	317.0	319.0	NA

ASTM C90 CHANGES (Table 1)
DESIGN IMPLICATIONS

- While on the surface this change to ASTM C90 may appear radically substantive, in reality it simply brings the standards in line with today's practice.

- Most importantly, it was implemented in such a way that structural engineers design concrete masonry the same as they have historically.

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

- For decades the unit strength table provided a quick/easy means of verifying f'_m.

Table 2 — Compressive strength of masonry based on the compressive strength of concrete masonry units and type of mortar used in construction

Net area compressive strength of concrete masonry units, psi (MPa)		Net area compressive strength of masonry, psi[1] (MPa)
Type M or S mortar	Type N mortar	
—	1,900 (13.10)	1,350 (9.31)
1,900 (13.10)	2,150 (14.82)	1,500 (10.34)
2,800 (19.31)	3,050 (21.03)	2,000 (13.79)
3,750 (25.86)	4,050 (27.92)	2,500 (17.24)
4,800 (33.10)	5,250 (36.20)	3,000 (20.69)

[1] For units of less than 4 in. (102 mm) height, 85 percent of the values listed.

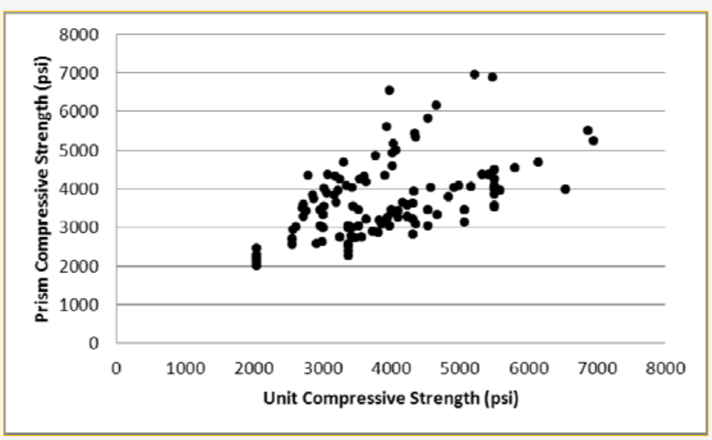
TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

Yet, this option has been very conservative to use due to:

- Data drawn from prism testing completed 30-60 years ago.
- Non-standardized and varying testing procedures.
- Correction factors needed to account for:
  - Gross vs. net area compressive strength
  - Face shell vs. full mortar bedding

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

- In 2010, a new research project was initiated to recalibrate the unit strength method.



TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

At lower unit compressive strength values, Type M or S mortars produce an assembly compressive strength equal to the unit compressive strength.

1,900 psi unit → 1,900 psi f'_m

2,000 psi unit → 2,000 psi f'_m

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

General observations:

- At relatively low unit compressive strength (<3,000 psi), mortar type/compressive strength has little influence on measured compressive strength of the prism.
- As unit compressive strength increases, mortar type/compressive strength begins to influence prism compressive strength.

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

Historically f'_m = 1,500 psi has been the default baseline for the specified compressive strength of concrete masonry.

The recalibrated table doesn't even go as low as f'_m = 1,500 psi; instead starting at 1,900 psi for Type S mortar.

But f'_m = 1,900 psi feels 'irregular'…

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

f'_m = 2,000 psi feels 'right'.

However, ASTM C90 requires a minimum compressive strength of 1,900 psi.

The solution…change ASTM C90. Hence, a couple years ago ASTM C90 was changed to have a minimum compressive strength of 2,000 psi.

TMS 602 Sect 1.4 B.2 Table 2
ASSEMBLY COMPRESSIVE STRENGTH (f'_m)

Net area compressive strength of concrete masonry units, psi (MPa)		Net area compressive strength of masonry, psi[1] (MPa)
Type M or S mortar	Type N mortar	
—	1,900 (13.10)	1,350 (9.31)
1,900 (13.10)	2,150 (14.82)	1,500 (10.34)
2,800 (19.31)	3,050 (21.03)	2,000 (13.79)
3,750 (25.86)	4,050 (27.92)	2,500 (17.24)
4,800 (33.10)	5,250 (36.20)	3,000 (20.69)

Table 2 – Compressive strength of masonry based on the compressive strength of concrete masonry units and type of mortar used in construction

Net area compressive strength of concrete masonry, psi (MPa)[1]	Net area compressive strength of ASTM C90 concrete masonry units, psi (MPa)	
	Type M or S Mortar	Type N Mortar
1,700 (11.72)	---	1,900 (13.10)
1,900 (13.10)	1,900 (13.10)	2,350 (14.82)
2,000 (13.79)	2,000 (13.79)	2,650 (18.27)
2,250 (15.51)	2,600 (17.93)	3,400 (23.44)
2,500 (17.24)	3,250 (22.41)	4,350 (28.96)
2,750 (18;96)	3,900 (26.89)	-----
3,000 (20.69)	4,500 (31.03)	-----

[1]For units of less than 4 in. (102 mm) nominal height, use 85 percent of the values listed.

TMS 602 Sect 1.4 B.2 Table 2

Table for Regular Strength Block

	Block Strength	f'm - Compressive Strength of Masonry	Allowable Load Factor	Allowable Design Strength	Transient Factor (Increase Due to Wind)	Useable Design Strength for Wind Loading	% Increase from Current
2008 TMS 402/602 (Current)	1900	1500	0.33	500	0.33	665	
2011 TMS 402/602 (Effective July 1st, 2015)	1900	1500	0.45	675	0	675	1.5
2013 TMS 402/602 (Requires Approval)	2000	2000	0.45	900	0	900	35

Table for High-Strength Block

	Block Strength	f'm - Compressive Strength of Masonry	Allowable Load Factor	Allowable Design Strength	Transient Factor (Increase Due to Wind)	Useable Design Strength for Wind Loading	% Increase from Current
2008 TMS 402/602 (Current)	2800	2000	0.33	660	0.33	878	
2011 TMS 402/602 (Effective July 1st, 2015)	2800	2000	0.45	900	0	900	3
2013 TMS 402/602 (Requires Approval)	3250	2500	0.45	1125	0	1125	28

TMS 602 Sect 1.4 B.2 Table 2

		Table for Ultra High-Strength Block					
	Block Strength	f'm - Compressive Strength of Masonry	Allowable Load Factor	Allowable Design Strength	Transient Factor (Increase Due to Wind)	Useable Design Strength for Wind Loading	% Increase from Current
2008 TMS 402/602 (Current)	3750	2500	0.33	825	0.33	1097	
2011 TMS 402/602 (Effective July 1st, 2015)	3750	2500	0.45	1125	0	1125	3
2013 TMS 402/602 (Requires Approval)	3900	2750	0.45	1237	0	1237	13

TMS 602 Sect 1.4 B.2 Table 2
SAMPLE LETTER TO BUILDING OFFICIALS

Company Letterhead

Date

Name of Building Official
Title of Building Official
Municipality or County
Address of Building Dept

RE: Request to Use an Alternate Method as the Basis of Design for **Project or Structure Name and Location**

Dear Mr. (Ms.) **Name of Building Official**,

Pease consider this a request by **Name of Designer** to use the 2013 edition of the TMS 402/602, ACI 530/530.1, ASCE 5/6 in designing the above referenced project **structure**. I have compared the currently adopted edition of TMS 402/602, ACI 530/530.1, ASCE 5/6 to the 2013 edition and I assert that it complies with the intent of the provisions of the Florida Building Code, **Edition**, and that the method of design is, for the purpose intended, at least the equivalent of that prescribed in the Florida Building Code, **Edition** in quality, strength, effectiveness, fire resistance, durability and safety.

