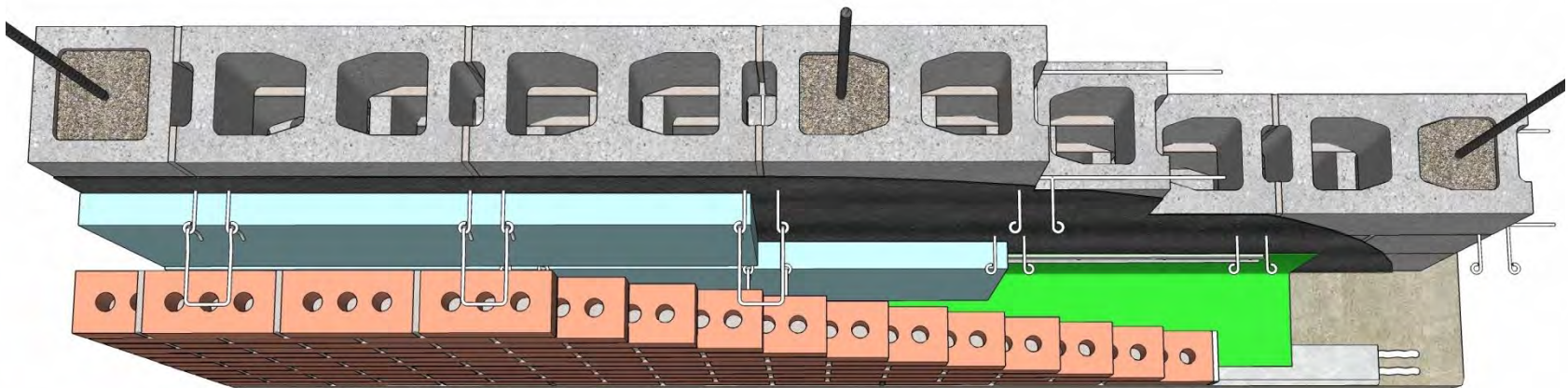




masonry job site troubleshooting



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➤ Course Evaluation

Welcome, AIA Members



learning objectives



review

basic masonry design concepts



understand

masonry expectations



discover

critical performance construction details



learn

how to diagnose masonry problems



UNION MASONRY CRAFTWORKERS
CONTRACTORS & CONSULTANTS

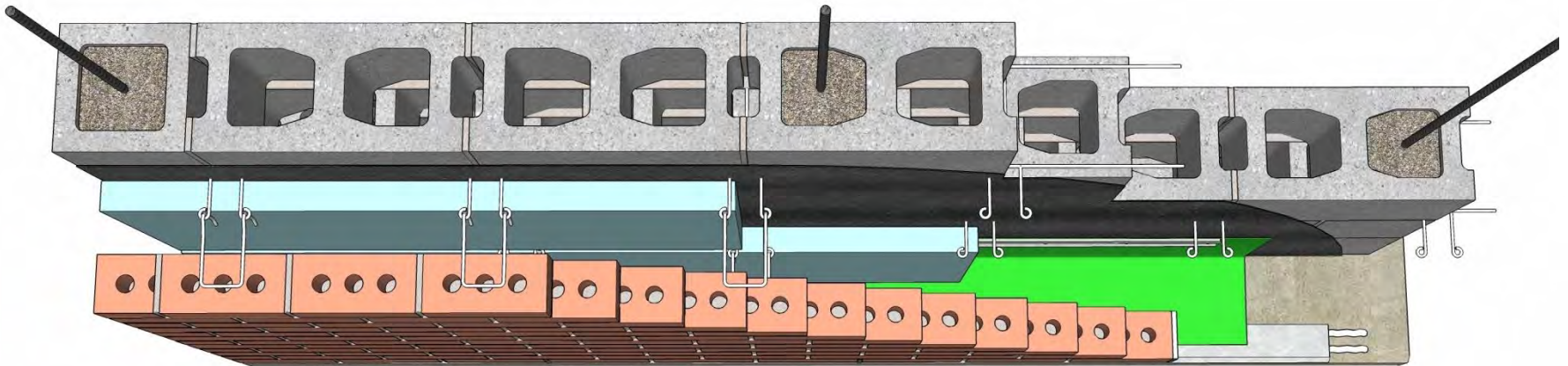
seminar outline



1. masonry codes & resources
2. water-resistive barrier
3. air space
4. flashing
5. weep vents
6. mortar joints
7. veneer connectors
8. joint reinforcement
9. shelf angles
10. movement joints



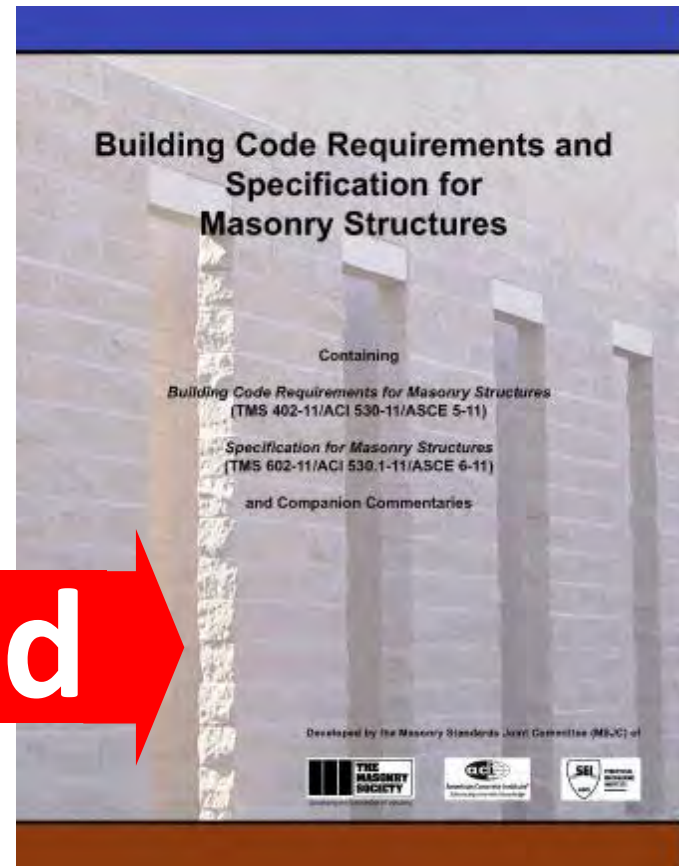
mason codes & resources



commercial masonry codes



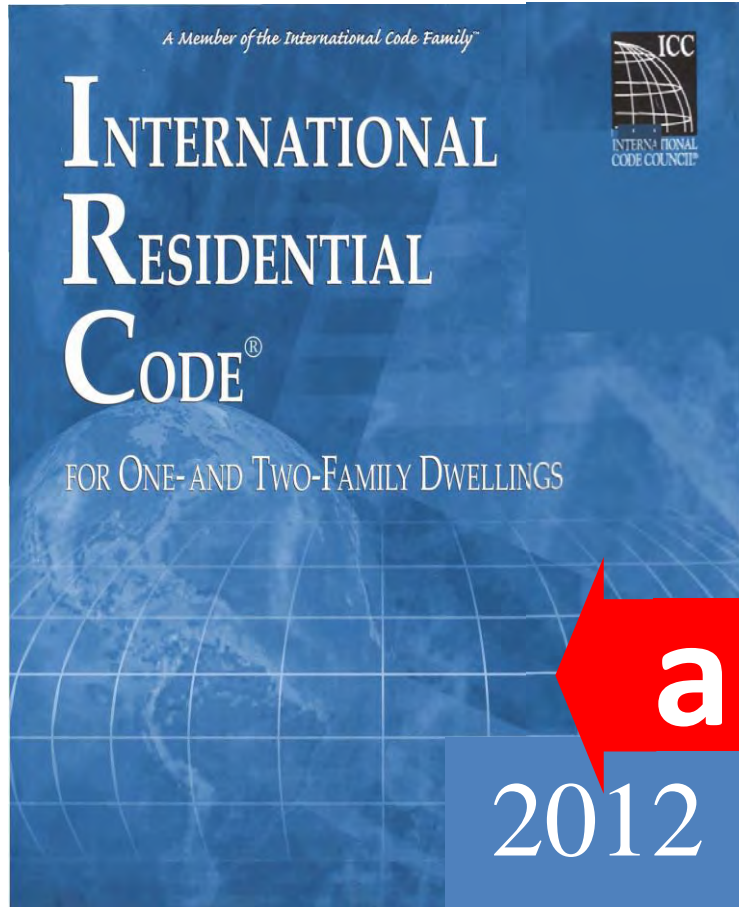
"IBC"



"MSJC"

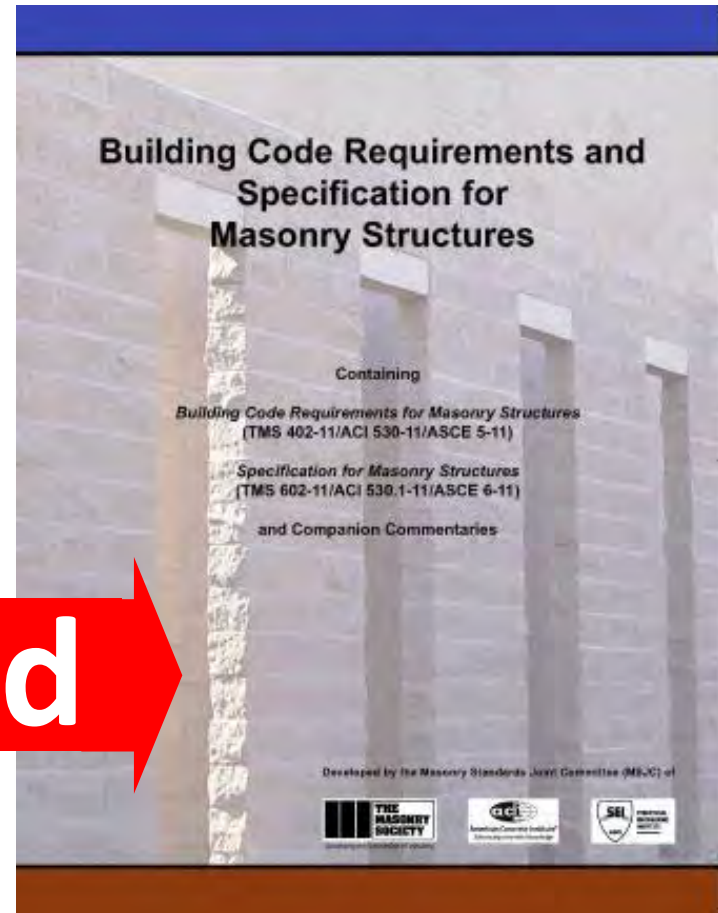
("ACI 530")

residential masonry codes



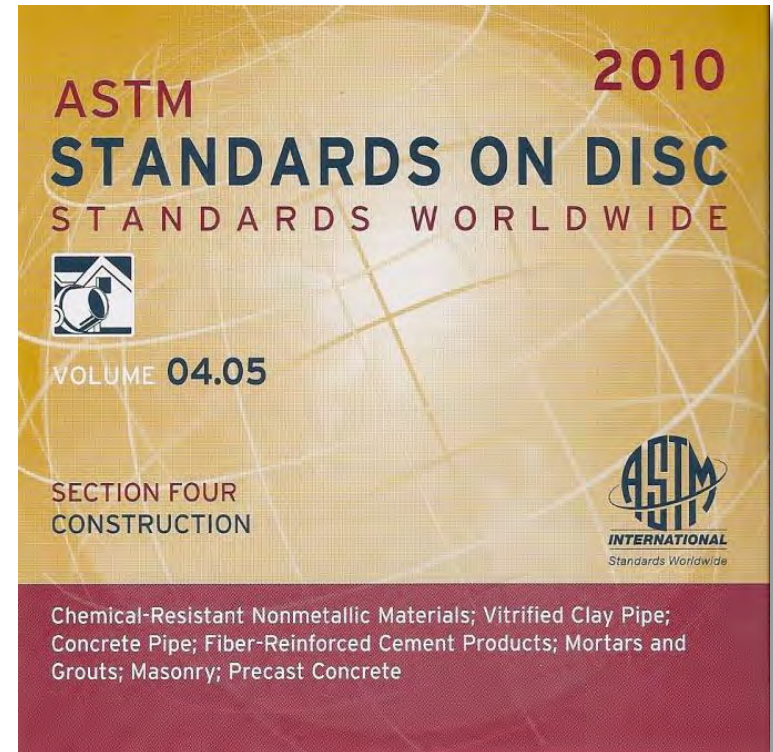
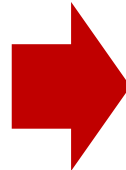
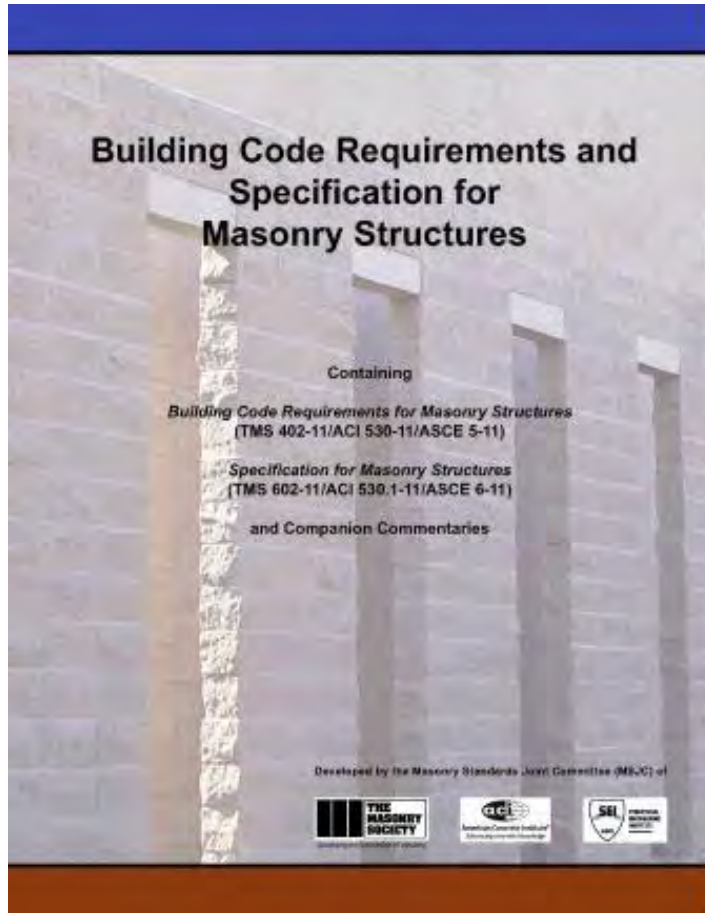
"IRC"

and



"MSJC"

ASTM Standards



masonry resources (online)

- Brick Industry Association (BIA)
- National Concrete Masonry Association (NCMA)
- The Masonry Society (TMS)
- **International Masonry Institute (IMI)**



ABOUT IMI TRAINING DESIGN TOOLS EDUCATION CALENDAR



Children's Hospital of Pittsburgh of UPMC, photo courtesy of Astorino

Masonry offers plenty of sustainable, desirable solutions. [See more](#)

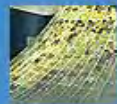


Multimedia Gallery / Press Room



GREEN SCHOOLS

School officials are making the smart choice: sustainable masonry.



"The Building Blocks of Green Masonry"
in the November issue
of *Construction Specifier* magazine.

News From IMI

- CASE STUDY: Lucas County Arena delivers best system and schedule
- Regional Newsletters
- IMI Today
- Golden Trowel Award Winners



IMI Technical Briefs

FEATURE: Hybrid
Masonry Design

"I wish I had taken this course earlier."

Contractors review the Sustainable Masonry Certification Program

QUICK LINKS:

IMI Tool Kit

Ask IMI

New Products

Sustainable Masonry

Structural Masonry

IMI Blog



The Envelope, Please
March 12, 2010
The Oscars remind us that performance is at the core of building envelopes.

Ready or Not, Green Contracting is Here
February 18, 2010

Sign up for IMI News

FLYNN CENTER Training Schedule

Pre-job Training

Train-the-Trainer Courses

Continuing Education Courses

Download Training Schedule



Masonry Details



Featured Detail

Conceptual
Wall Section,
Brick & Block
Cavity Wall

IMI can work with you to get the right detail for your project. Call 1-800-IMI-0988 or email techresources@imiweb.org.

IMI “Masonry Detailing Series”



01.201: Sill detail



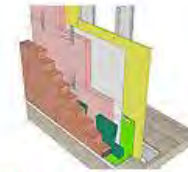
01.201.2D: Sill Detail



01.402.2D: Window Jamb Detail



01.501: Floor detail: shelf angle



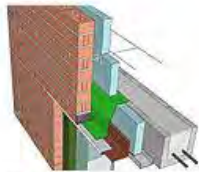
(NEW) 02.102: Foundation detail w/ termination bar & cavity insert



02.103: Foundation detail w/ termination bar, cavity insert & below grade brick



01.202: Sill detail Interior



01.301: Head detail: steel lintel & bond beam



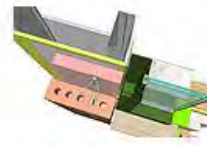
(NEW) 01.502: Shelf angle w/ lipped brick



01.601: Architectural effect: projected soldier course



02.201: Sill detail



02.401: Window jamb detail



01.302: Head detail: steel lintel & bond beam w/ cavity insert



01.303: Head detail: steel lintel w/ double angle



(NEW) 01.701: Roof detail: metal cropping at parapet



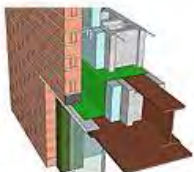
(NEW) 01.703: Roof detail: low parapet



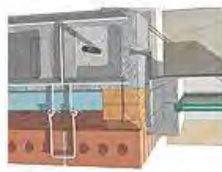
03.501: Floor detail: concrete floor connection



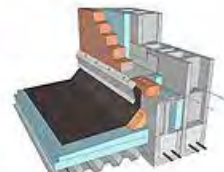
03.502: Floor detail: CMU firewall, top of wall



01.304: Head detail: plate welded to I-beam



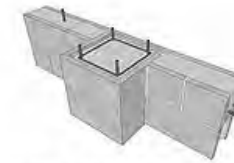
01.401: Window jamb & sills



(NEW) 01.704: Roof detail: low roof - high wall



01.801: Movement joint in brick & block cavity wall



03.904: Load bearing pilaster

www.masonrydetails.org

other masonry resources

- *manufacturer installation instructions*
- *ICC Evaluation Services Reports (ICC-ESR)*
- *Cast Stone Institute (CSI)*
- *Indiana Limestone Institute (ILI)*
- *Manufactured Veneer Masonry Association (MVMA)*
- *Rocky Mountain Masonry Institute (RMMI)*



ICC Evaluation Services Report (1)



Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-2665

Issued March 1, 2009

www.icc-es.org | (800) 423-6587 | (562) 699-0543

A Sub

DIVISION: 04—MASONRY
Section: 04710—Simulated Brick
Section: 04730—Simulated Stone

REPORT HOLDER:

BOULDER CREEK STONE
8282 ARTHUR STREET NE
MINNEAPOLIS, MINNESOTA 55432
(763) 786-7138
www.bouldercreekstone.com

EVALUATION SUBJECT

BOULDER CREEK STONE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 International Building Code® (IBC)
- 2006 International Residential Code® (IRC)

Properties evaluated

- Veneer strength and durability
- Surface-burning characteristics
- Thermal resistance

2.0 USES

Boulder Creek Stone is used as an adhered, non-load-bearing veneer on interior and exterior, non-fire-resistance-rated wood-framed or light gage steel stud walls, concrete walls and masonry walls.