The 2013 edition of the TMS 402/602, ACI 530/530.1, ASCE 5/6 will be applied to the project using all applicable references and Florida Specific Amendments from the Florida Building Code, **Edition**. The 2015 Editions of the International Building Code adopts the TMS 402/602, ACI 530/530.1, ASCE 5/6-2013 and it is my understanding this will be adopted statewide in the next code change cycle.

Please verify that the use of the 2013 edition of the TMS 402/602, ACI 530/530.1, ASCE 5/6, as detailed above, is acceptable to your Building Department as an alternate method under the provisions of Section 104.11 of the Florida Building Code.

Sincerely,

Designers Signature Block and Seal

Available on www.floridamasonry.com/resources.html

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TMS 602 Sect 1.4 B.2 Table 2

INCREASED DESIGN STRENGTH FOR MASONRY IN THE 2013 CODE

Date: January 6th, 2015
To: All Interested Parties in Masonry Production, Design and Installation
From: The Masonry Association of Florida
RE: White Paper on Increased Design Strength of Masonry Provided in the *2013 Building Code Requirements and Specification for Masonry Structures* (TMS 402/602-13, ACI 530/530.1-13, ASCE 5/6-13)

The Building Code Requirements and Specification for Masonry Structures contains two standards and their commentaries: *Building Code Requirements for Masonry Structures* (TMS 402, ACI 530, ASCE 5) and *Specification for Masonry Structures* (TMS 602, ACI 530.1, ASCE 6). These standards are produced through the joint efforts of The Masonry Society (TMS), the American Concrete Institute (ACI), and the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE) through the Masonry Standards Joint Committee (MSJC). The mission of the MSJC is to develop and maintain design and construction standards for masonry for reference by or incorporation into model building codes regulating masonry construction.[1]

For the purposes of this paper we will refer to *The Building Code Requirements and Specification for Masonry Structures* as TMS 402 and the *Specification for Masonry Structures* as TMS 602. These are the most common designations for the code and specification. TMS 402/602 form the basis for masonry design in both the ICC and FBC and have for many

Available on www.floridamasonry.com/resources.html

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2011 edition both in technical requirements and in layout. This edition will be referenced by the 2015 International Building Code for the design and construction of structural masonry, veneer, and glass unit masonry. Many revisions and enhancements have been made to the 2013 Building Code Requirements and Specification for Masonry Structures including: • a complete reformatting of the document into a more user friendly format • the addition of an Appendix on an optional limit design method for special reinforced masonry shear walls • a new Chapter for the prescriptive design of masonry partition walls • movement of the empirical provisions into an Appendix • a change to permit a moment magnifier approach for the design of reinforced clay, concrete masonry and autoclaved aerated concrete (AAC) masonry walls • revisions of design requirements for partially grouted shear walls • changes to the requirements for joint reinforcement and seismic clips for anchored veneer in SDC D, E, and F

Masonry & Net Zero Don Beers, PE

Lateral Bracing Don Beers, PE

Masonry Fact Sheet - Energy Comparison Masonry vs. Wood Fra

Sample Letter to Building Officials (Use of the Code)

White paper:Increased Design Strength for Masonry in the 2013 Code:: Don Beers, PE

TMS 602 Sect 1.4 B.2 Table 2

5th Edition Florida Building Code

2010 FBC, EC

TABLE 402.1.1
COMPONENT EFFCIENCIES REQUIRED[a, i]

% Glazing[c]	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b]	CEILING R-VALUE	ROOF REFLECTANCE TESTED PER SECTION 405.6.2	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE/ SLAB R-VALUE[d]	DOOR U-FACTOR	DUCTS: R-VALUE/ LOCATION[k]	AIR HANDLER LOCATION[k]	AIR LEAKAGE TESTED PER SECTION 403.2.2.1
20%	0.65[j]	0.75	0.30	30	0.25	13	6/7.8	13/0	0.65	R-6/ Conditioned	Conditioned	Qn= 0.03

5TH ED FBC, EC

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b, j]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	.65	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0

NEW CODE COMPARES MASONRY TO MASONRY

Table R405.5.2(1)

2010 Code Compared Masonry to Wood and Did Not Properly Factor in Thermal Mass (i.e., wood has an unfair advantage in the FSEC EnergyGauge software).

TABLE 2 - ENERGY DIFFERENCES BETWEEN R4 CMU AND R13 WOOD WALLS

Total Energy $ Savings per Year Over Standard CMU w/R4 Added Insulation					
Wall#	Wall Disc	Overall R Value	Miami	Orlando	Jax
11	CMU R4	5.8	0	0	0
12	Wood R13	10.9	$46	$15	$18

FBC 5TH ED. – CH. 4 COMMERCIAL ENERGY EFFICIENCY

C402.1.2 U-FACTOR ALTERNATIVE

An assembly with a U-factor, C-factor, or F-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the R-value in Table C402.2.

TABLE C402.2

OPAQUE THERMAL ENVELOPE REQUIREMENTS

(By Added Continuous Insulation R Value)

CLIMATE ZONE	1		2	
	All Other	Group R	All Other	Group R
Mass[c]	R-5.7ci[c]	R-5.7ci[c]	R-5.7ci[c]	R-7.6ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20

TABLE C402.1.2

OPAQUE THERMAL ENVELOPE REQUIREMENTS

(By Through Wall U Value)

CLIMATE ZONE	1		2	
	All Other	Group R	All Other	Group R
Mass	U-0.142	U-0.142	U-0.142	U-0.123
Metal building	U-0.079	U-0.079	U-0.079	U-0.079
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064
Wood framed and other	U-0.064	U-0.064	U-0.064	U-0.064

CONVERSION OF R TO U (U=1/R) (R=1/U)

LAYERS → $R_{TOTAL} = R_1 + R_2 + R_3 + \ldots$

WHOLE WALL
Includes Air Films → $R_{TOTAL} = R_1 + R_2 + R_3 + \ldots.$

$U = 1/R_{TOTAL}$

WHERE THE CONFUSION COMES IN

C402.2.3 Thermal resistance of above-grade walls. The minimum thermal resistance (R-value) of the insulating materials installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table C402.2, based on framing type and construction materials used in the wall assembly.