3.0 DESCRIPTION

The veneer is a precast concrete product made to resemble natural stone in color and in texture. The concrete is composed of portland cement, aggregate, water, admixtures and coloring. The veneer units are molded and cured at the plant. The average saturated weight of the installed veneer units does not exceed 15 pounds per square foot (73.2 kg/m²). The precast stone veneer has a Class A finish rating in accordance with IBC Section 803.1, and complies with the flame-spread and smoke-development requirements of IRC Section R315. The veneer units have an R-value ("F-ft²-h/Btu") of 0.87 (0.15 m²K/W) when tested in accordance with ASTM C 518 at an average thickness of 1.7 inches (43 mm). Recognized patterns are listed below:

- Bavarian Castle
- Bluffstone

- Cliffstone
- Country
- Eastern
- Fast Stone
- Italian
- Montana
- Mountain
- Nugget
- Ohio River
- Pebble
- Prairie
- River Rock
- Sangria
- Southern
- Splitface
- Venetian Cobble
- Weathered Edge
- Washed River Rock
- Western Ledge Slab
- Thin Brick - Tumbled

4.0 INSTALLATION

4.1 General:

Installation of Boulder Creek Stone must comply with this report, the manufacturer's published installation instructions, and the applicable code. The manufacturer's published installation instructions must be available at the jobsite at all times during installation. The veneer must be applied to backings of cement plaster.

4.2 Preparation of Cement Plaster Backings:

Cement plaster backings may be applied over sheathing, supported by wood or steel studs, and over concrete or masonry walls.

4.2.1 Installation over Sheathing: For exterior installations, cement plaster backings must be installed over a water-resistive barrier complying with IBC Sections 1404.2 and 2510.6 or IRC Sections R703.2 and R703.6.3, as applicable. Also, flashing must be installed as required by IBC Section 1405.3 or IRC Section R703.8, as applicable, and weep screeds must be installed at the bottom of the veneer. The weep screeds must comply with,

Section 5.1 – Conditions of Use

In the event of a conflict between the manufacturer's published installation instructions and this report, this report governs.

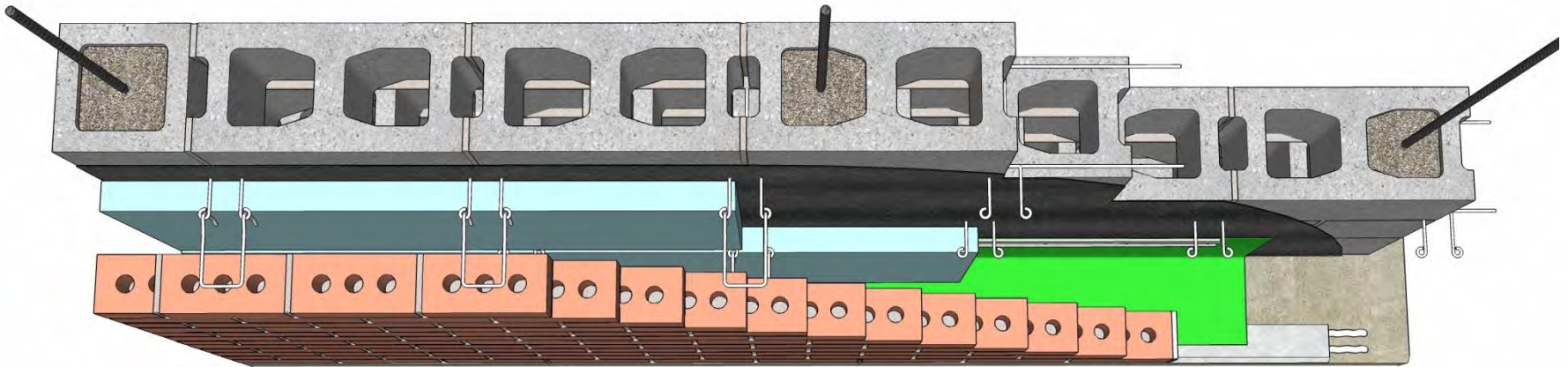
ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, Inc., express or implied, as to any finding or other matter in this report, or as to any product covered by the report.



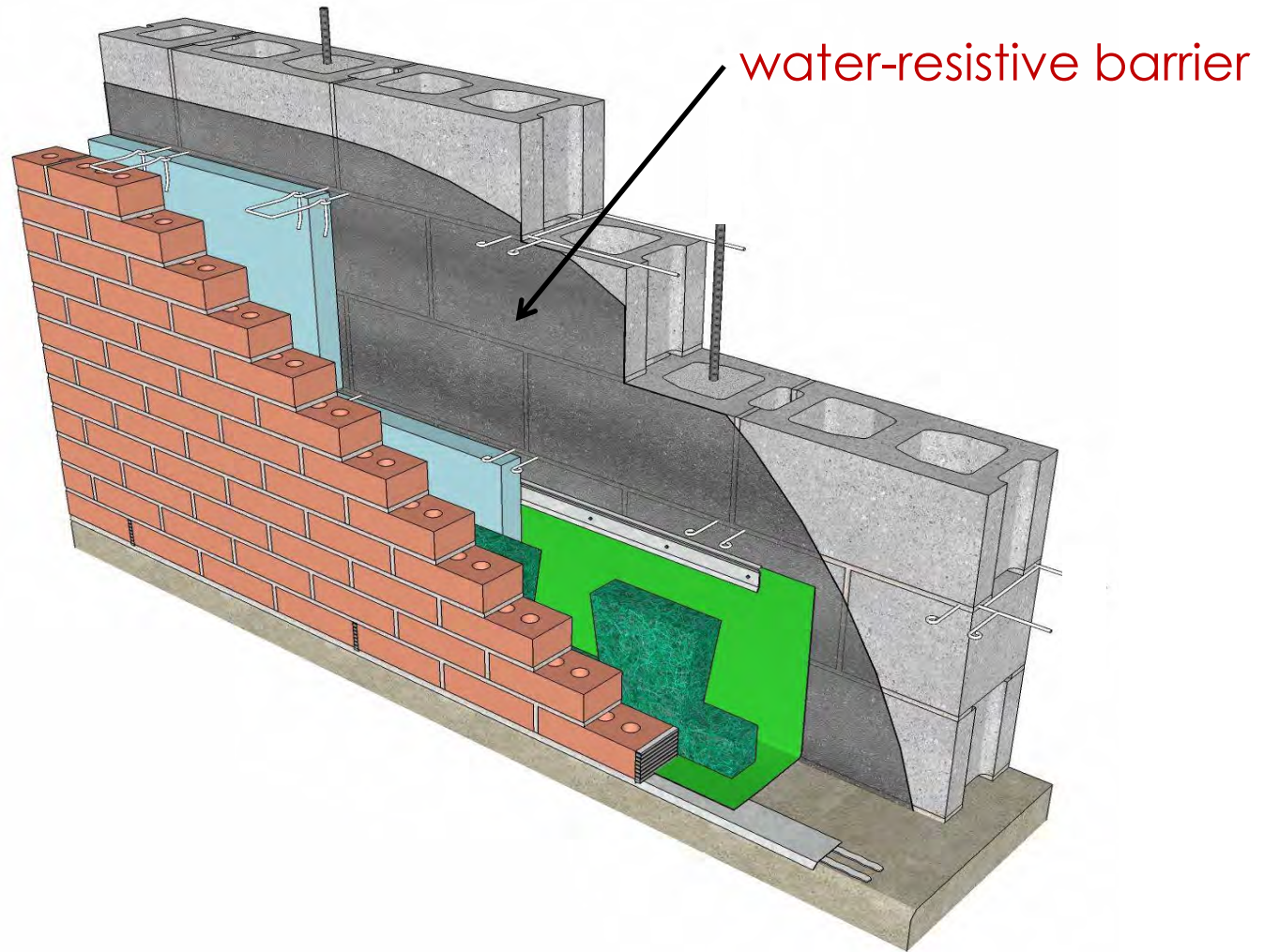
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Page 1 of 2

water-resistive barrier (WRB)



masonry cavity wall



water-resistive barrier on CMU



WRB requirement (1)



MSJC-2011, Section 6.1.6.1

“Design and detail the backing system of exterior veneer to resist water penetration.

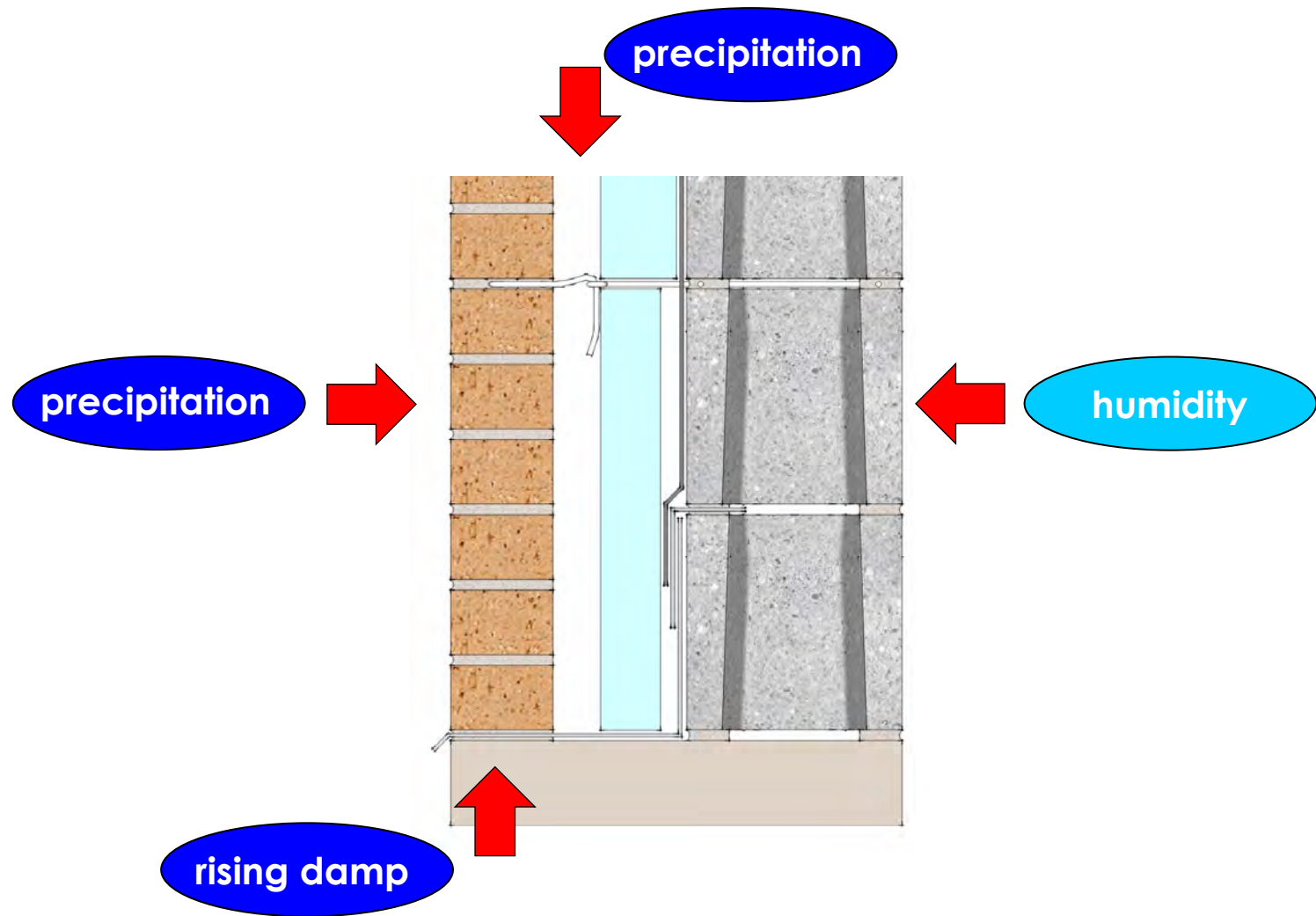
Exterior sheathing shall be covered with a water-resistant membrane,

unless the sheathing is water resistant and the joints are sealed.”

no WRB !



moisture sources



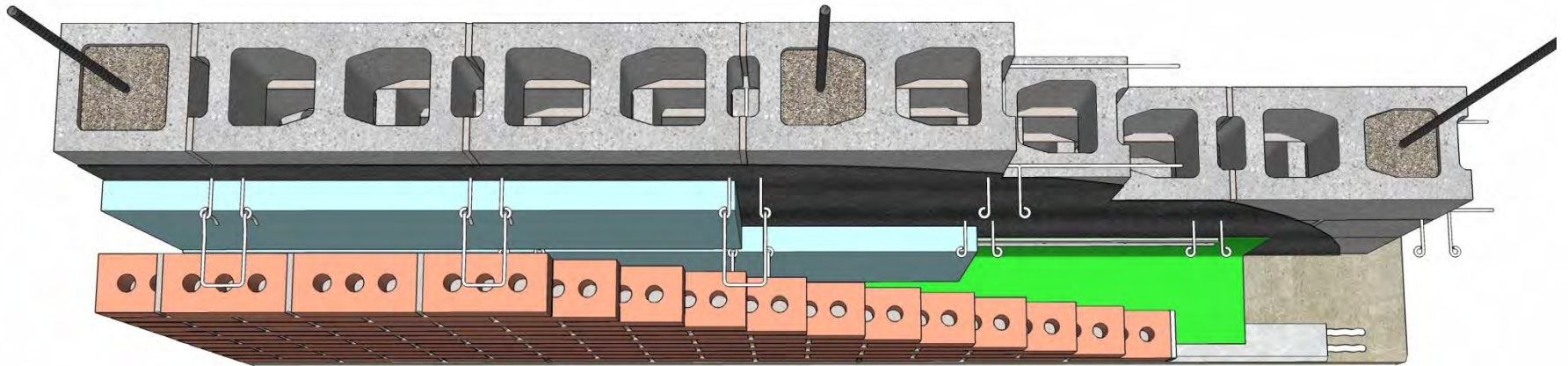
Who plugs the hole ?



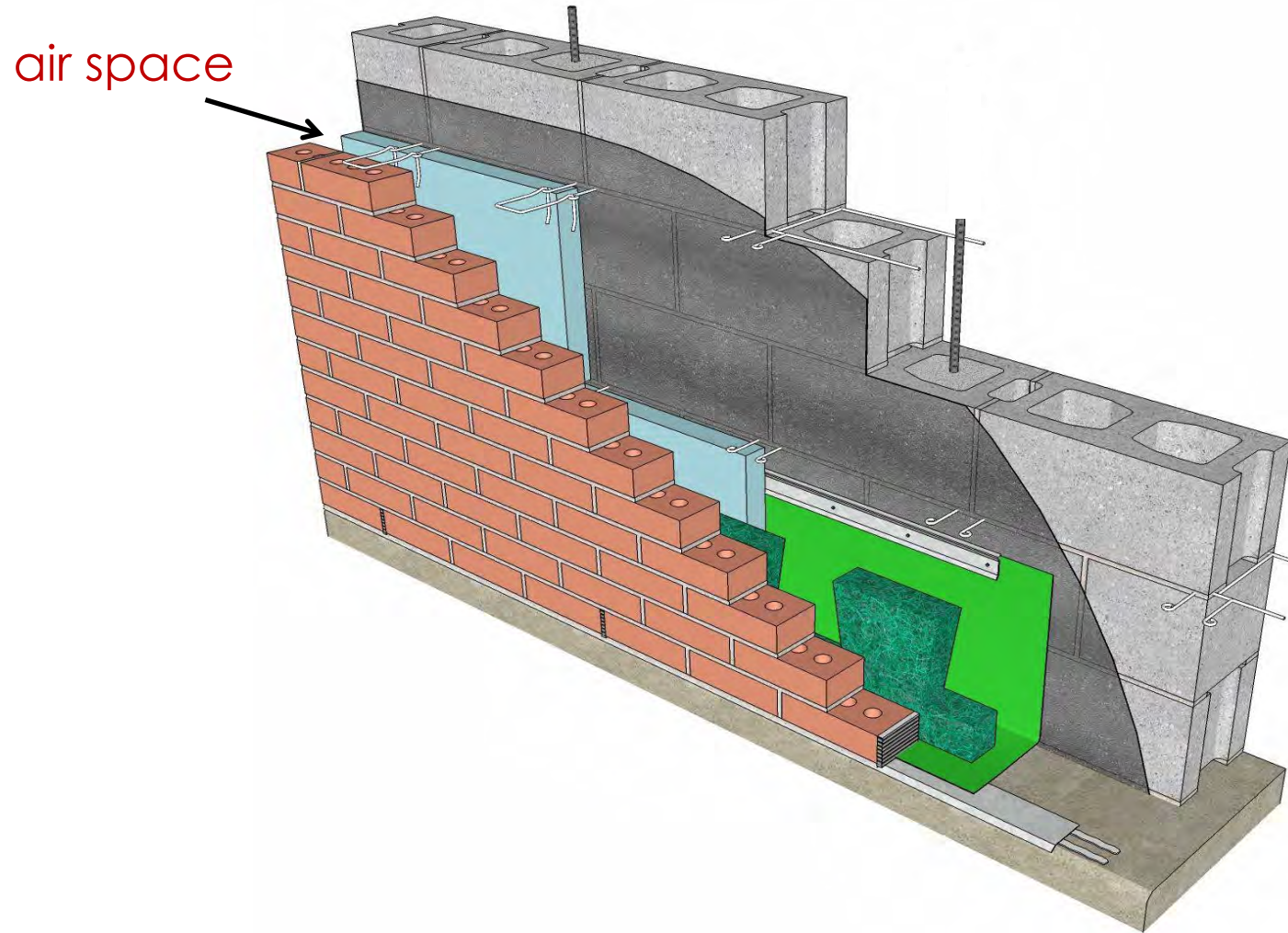
water/air barrier & flashing coordination



air space



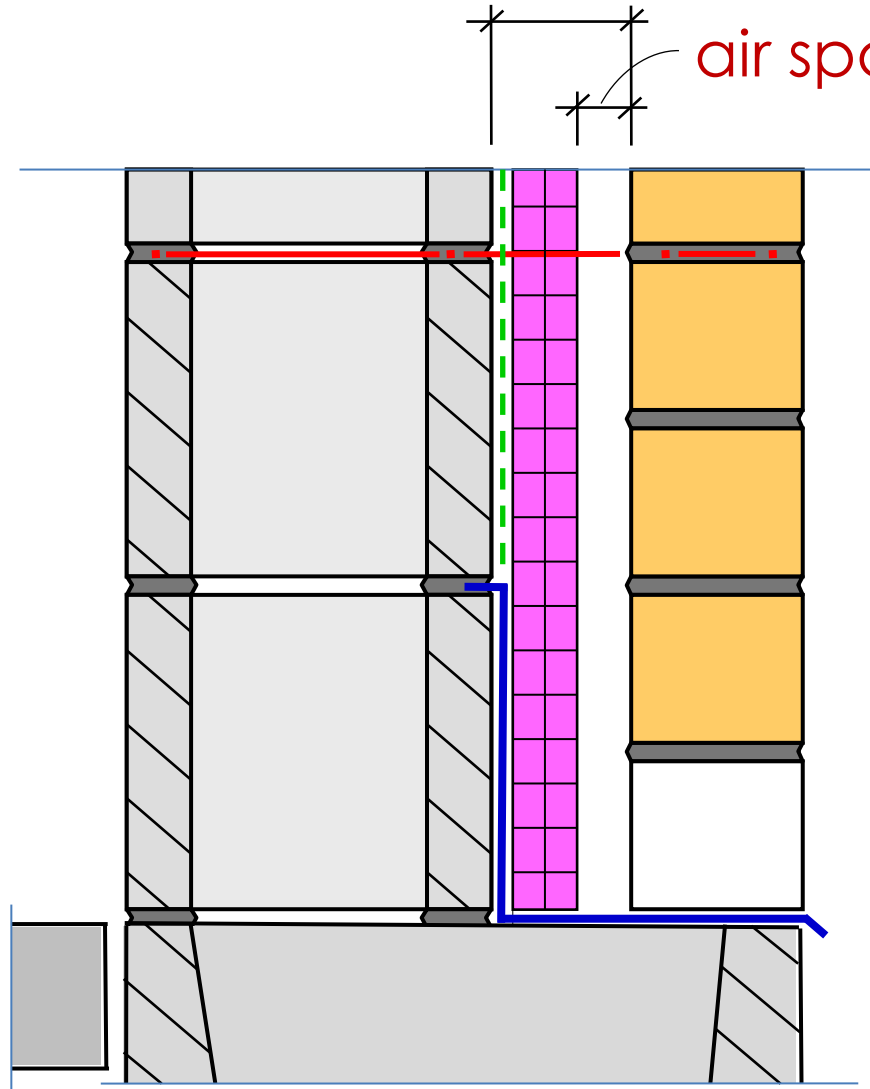
masonry cavity wall



wall cavity vs. air space

wall cavity

air space



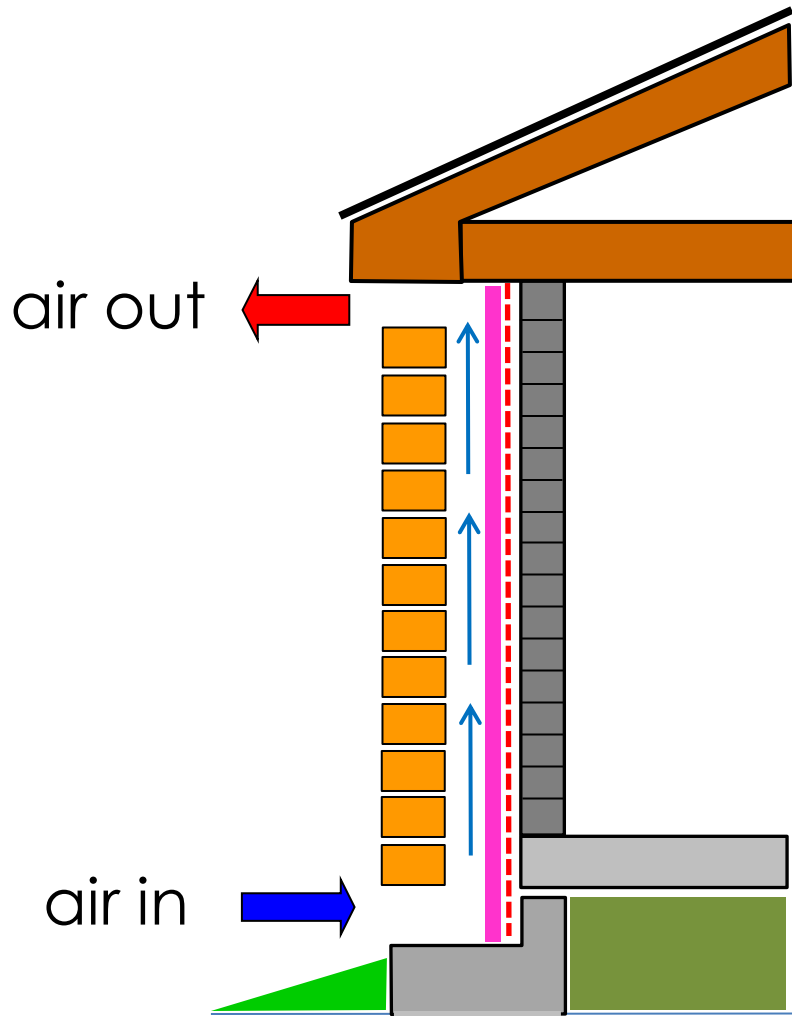
inadequate air space



water + pressure + wood = **lawyer**



2 function of an air space



1) drainage

2) drying



air control recommended on support wall when ventilating wall cavity,

air space width



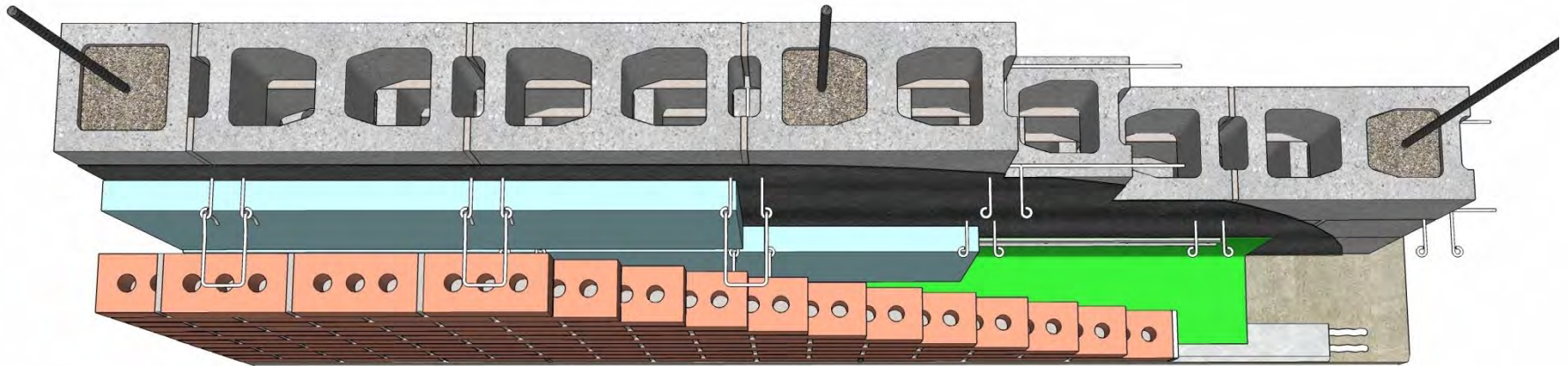
1" code (a)

2" recommended (b)

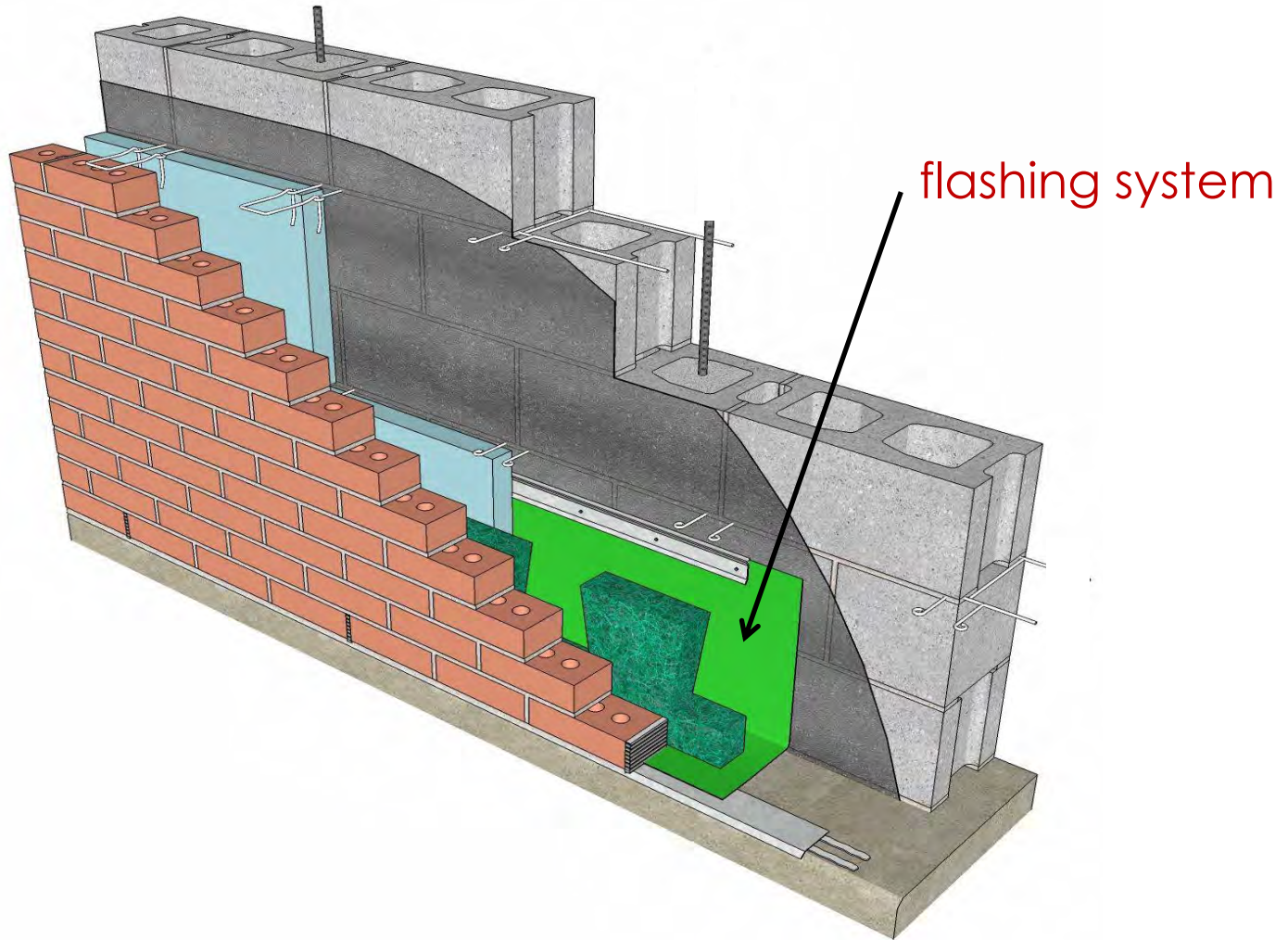
(a) minimum, Masonry Standards Joint Committee Code (MSJC)

(b) International Masonry Institute (IMI), Brick Industry Association (BIA), National Concrete Masonry Association (NCMA), The Masonry Society (TMS)

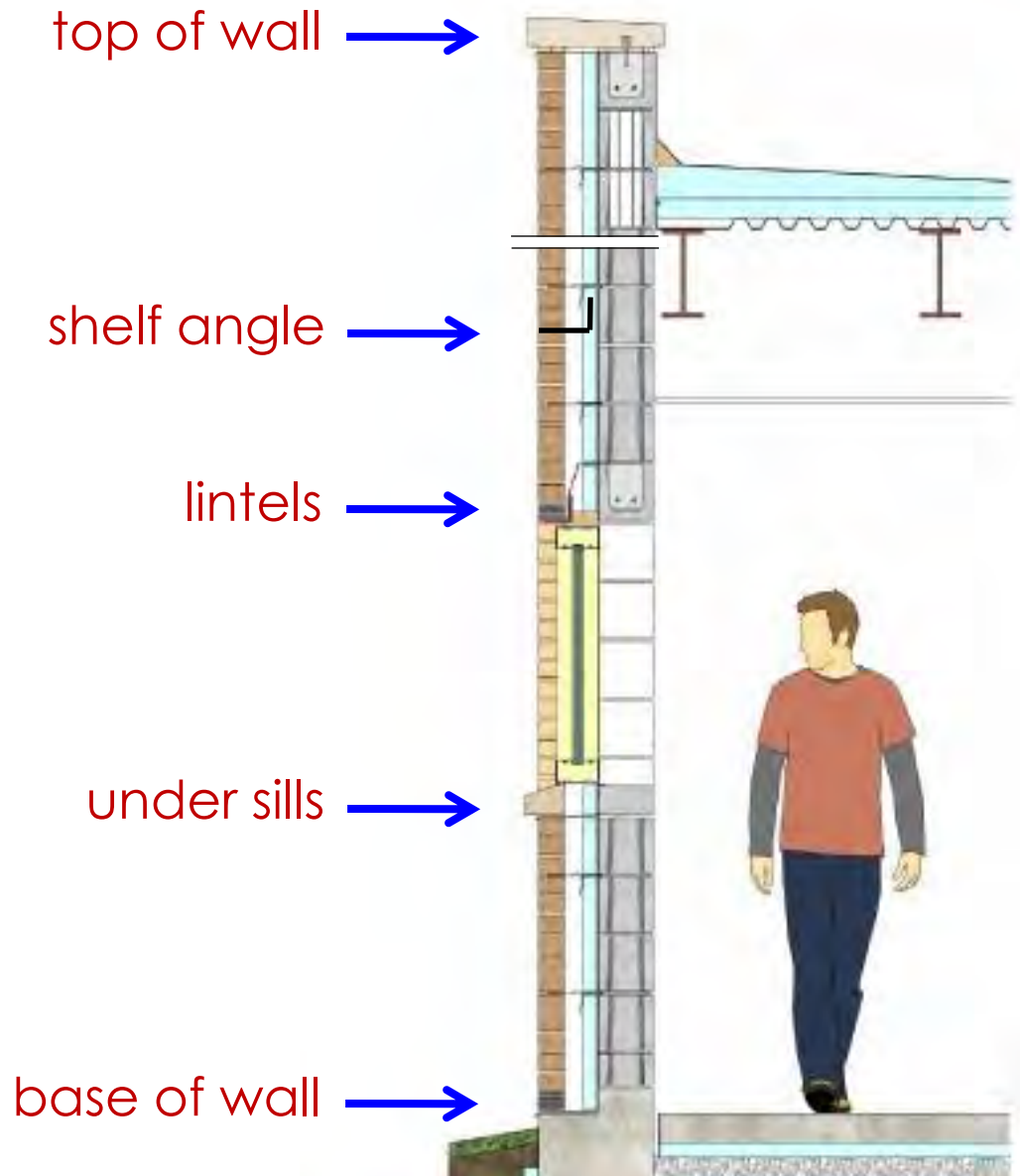
flashing



masonry cavity wall



flashing locations



what's wrong?



concealed flashing (not good)



drip edge detail

1" min. lap, sealed w/
mfr-approved adhesive

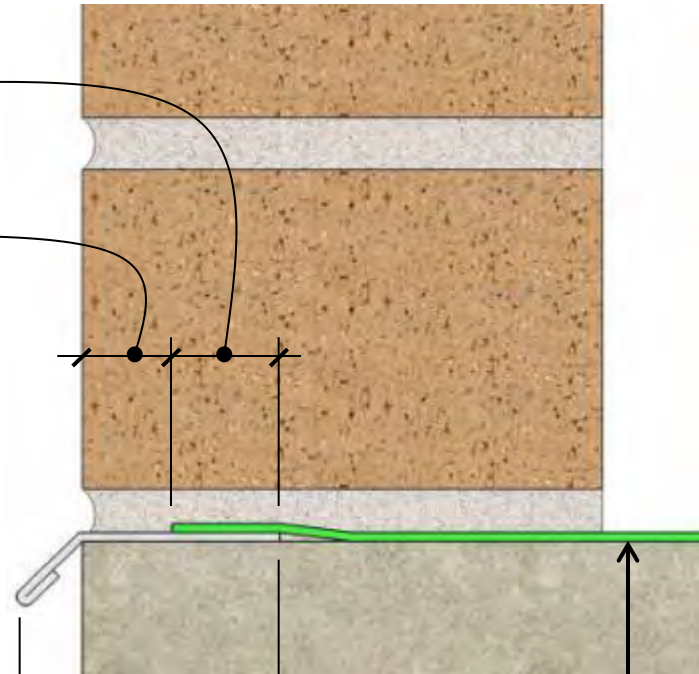
1/2" to 3/4" min.
if unstable rubberized
asphalt flashing - to
prevent drool

1/2" - 3/4"