The R-value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table C402.2.

COMMERCIAL ENERGY EFFICIENCY

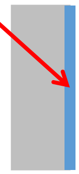
FBC 5TH ED. – CHAPTER 4

C402.1.2 U-factor alternative. An assembly with a U-factor, C-factor, or F-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the R-value in Table C402.2.

Commercial "R" Value Prescriptive Table C402.2

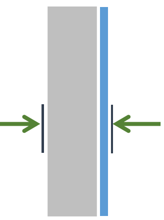
CLIMATE ZONE	1		2	
	All Other	Group R	All Other	Group R
Mass[c]	R-5.7ci[c]	R-5.7ci[c]	R-5.7ci[c]	R-7.6ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20

PER 5TH ED. FBC ENERGY



U Value Table C402.1.2

CLIMATE ZONE	1		2	
	All Other	Group R	All Other	Group R
Mass	U-0.142	U-0.142	U-0.142	U-0.123
Metal building	U-0.079	U-0.079	U-0.079	U-0.079
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064
Wood framed and other	U-0.064	U-0.064	U-0.064	U-0.064



Exterior Air Film	R=.25
8" CMU	R=1.3
1 ½ " Reflective Air Space	R=5.6
Int Gypboard	R=.45
Interior Air Film	R=.68
Tot R Value	**R=8.28**

U=1/R=1/8.28=.121<.123
Meets Code by Overall "U" Value

TABLE C402.1.2 OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

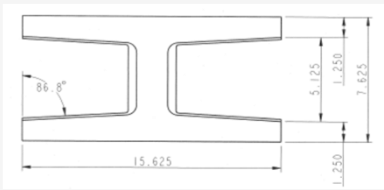
CLIMATE ZONE	1		2		
	All Other	Group R	All Other	Group R	R Value
Mass	U-0.142	U-0.142	U-0.142	U-0.123	R-8.13
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	R-12.66
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	R-15.62
Wood framed and other	U-0.064	U-0.064	U-0.064	U-0.064	R-15.62

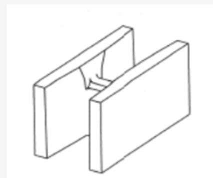
All of these walls are considered by the code to be equivalent in their energy efficiency

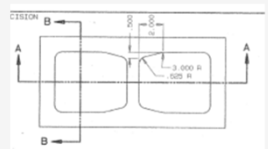
The difference is MASS

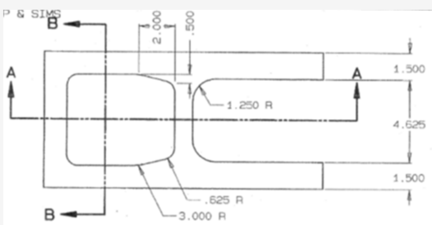
C90-11B Table 1 WEB REVISIONS

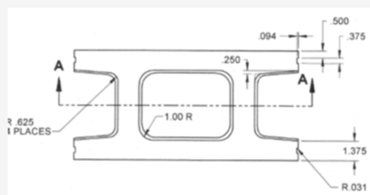
Many alternative configurations…Unit Configurations

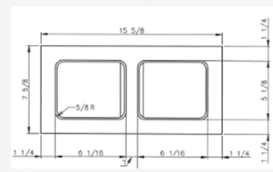












DEVELOPMENT OF REINFORCING

pg. C-99 Sect 8.1.6.3

8.1.6.3 *Development of bars in tension or compression* — The required development length of reinforcing bars shall be determined by Equation 8-12, but shall not be less than 12 in. (305 mm).

$$l_d = \frac{0.13\, d_b^{\,2} f_y \gamma}{K\sqrt{f'_m}} \qquad \text{(Equation 8-12)}$$

pg. C-105 Sect 8.1.6.7.1

8.1.6.7.1 *Lap splices*

8.1.6.7.1.1 The minimum length of lap for bars in tension or compression shall be determined by Equation 8-12, but not less than 12 in. (305 mm).

EMBEDMENTS & LAPS

TMS 402 pg. C-99 Sect 8.1.6.3

DEVELOPMENT LENGTHS (l_d)

	40 Bar Dia (Min allow by Fla. Code)	48 Bar Dia (Historic for GD 60 and HVHZ)	72 Bar Dia (Max Required under Fla. Code)	40 Bar Dia for One Size Increase of Bar (12 IBC)	48 Bar Dia for One Size Increase of Bar in High Wind Zone (12 IBC)	MSJC 13 with 5th Edition Fla Code Mods
3	15	18.0	27.0	(#4 Bar) 20	(#4 Bar) 24	15.1
4	20	24.0	36.0	(#5 Bar) 25	(#5 Bar) 30	20.1
5	25	30.0	45.0	(#6 Bar) 30	(#6 Bar) 36	25.1
6	30	36.0	54.0	(#7 Bar) 35	(#7 Bar) 42	34.2
7	35	42.0	63.0	(+#4 bar) 35	(+#4 bar) 42	47.4
8	40	48.0	72.0	(+#4 bar) 40	(+#4 bar) 48	73.0
9	45.1	54.1	81.2	(+#5 bar) 45	(+#5 bar) 54	94.6

ASSUMPTIONS

- f_y=60,000 psi
- f'm=1,500 psi
- Bar spacing > $5d_b$
- Bars centered in cell

2014 FBC 2107.2.1

- Minimum 48 bar diameters no longer in the HVHZ Section of the 5th Edition FBC. Minimum is still 40 bar dia. in Florida.

GO TO LAP CALCULATOR

Bar Size	Simple Laps: 40db (Min per FBC)	Simple Laps: 48db (No Longer the Min in FBC HVHZ)	Simple Laps: 72db (Max Req per FBC)	8" Block: Lap Per TMS 402-13	8" Block: Lap Per TMS 402-13 w/FBC Y Factors	12" Block: Lap Per TMS 402-13	12" Block: Lap Per TMS 402-13 w/FBC Y Factors	
3	15.0	18.0	27.0	12.0	12.0	12.0	12.0	
4	20.0	24.0	36.0	14.1	14.1	12.0	12.0	
5	25.0	30.0	45.0	22.5	22.5	14.3	14.3	
6	30.0	36.0	54.0	42.8	34.2	27.1	21.7	
7	35.0	42.0	63.0	59.3	47.4	37.3	29.8	
8	40.0	48.0	72.0	91.3	73.0	56.9	45.5	#8 and #9 Bars recommended
9	45.0	54.0	81.0	117.6	94.1	72.8	58.3	for use in 12" Masonry Only

fy (psi)	60,000	Change only these cells
f'm (psi)	1,500	

$$\frac{0.13 d_b^2 f_y \gamma}{K \sqrt{f'_m}}$$

Users of this program do so at their own risk. No claim is made to the accuracy of the results.