3" typical

best practice to install mortar
wash for "slope to drain" ⁽¹⁾

(1) must be detailed and/or specified in construction documents



flashing drool



exposed flashing membrane



drip edge option

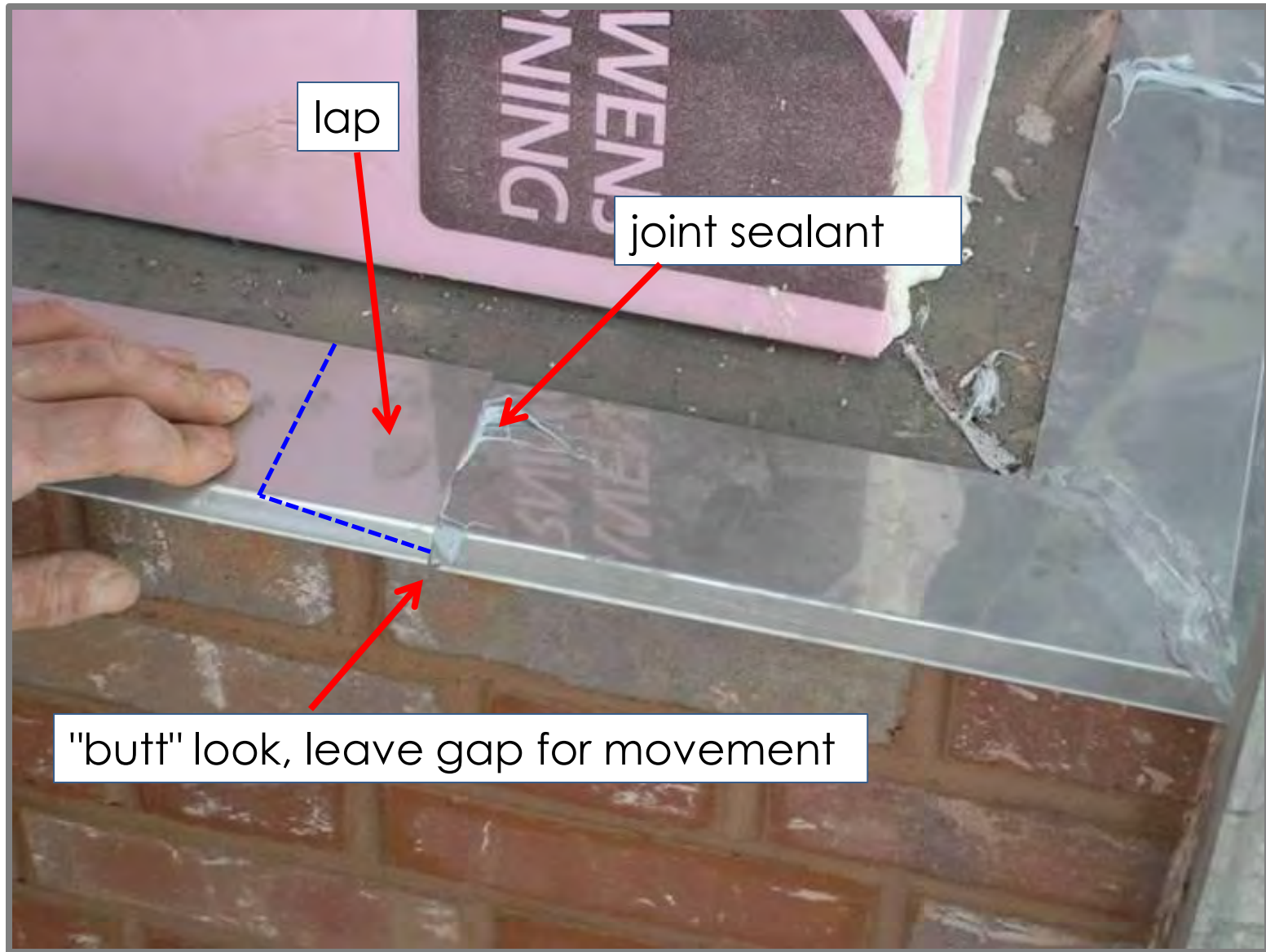


membrane flashing system



Hohmann & Barnard's TeXtroflash™

drip edge connection



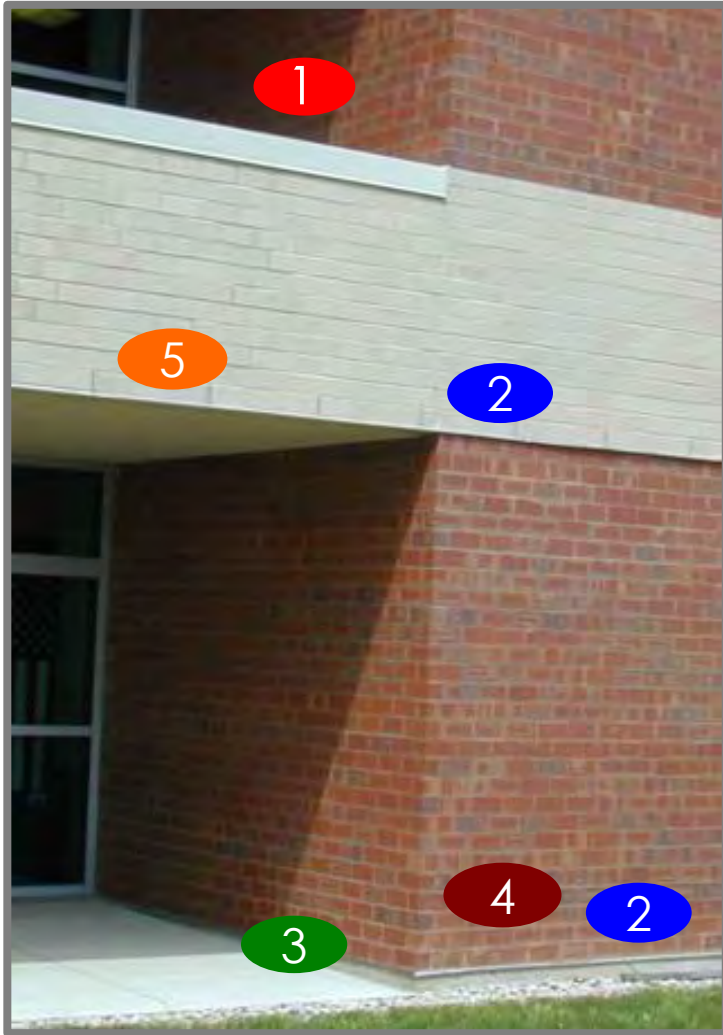
drip edge – seal to substrate



field-formed outside corner drip



flashing functions

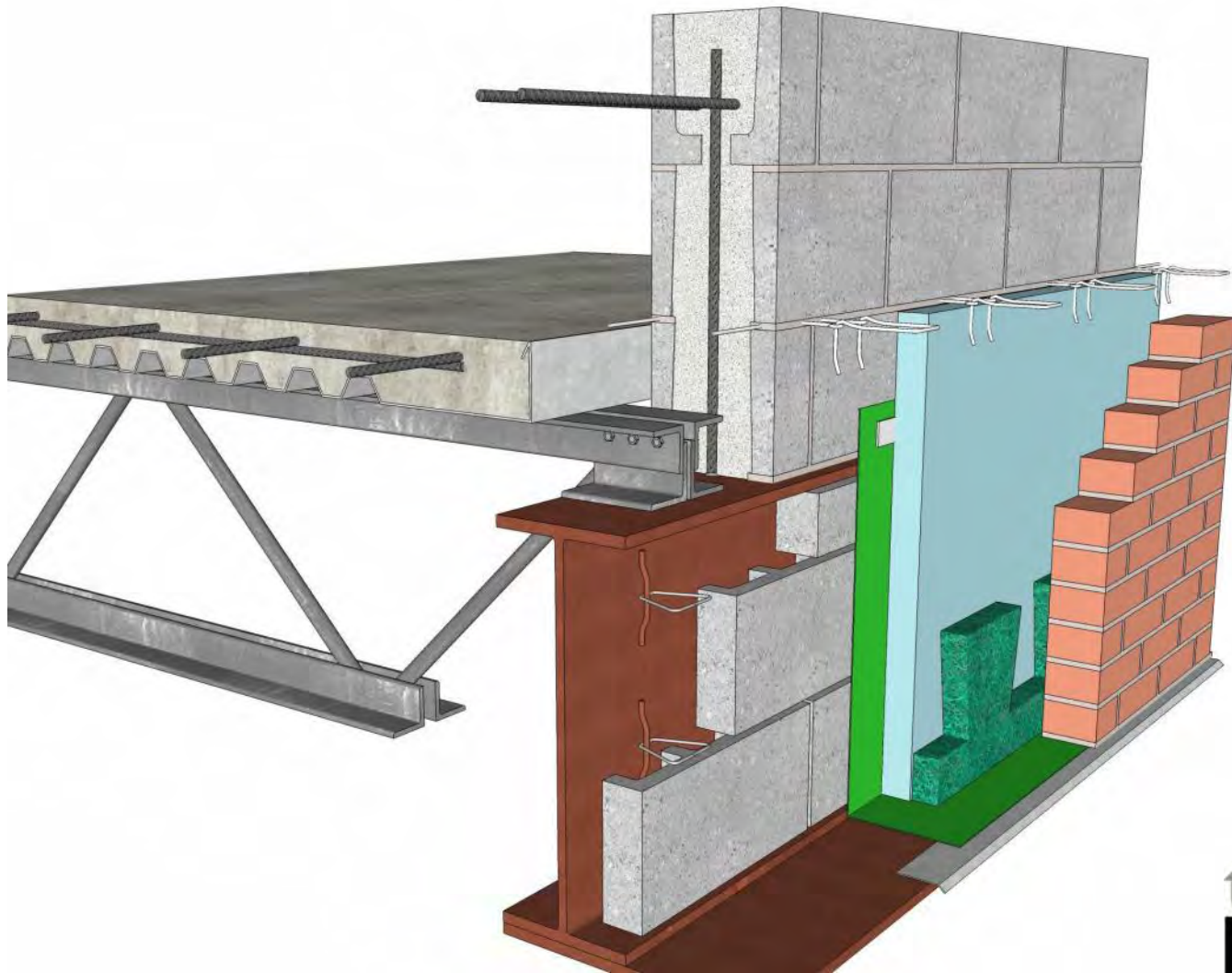


- 1 keep water out
- 2 drain water
- 3 break bond
- 4 prevent rising damp
- 5 protect structural steel

flashing protects structural steel



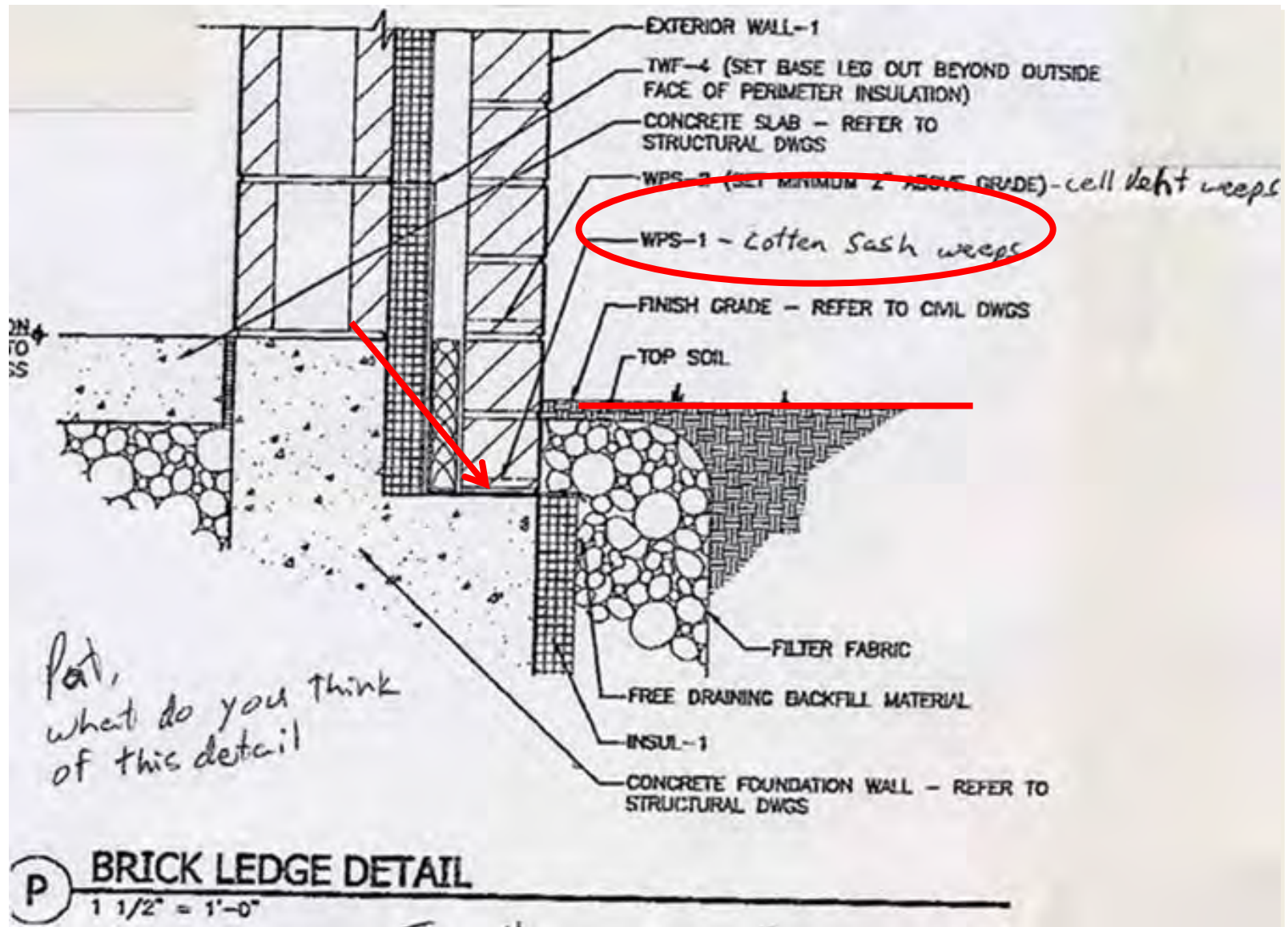
flashing at beam



protect the steel



What's wrong?

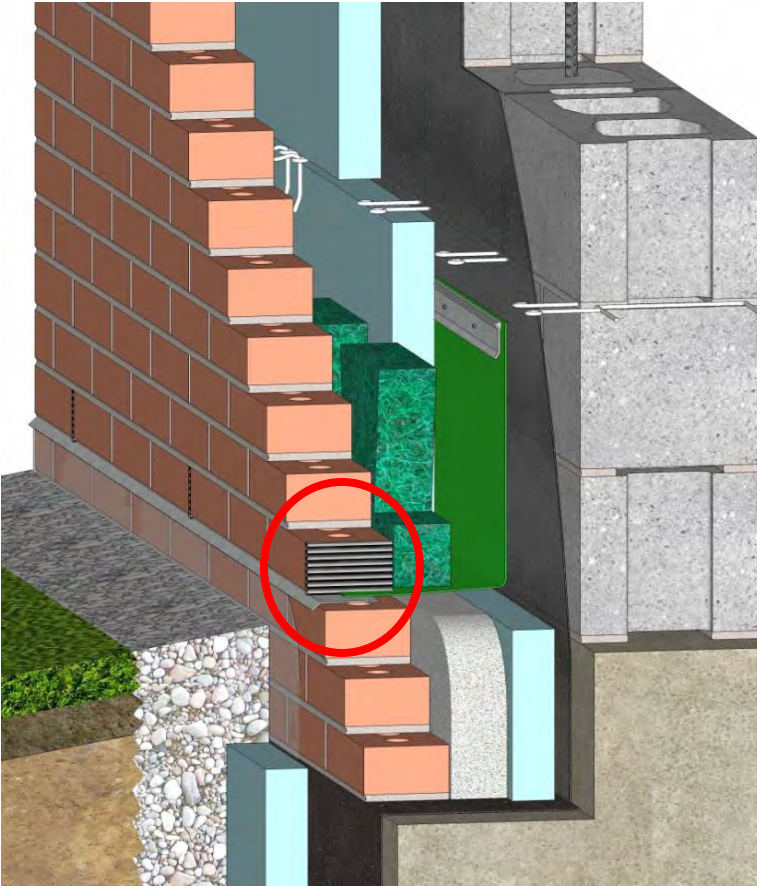


International Building Code (1)



- Section 1405.4.2
"Flashing and weepholes 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..."

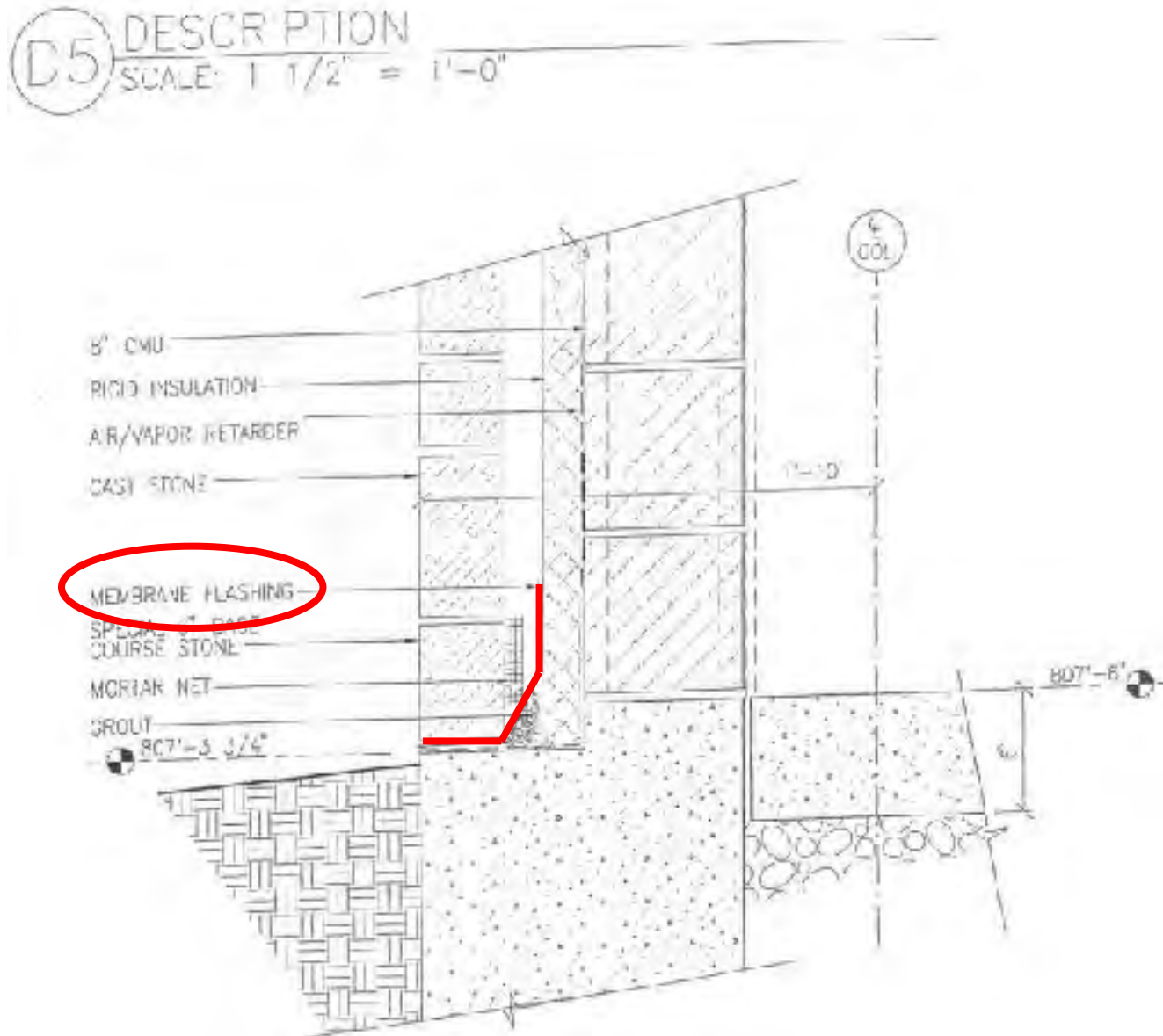
below grade masonry veneer (1)



- use durable veneer units
- install site drainage material adjacent to veneer
- grout solid behind below-grade veneer units
- insulation behind below-grade veneer units to break thermal bridge
- support flashing so it does not sag
- keep flashing & weep vents above grade

(1) best-practice: recommended to keep veneer completely above grade

what's wrong ?



what to do if the MDCD does not fit...



common flashing materials



self-adhering
membranes



copper



EPDM



copper or
stainless steel
composite

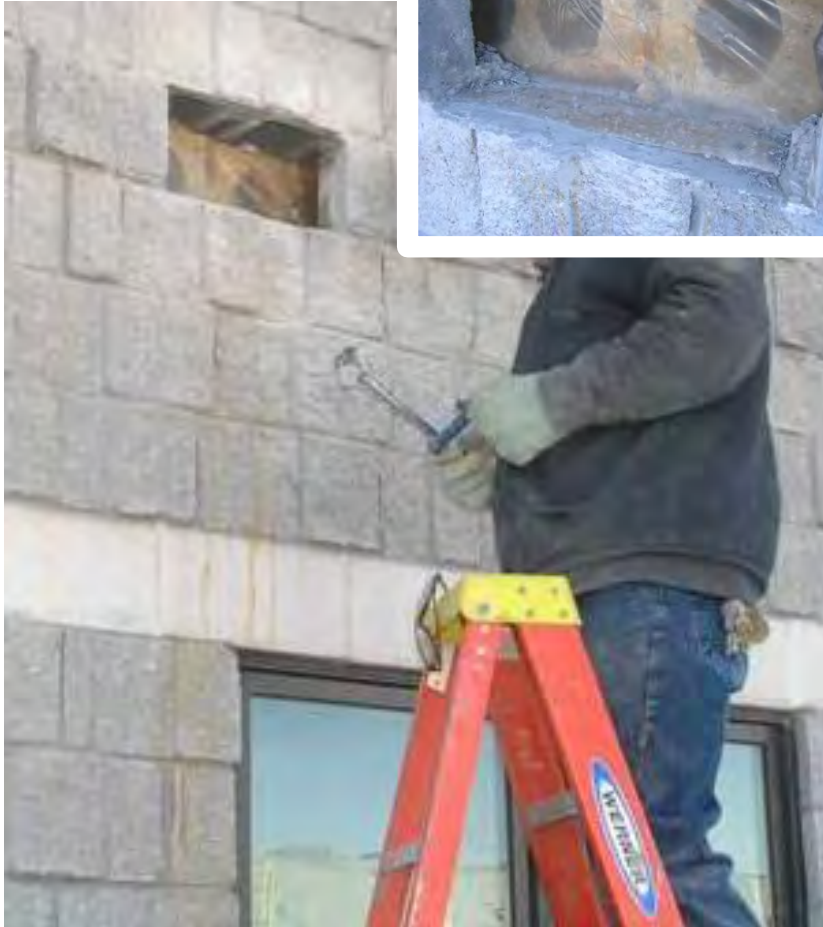


stainless steel

PVC

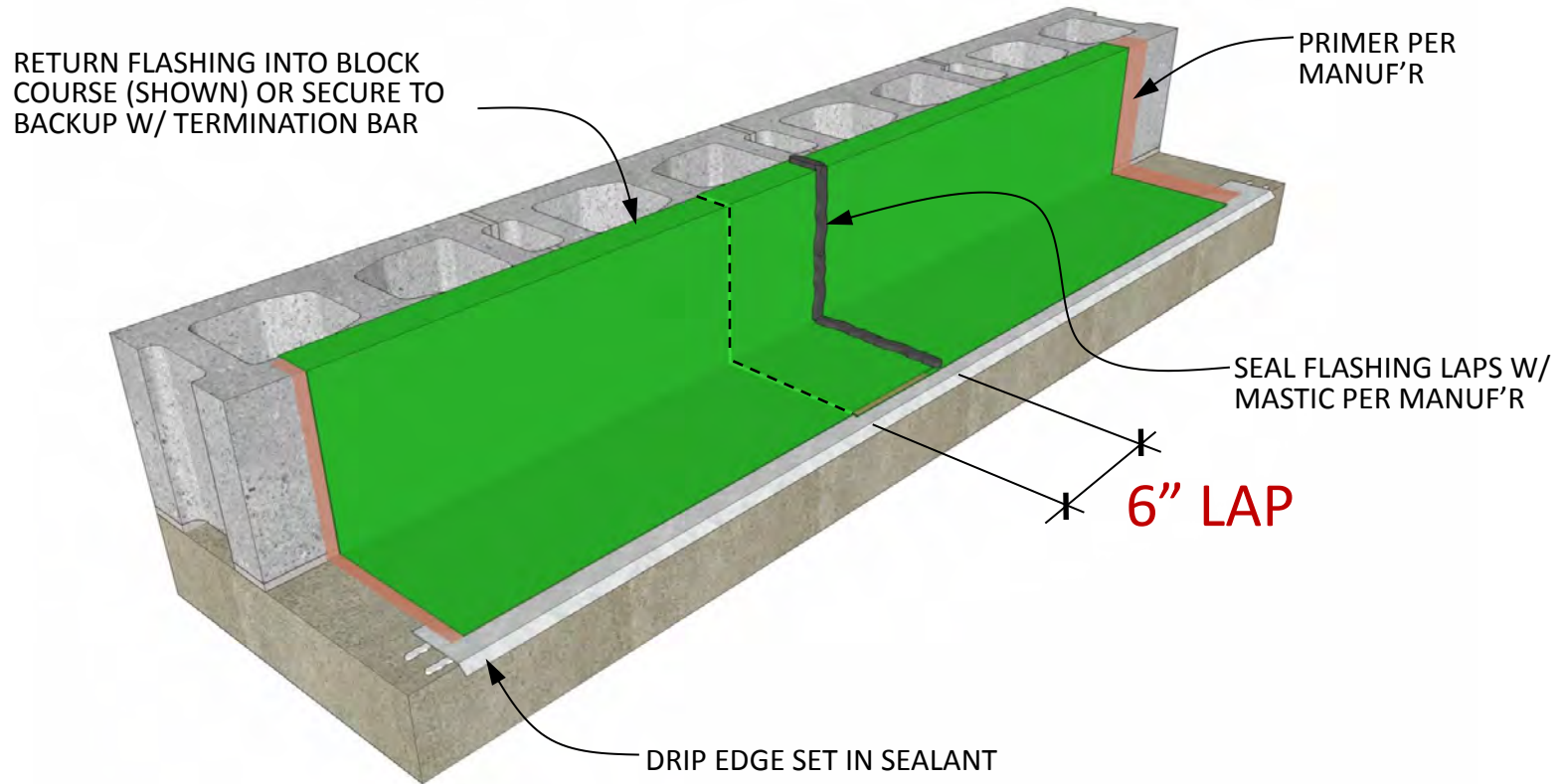


materials that are NOT flashing



- light-gauge PVC
 - "Nervastral"
- aluminum
- polyethylene sheeting
- asphalt-saturated felt
- building paper
- building wrap
- Hefty garbage bags

flashing lap detail



FLASHING LAP

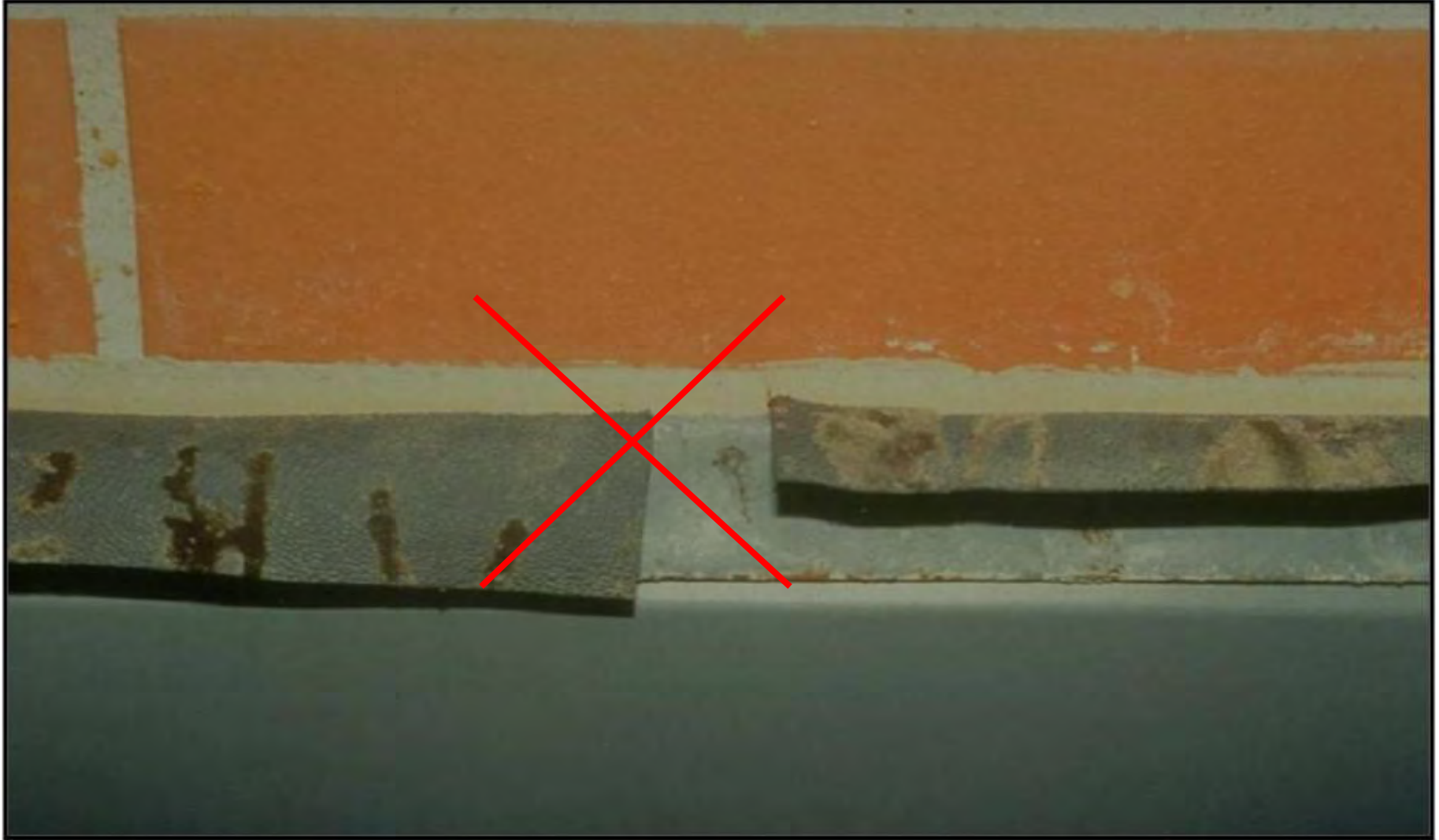
DIAGRAM 15.410.4101

REV. 02/10/11

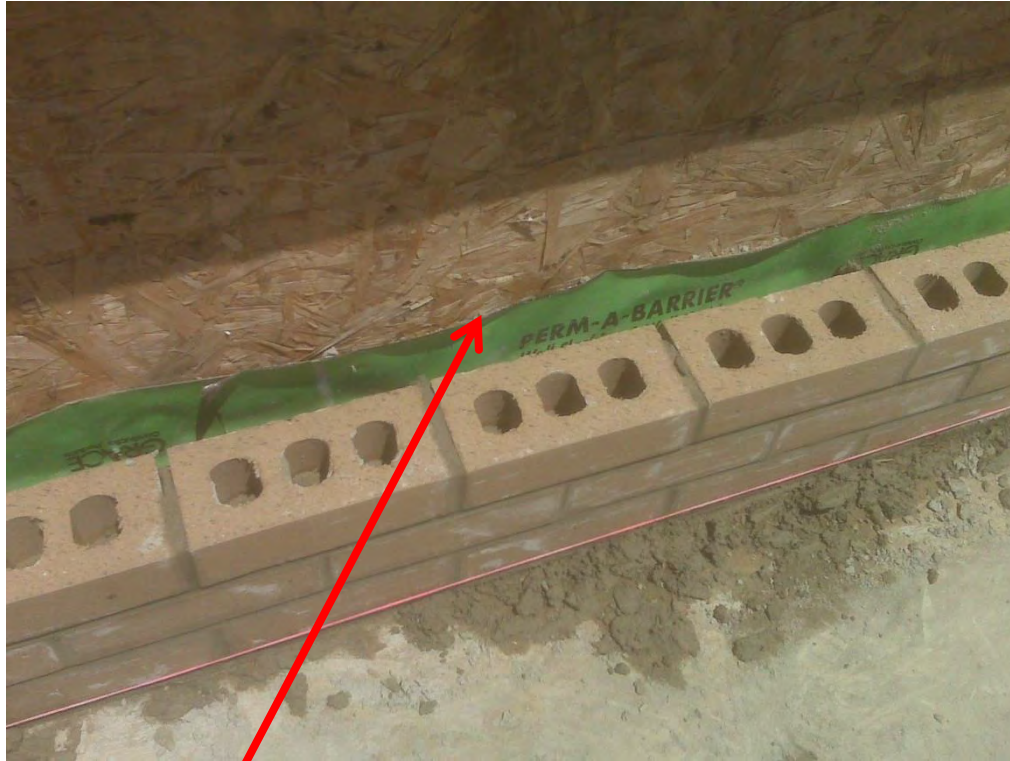
flashing laps



seal laps



secure top edge



BAD

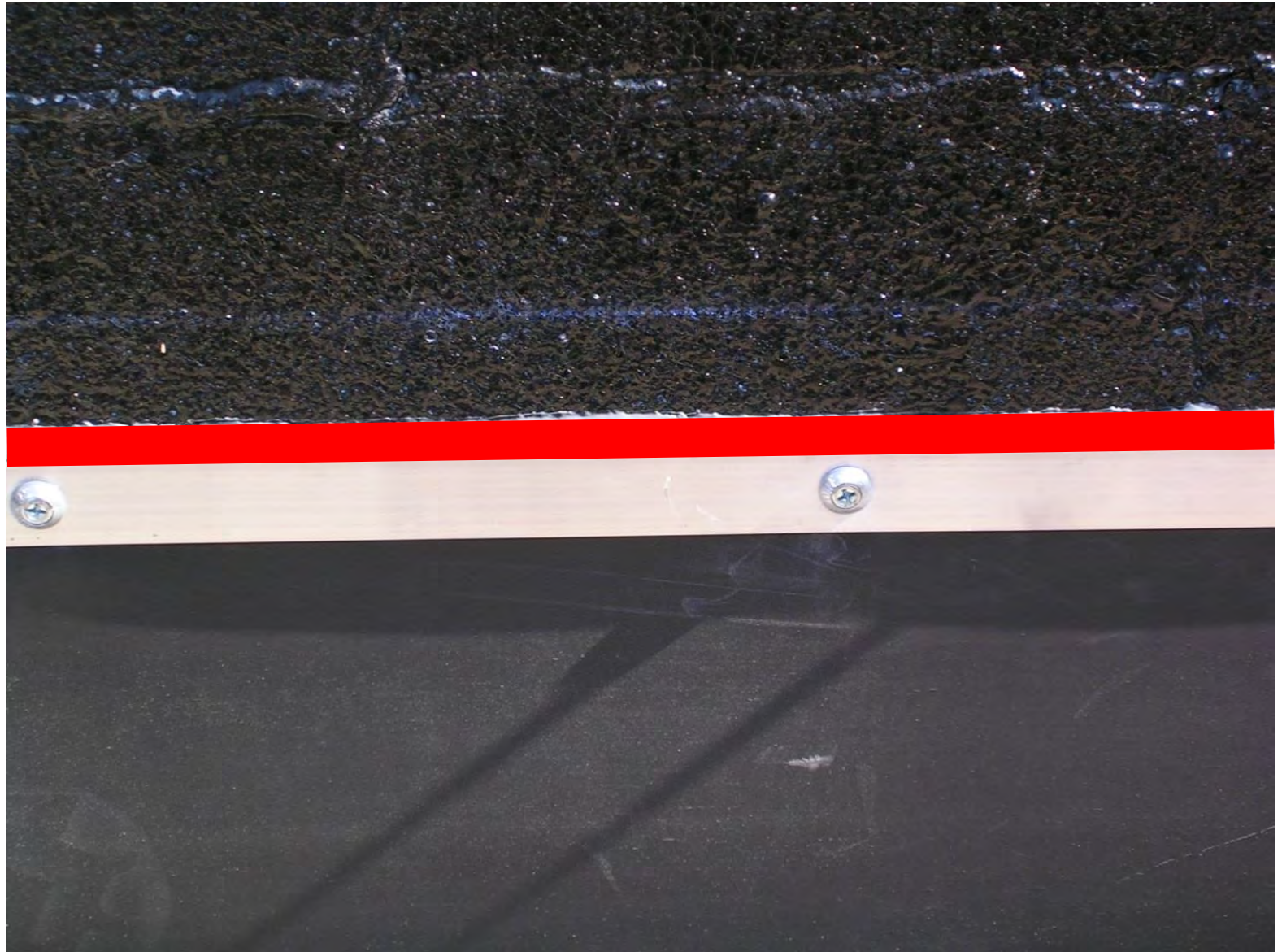


GOOD

secure top edge - termination bar



secure top edge - termination bar



secure top edge - embed



good ad for term bar!!



what's wrong?



what's wrong?