Bar Size	K Chart: 9 x db	Cover for 8" Masonry	K for 8" Masonry	Cover for 12" Masonry	K for 12" Masonry	Y: Per TMS 402-13	Y: Per FBC 5th Ed.
3	3.38	3.63	**3.38**	5.63	**3.38**	1	**1**
4	4.50	3.56	**3.56**	5.56	**4.50**	1	**1**
5	5.63	3.50	**3.50**	5.50	**5.50**	1	**1**
6	6.75	3.44	**3.44**	5.44	**5.44**	1.3	**1.04**
7	7.88	3.38	**3.38**	5.38	**5.38**	1.3	**1.04**
8	9.00	3.31	**3.31**	5.31	**5.31**	1.5	**1.2**
9	10.13	3.25	**3.25**	5.25	**5.25**	1.5	**1.2**

TMS 402 pg. C-99 Sect 8.1.6.3

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MANDATORY INSPECTIONS FROM TMS 402

2014 FBC 2107.1 Exception

Mod 5973 provides an exception to inspections required by TMS 402/ACI 530/ASCE 5 Chapter 1 Section 1.19 and TMS 602/ ACI 530.1/ASCE 6 Section 1.6 where inspections are provided by a building department. The architect, engineer, or the building official is permitted to require the inspections specified by TMS (Strength Design Method).

2 HOUR TOWNHOUSE SEPARATION

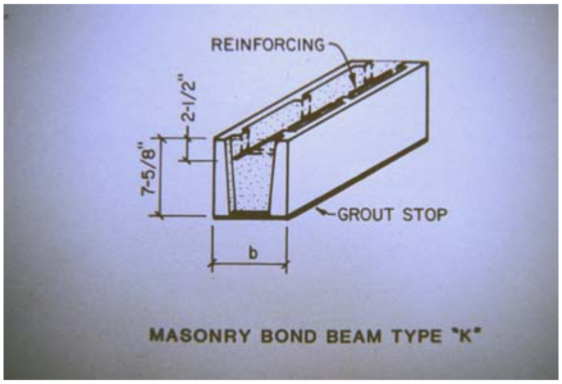
RESIDENTIAL CODE

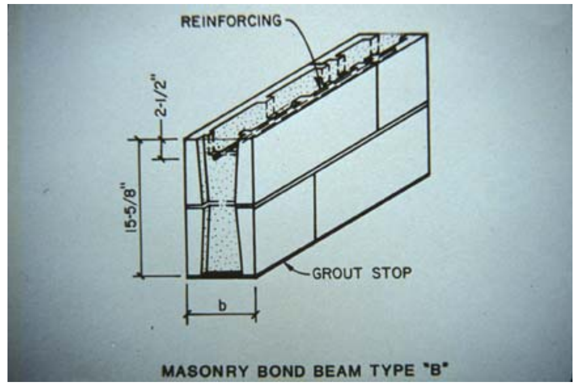
- Mod 6011 retains provisions permitting single two-hour fire resistant wall to separate townhouses.
- R302.2 Townhouses. Each townhouse shall be considered a separate building and shall be separated by fire-resistance rated wall assemblies meeting the requirements of Section R302.1 for exterior walls.

PRESCRIPTIVE RESIDENTIAL REQUIREMENTS

- Mod 6107 adds extensive prescriptive provisions for grouted concrete masonry dwelling construction to residential code. Copy is attached to email transmitting this report.

  2014 FBC R301.2.1.1 Exceptions: 7.
- Mod 5998 adds a reference to the prescriptive provisions of the code for CMU construction (Chapter 6); adds the MAF Guide to Concrete Masonry Residential Construction in High Wind Areas and TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6 as permitted construction and design documents.





Masonry Association of Florida

SECTION 3

MASONRY BEST PRACTICES

Flashing | Weeps |Movement

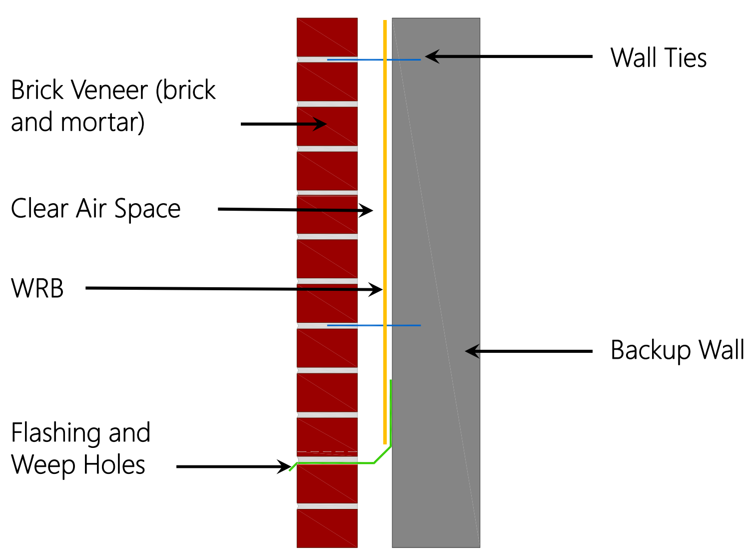
TMS 402/ACI 530/ASCE 5 (MSJC)
As referenced in the Florida Building Code – 5th Edition

BUILD YOUR CREDENTIALS. BUILD THE INDUSTRY.