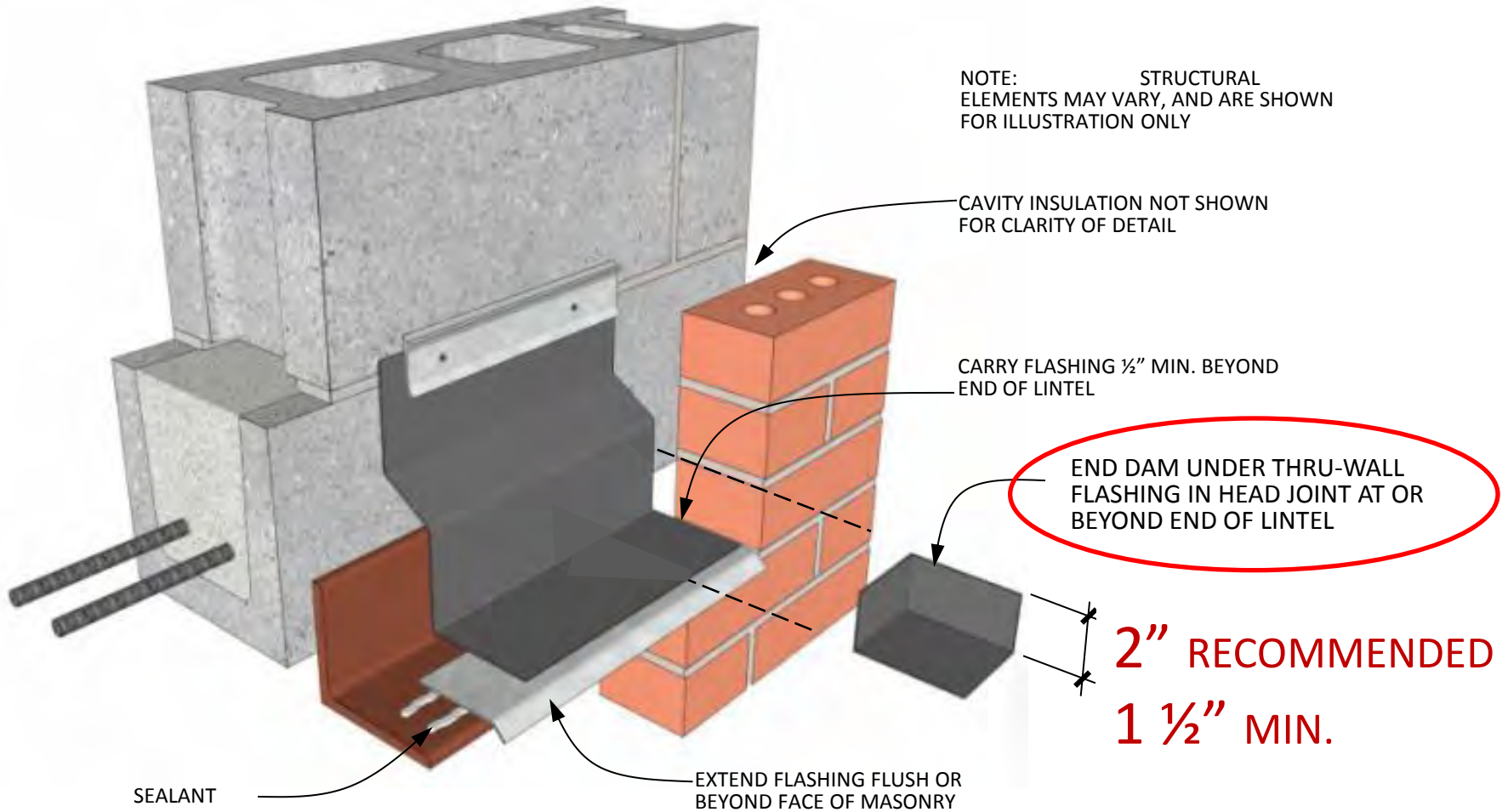
end dams



“Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect it to the exterior.” (1)

(1) International Building Code (IBC), Section 1405.4

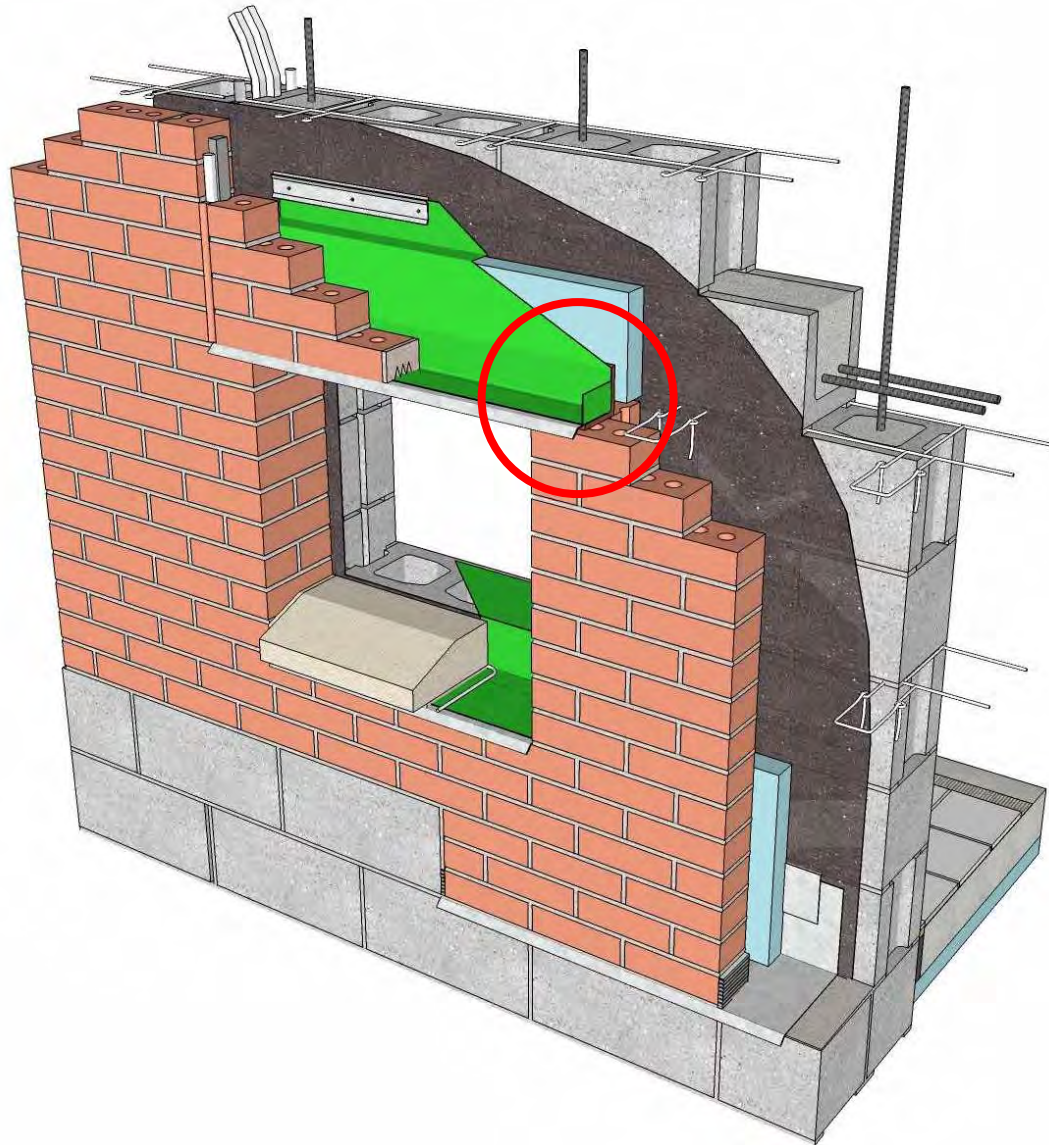
end dam



what's wrong?



end dam above opening



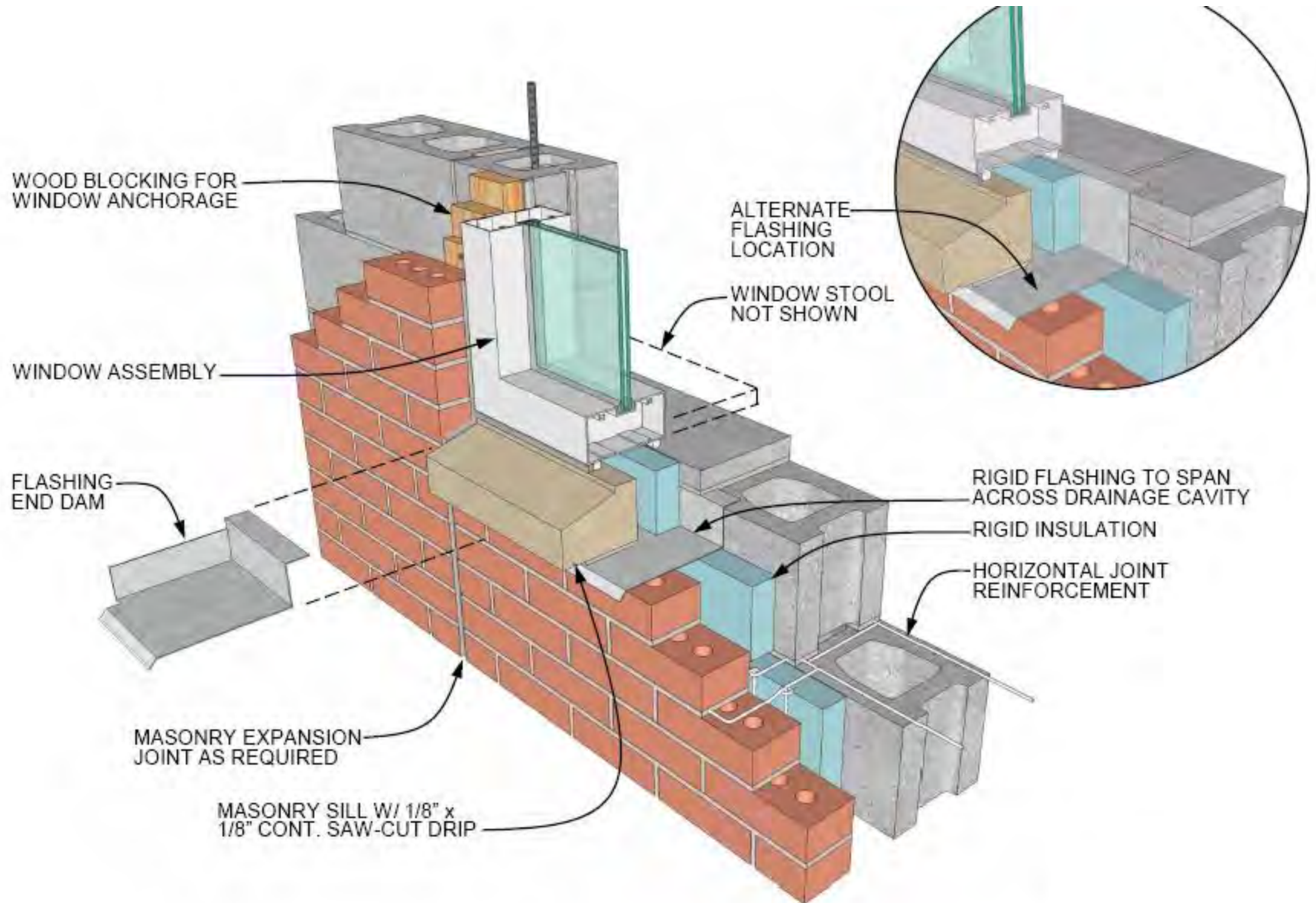
great drip edge/end dam detail



prefabricated end dam



sill flashing



sill flashing & end dam



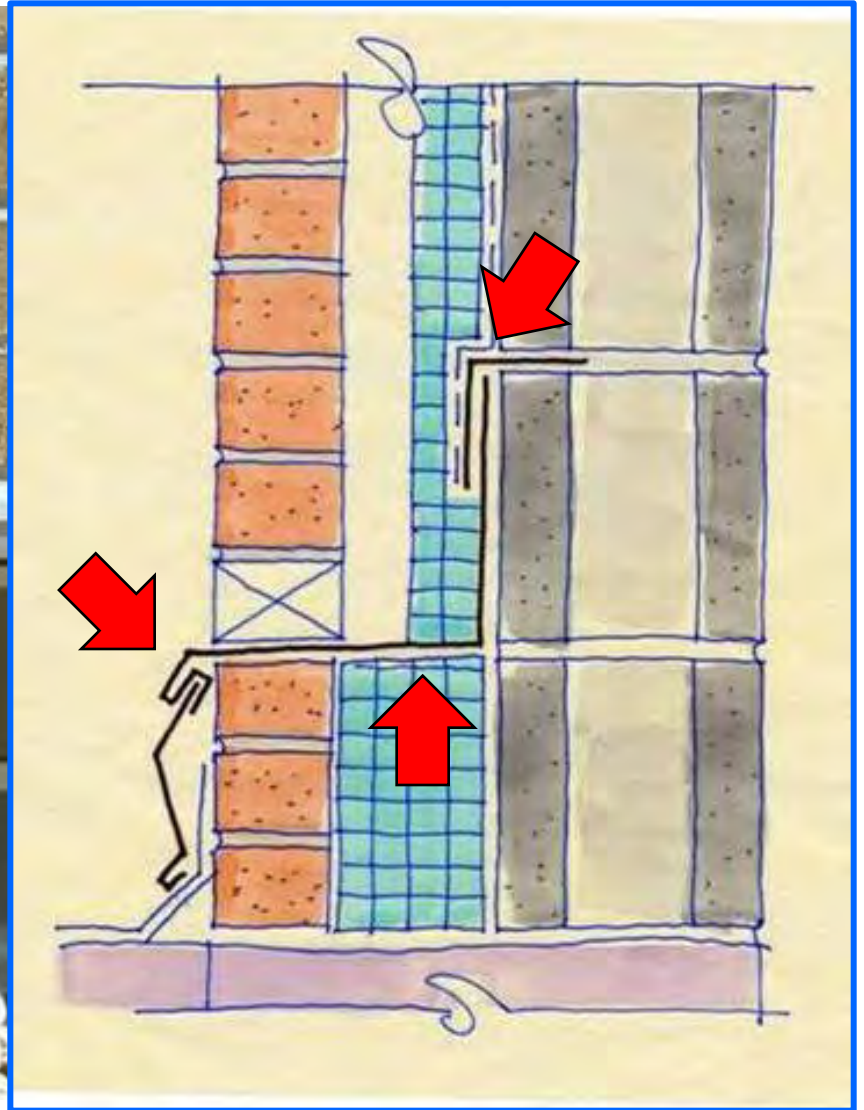
roof-to-wall interface



what's wrong??