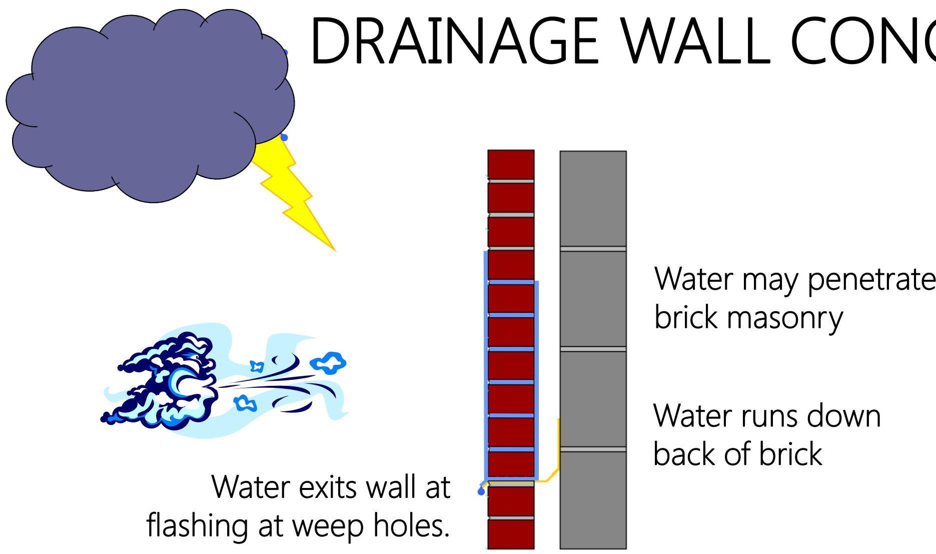
Drainage Wall System

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

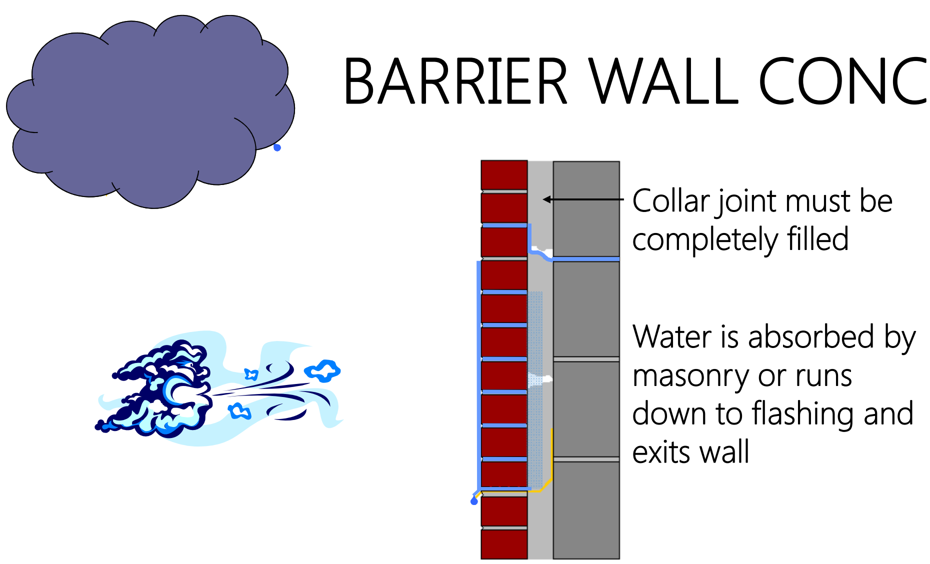
DRAINAGE WALL COMPONENTS



DRAINAGE WALL CONCEPT



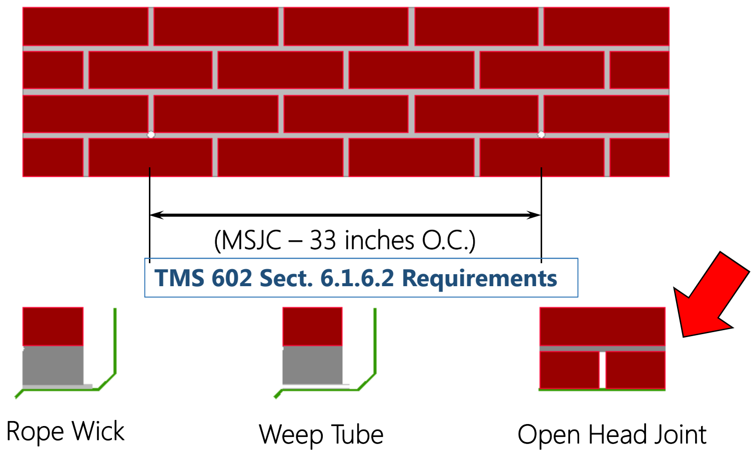
BARRIER WALL CONCEPT



WEEP HOLES

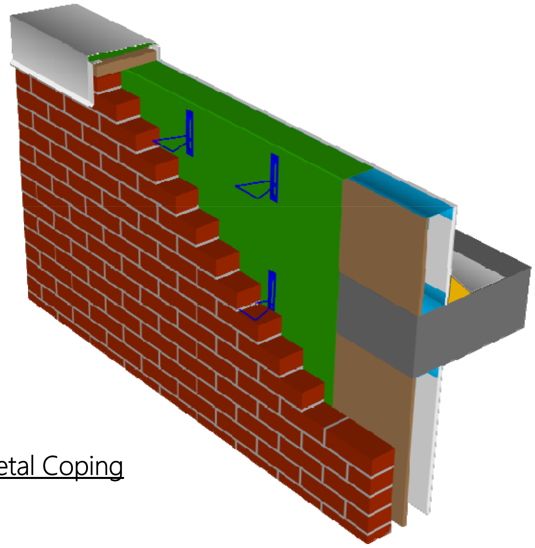
BIA Suggested Spacings

Weep Holes @ 24 " O.C., Wicks @ 16" O.C.



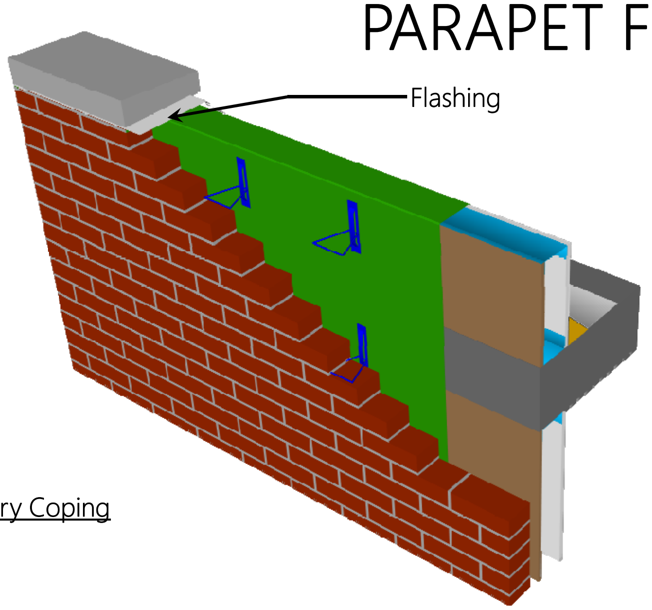
REQUIRED FLASHING LOCATIONS

PARAPET FLASHING



Prefinished Metal Coping

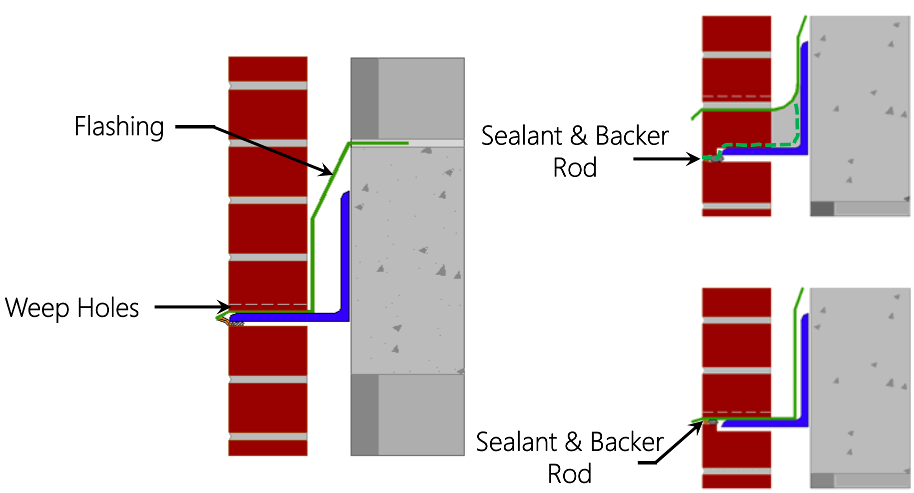
PARAPET FLASHING



Masonry Coping

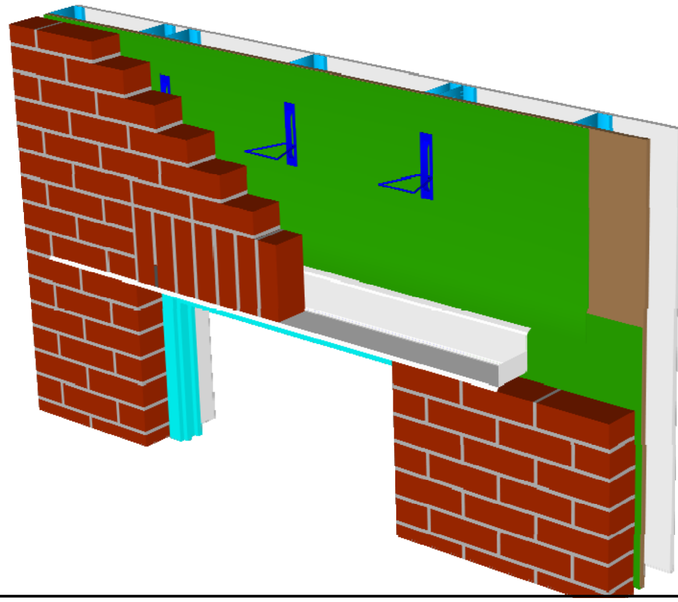
REQUIRED FLASHING LOCATIONS

SHELF ANGLE FLASHING

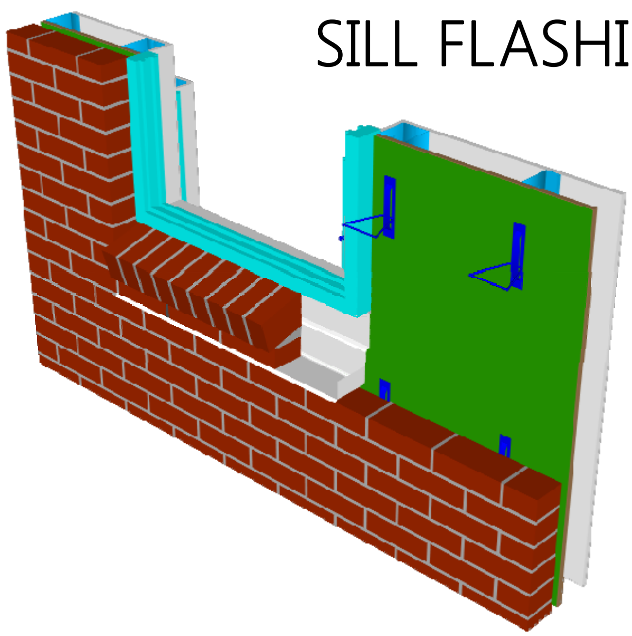


REQUIRED FLASHING LOCATIONS

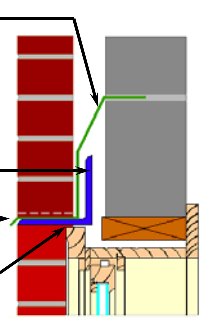
HEAD/LOOSE LINTEL FLASHING



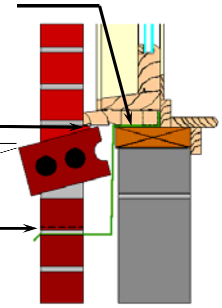
SILL FLASHING



WINDOW FLASHING

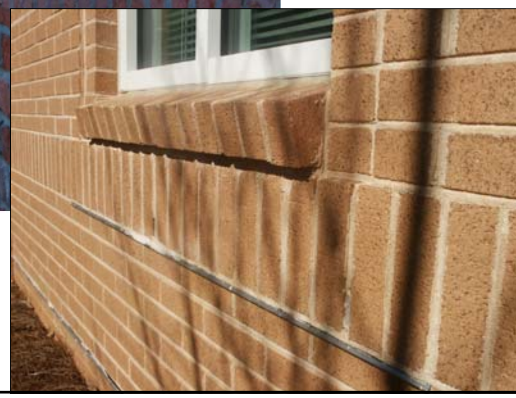


Window Head



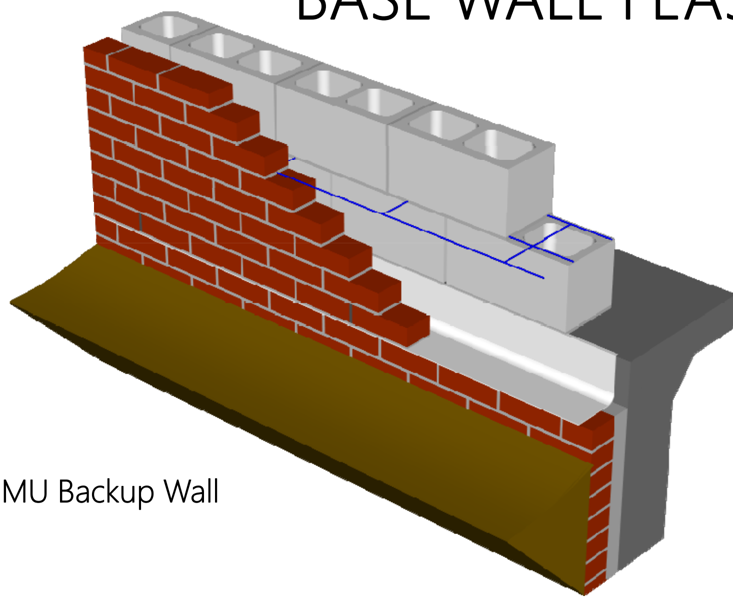