roof-to-wall interface detail



good flashing to roof connection



low roof to tall wall interface

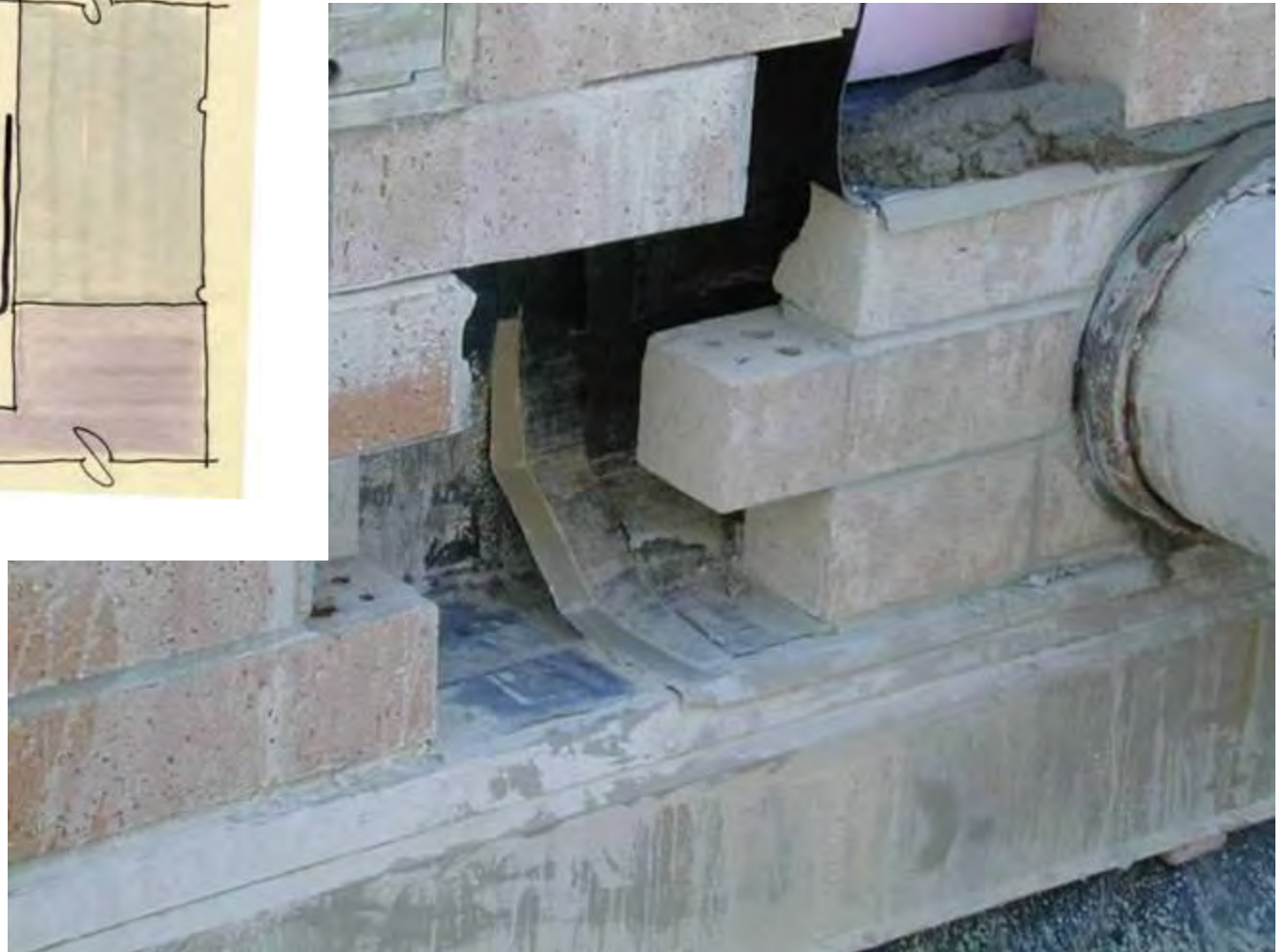


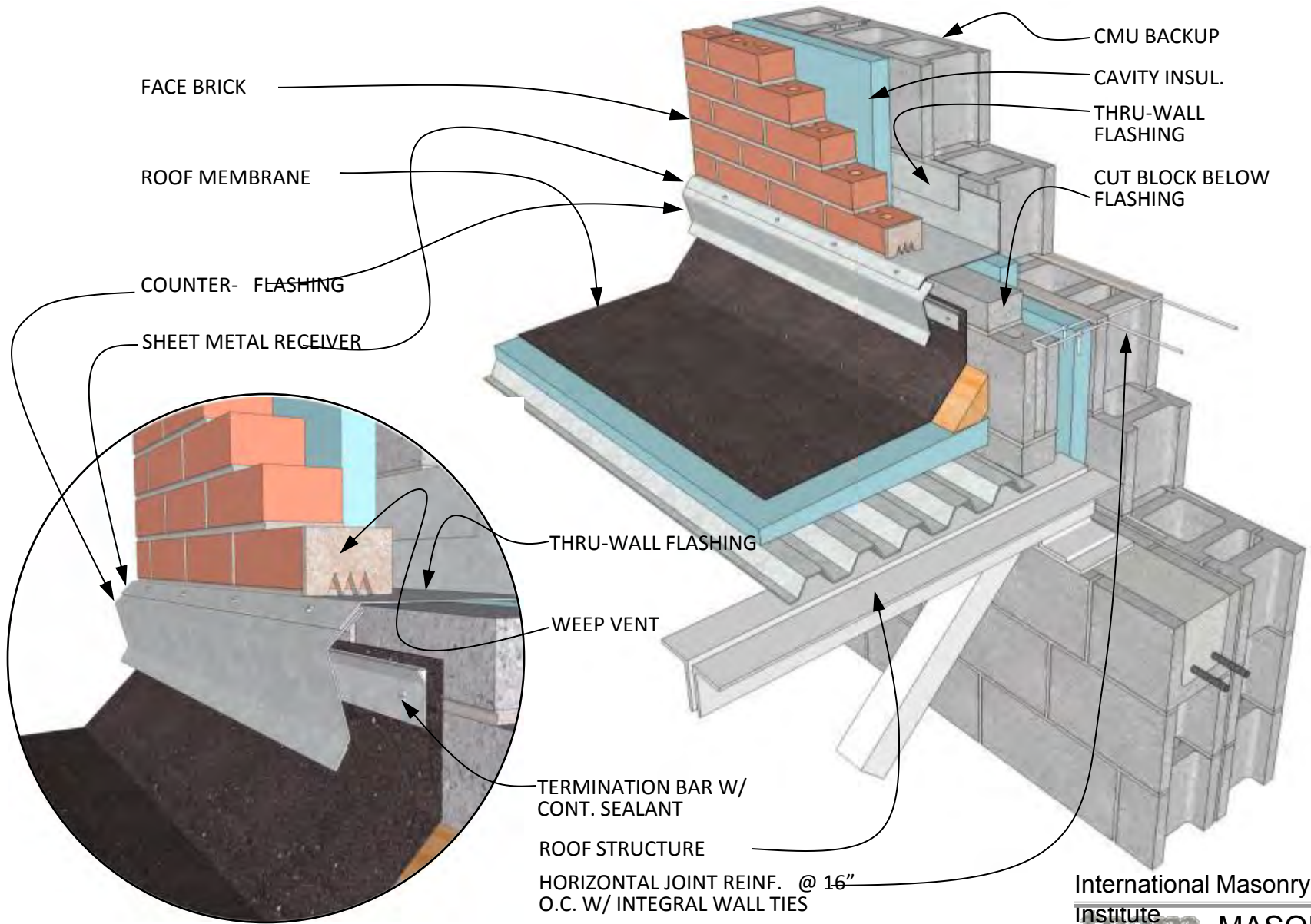
- First Brick Course unprotected
- “Low Roof to Vertical Wall Connection is What Lawsuits Are Made Of”

flashing repair



flashing repair



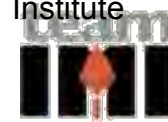


ROOF DETAIL HIGH WALL – LOW ROOF

DETAIL 01.704

REV. 11/6/07

International Masonry
Institute



MASONRY
DETAILING
SERIES

800-IMI-0988 www.imiweb.org

flashing sag



seal flashing penetration



MASONRY COPING: LIMESTONE, CAST STONE, CALCIUM SILICATE, OR PRECAST CONCRETE; OVERHANG MASONRY WALL 1½" MIN.; SLOPED TOP

1/8" SAW-CUT DRIP, BOTH SIDES OF WALL CAP

SEALANT & BACKER ROD, BOTH SIDES OF WALL CAP

FACE BRICK

SLOPED MORTAR BED TO SUPPORT CANTED FLASHING, OPT.

RIGID INSULATION

OPEN DRAINAGE CAVITY, OPTIONAL ABOVE ROOF LINE; ALSO SEE DETAIL 01.752

S.S. DOWEL W/ SEALANT AROUND PENETRATIONS THROUGH FLASHING

SEE DETAIL 01.759 FOR WALL CAP JOINT OPTIONS

CANTED S.S. THRU-WALL FLASHING W/ 1/2" EXPOSED DRIP EDGE

SEALANT BELOW DRIP, OPT. (NOT SHOWN)

GROUT & REINFORCING AS REQ'D.

HORIZONTAL JOINT REINFORCEMENT W/ WALL TIES

MASONRY WALL CAP

DETAIL 01.751

OPEN CAVITY

REV. 11/04/08

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DETAILING
SERIES

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flashing recommended under stone copings



proper top-of-wall flashing



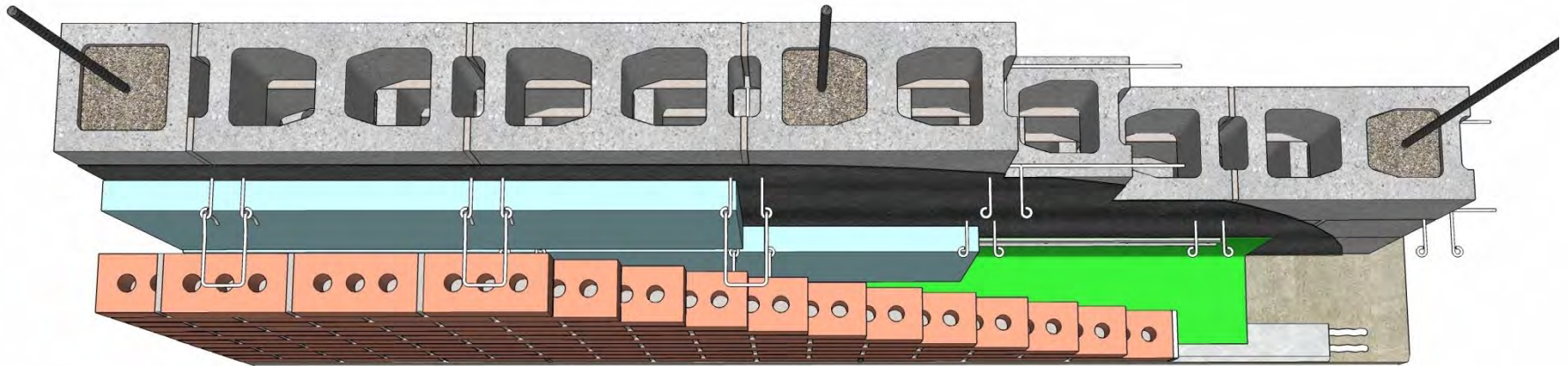
parapet detail



top-of-wall



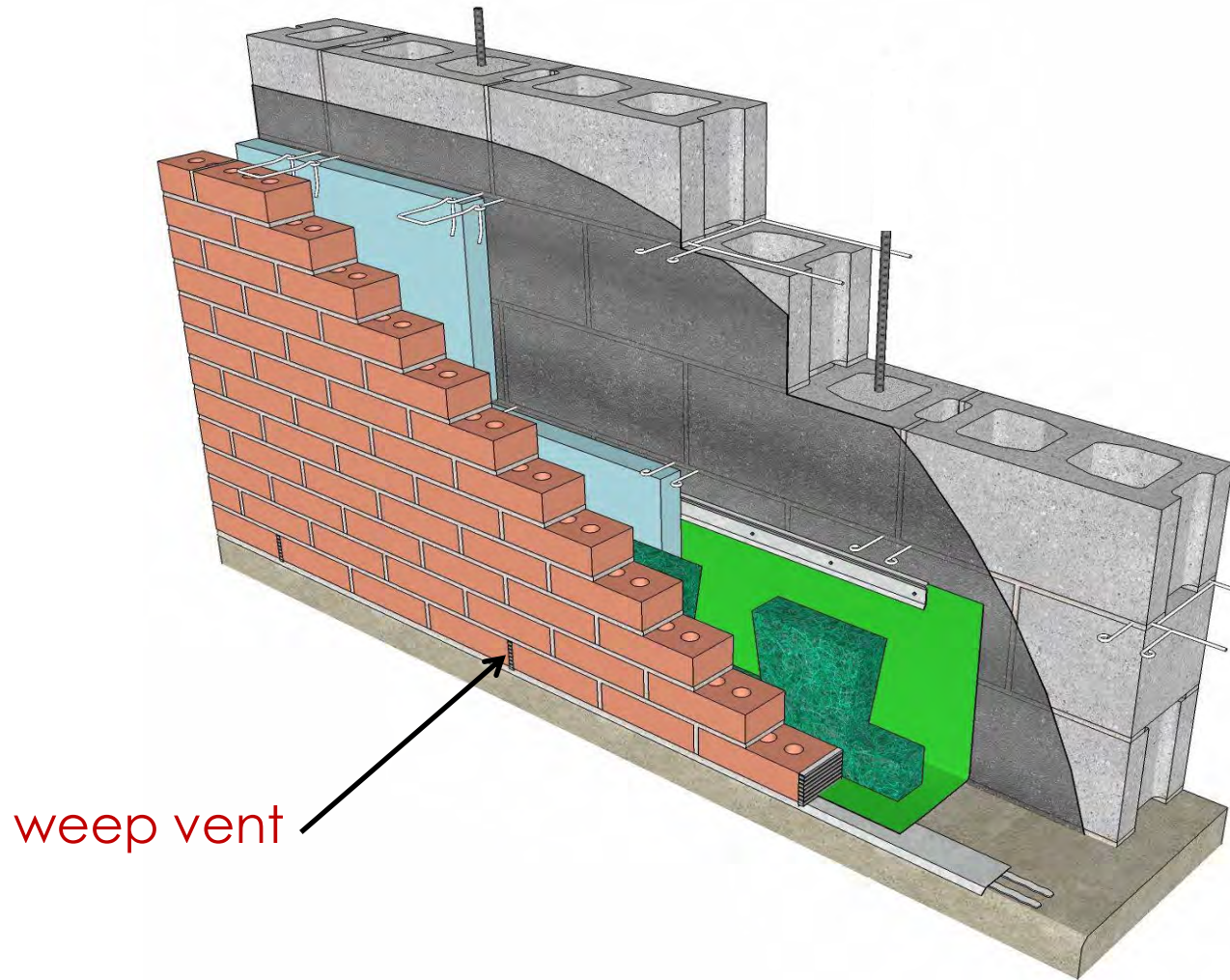
weep vents



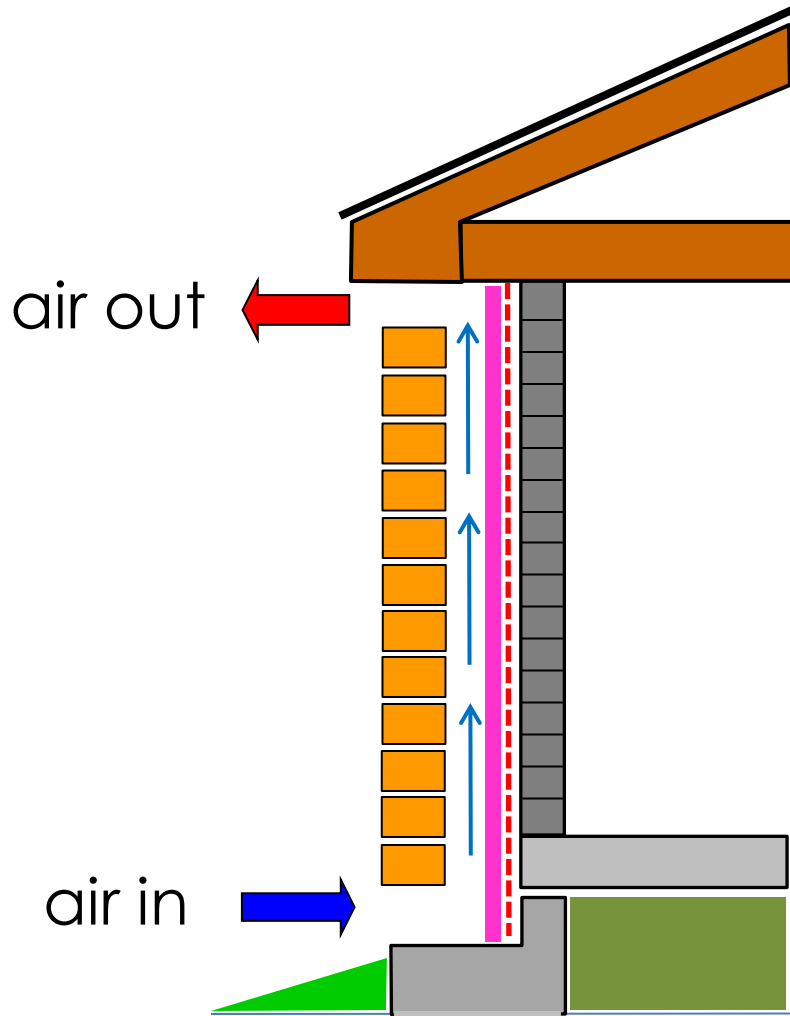
weep vent options



masonry cavity wall



2 function of weep vents



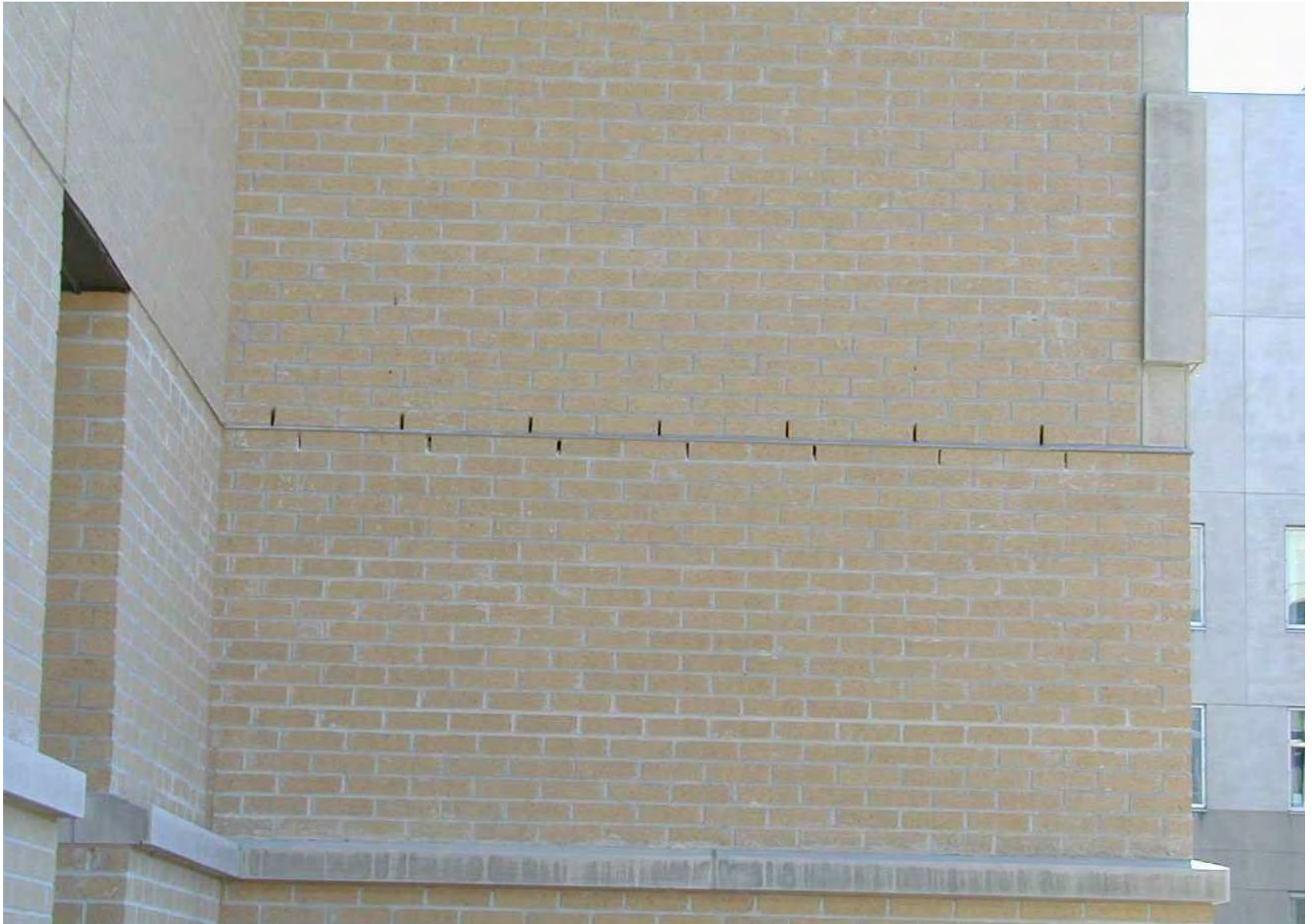
1) drainage

2) drying



air control recommended on support wall when ventilating wall cavity,

open head joints



ventilated cavity wall



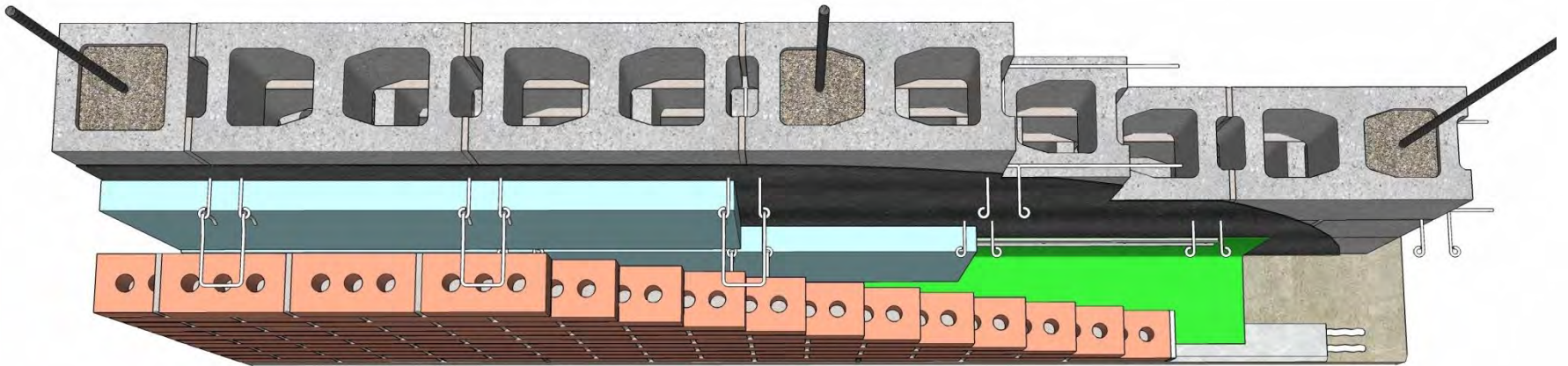
what's wrong?