Window Sill

Window Sills- ¾" Slope Minimum

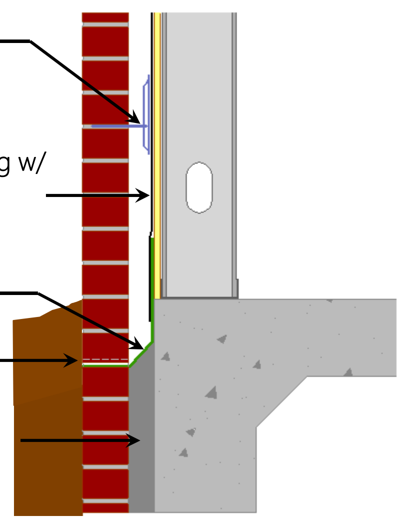


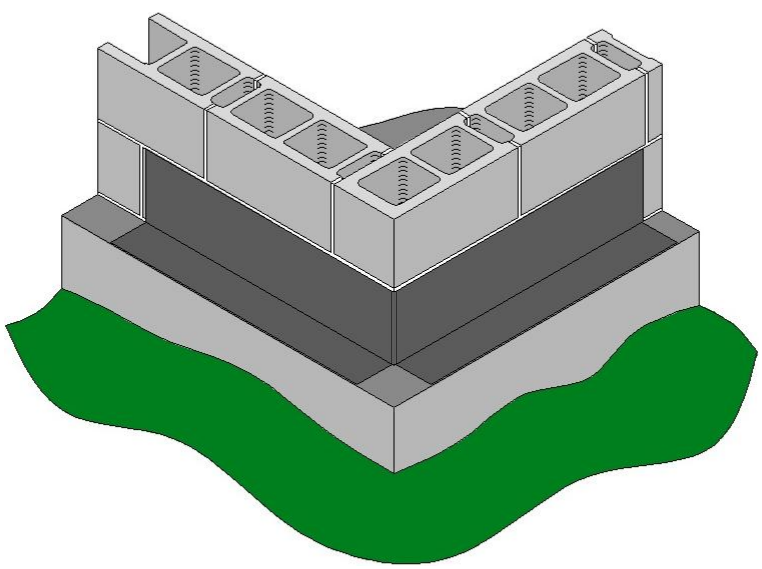
REQUIRED FLASHING LOCATIONS

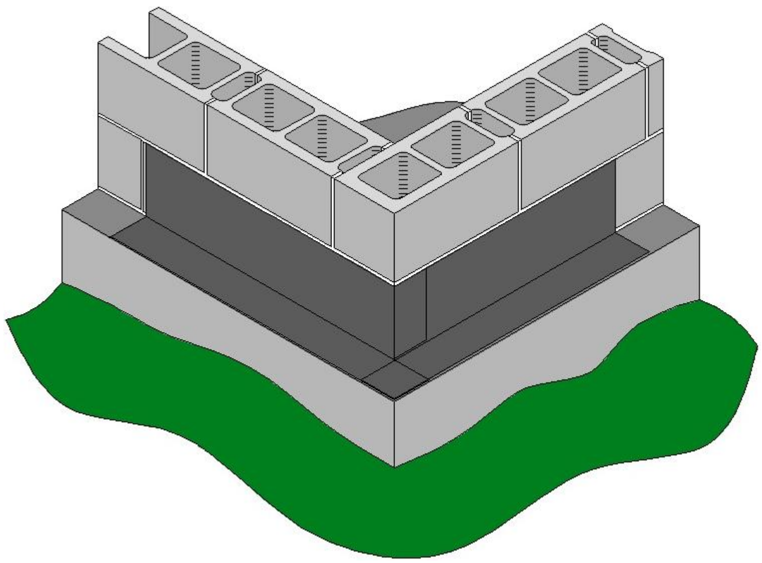
BASE WALL FLASHING



Through Wall Flashing







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.

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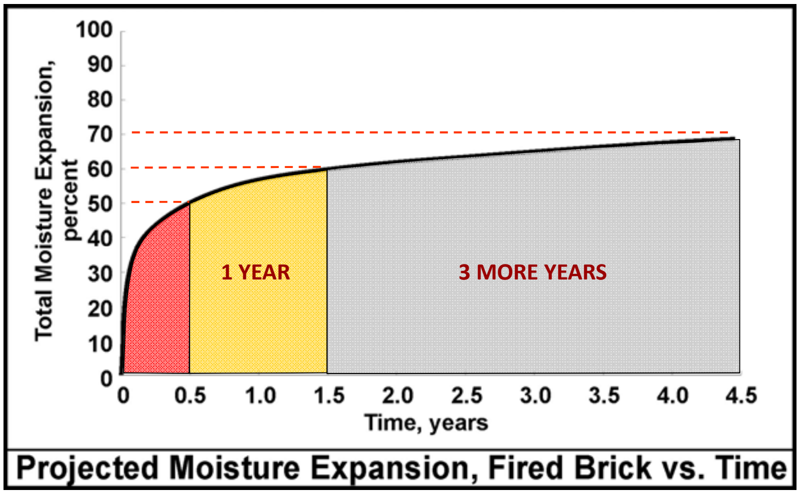
EXPANSION JOINT DESIGN

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



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)
ΔT = temperature change in brickwork

EXPANSION JOINTS
Spacing of Vertical & Horizontal Joints

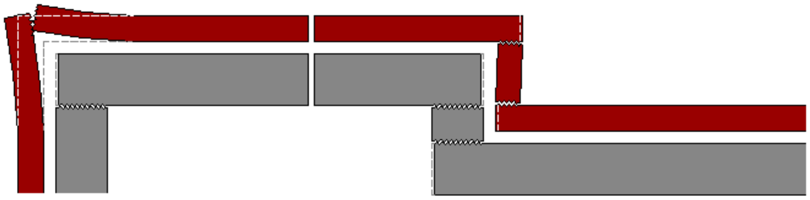
30 & 4

EXPANSION JOINTS
Spacing of Vertical & Horizontal Joints

30’ Run Max
4’ From Corner Max

MOVEMENT

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

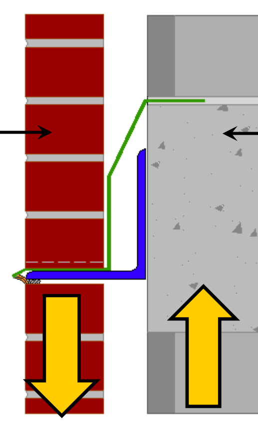


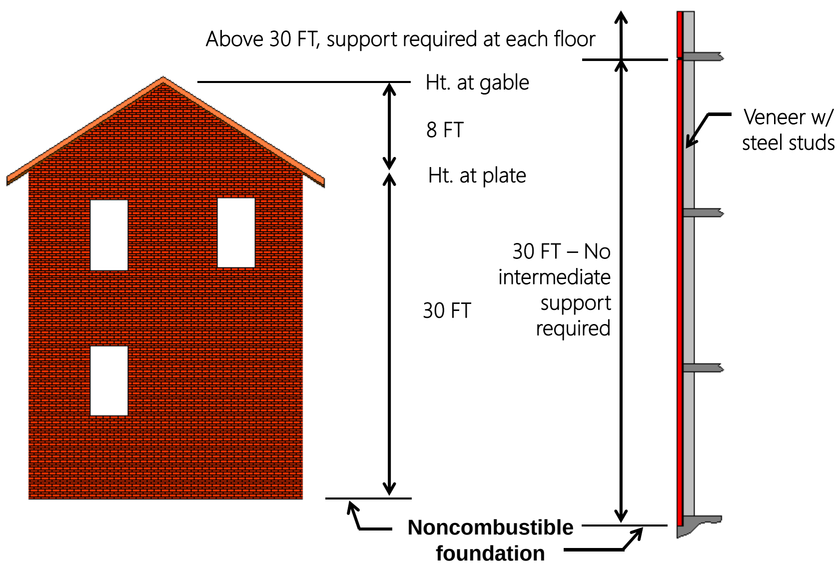
Example: 100 ft brick wall, 100°F Summer, 40°F Winter

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.

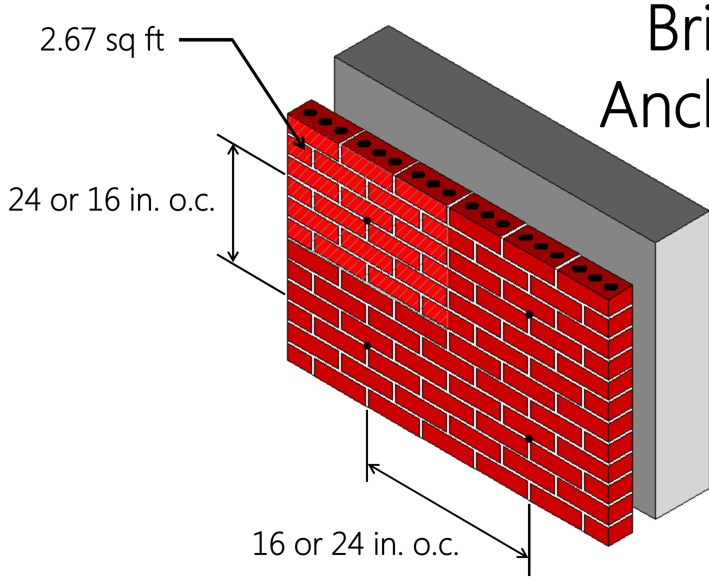
TYPICAL EXPANSION JOINT LOCATIONS

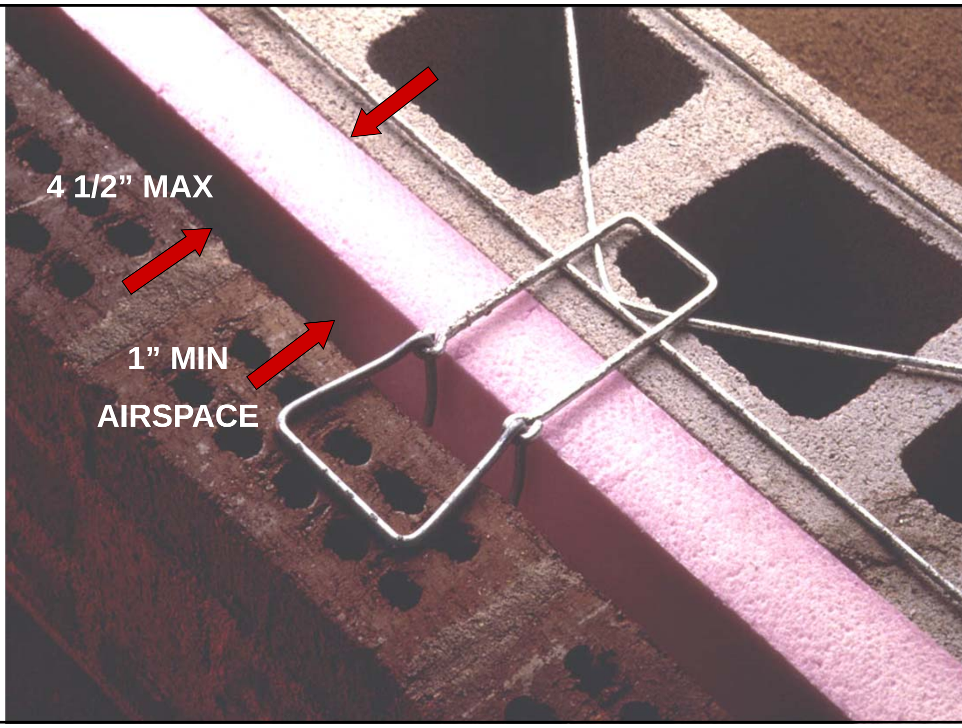
HORIZONTAL EXPANSION JOINTS



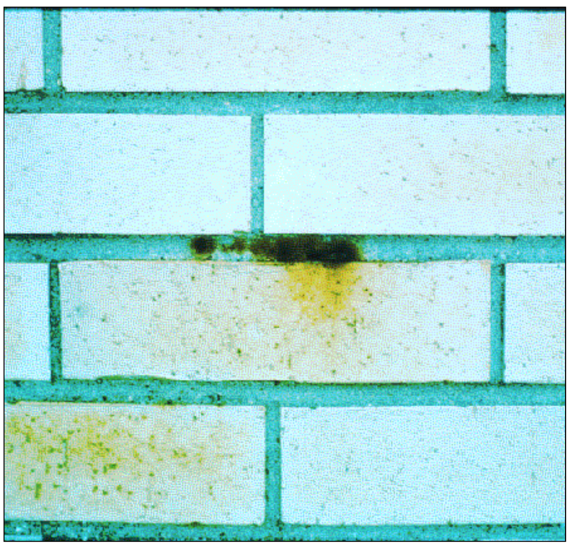

Above 30 FT, support required at each floor
Ht. at gable
8 FT
Ht. at plate
30 FT
30 FT – No intermediate support required
Veneer w/ steel studs
Noncombustible foundation

Brick Anchors





...at least 5/8 in. (15.9 mm) mortar cover to the outside face.



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

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 Association of Florida

SECTION 4

QUESTIONS?

Thank you for attending!

BUILD YOUR CREDENTIALS. BUILD THE INDUSTRY.

This concludes The American Institute of Architects
Continuing Education Systems Course

AIA Florida

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