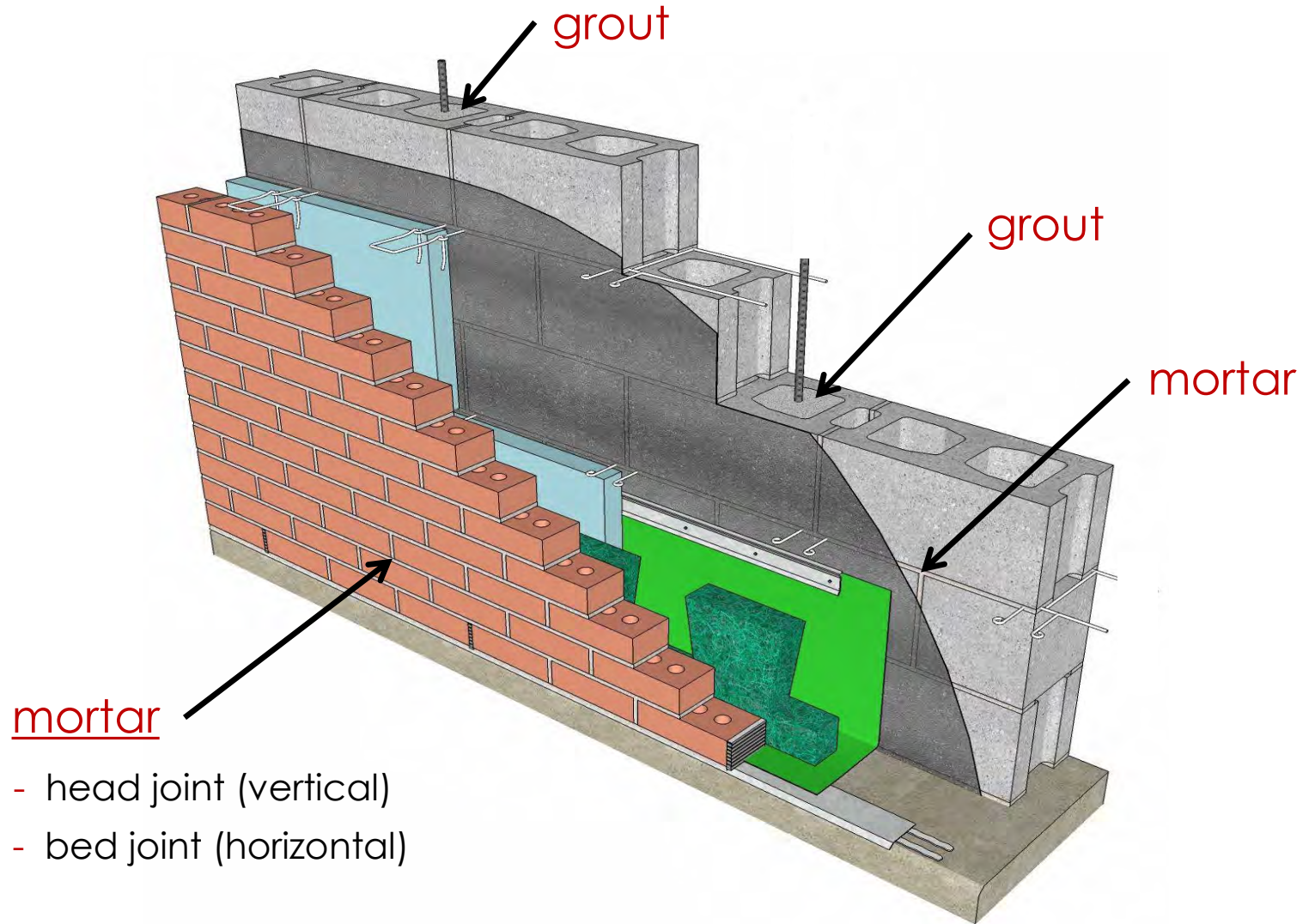
what's wrong?



mortar joints



masonry cavity wall



mortar types in ASTM C270

CMU structural wall ⁽¹⁾

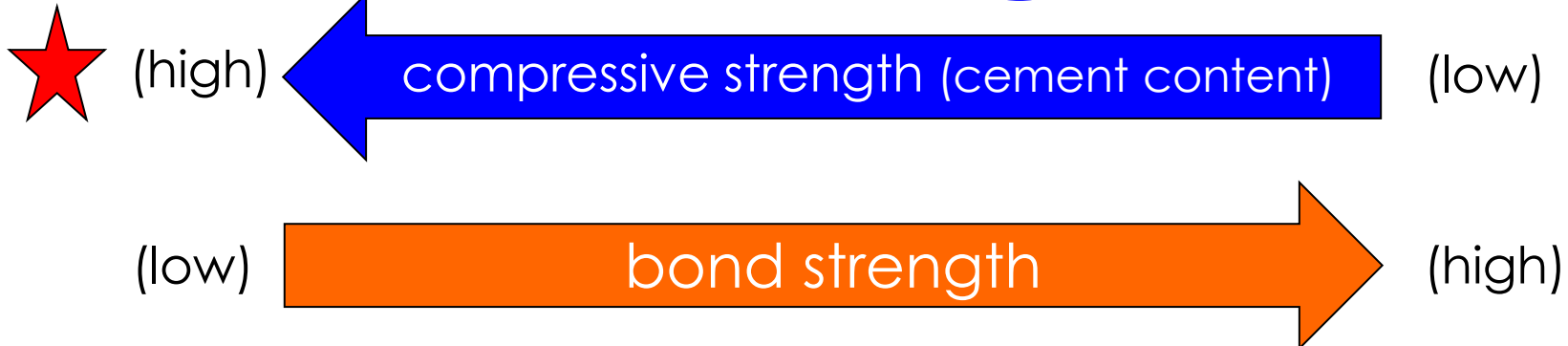
non-structural walls (veneers) ⁽¹⁾

M

S

N

O



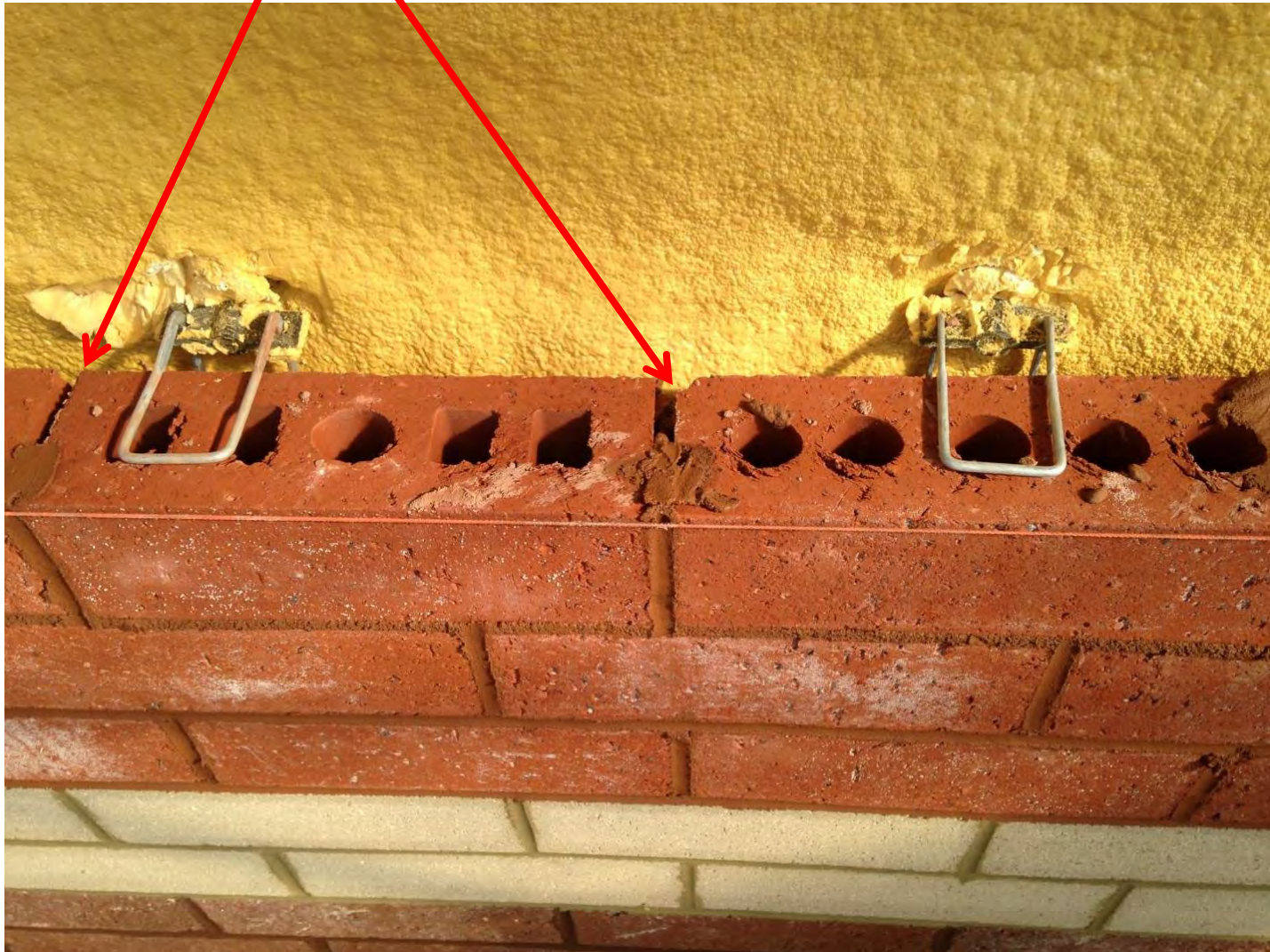
(1) typical applications

★ more important for structural masonry design

head joints not full



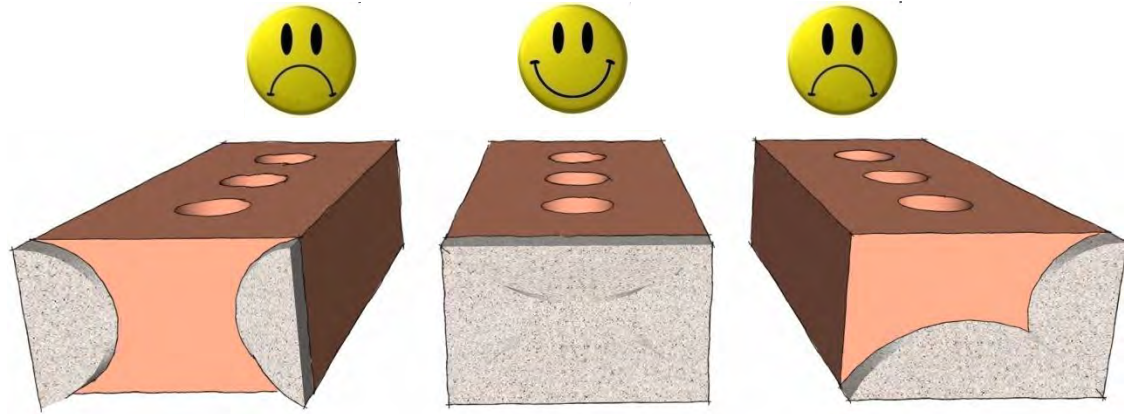
head joints not full



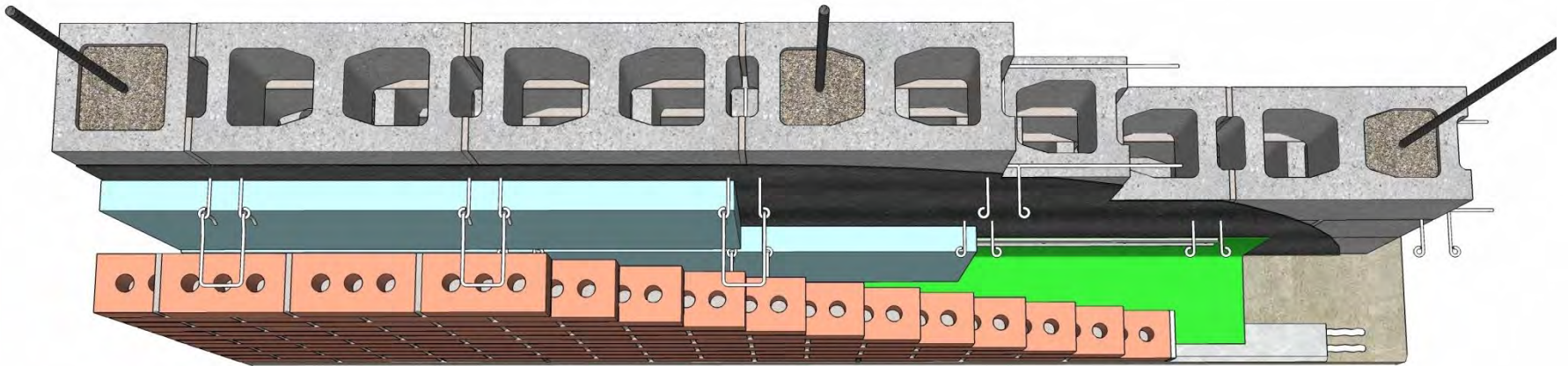
head joints not full



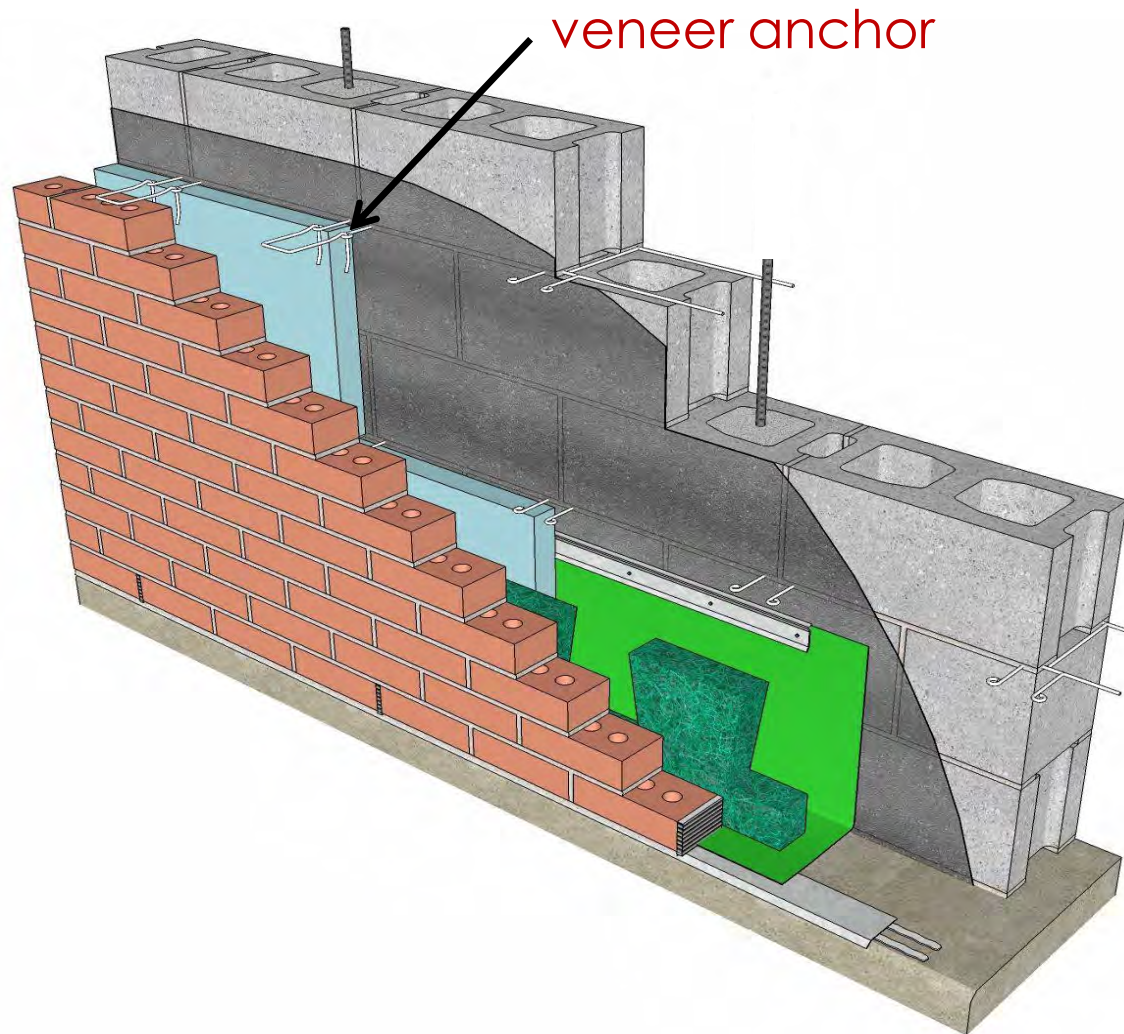
full head joint



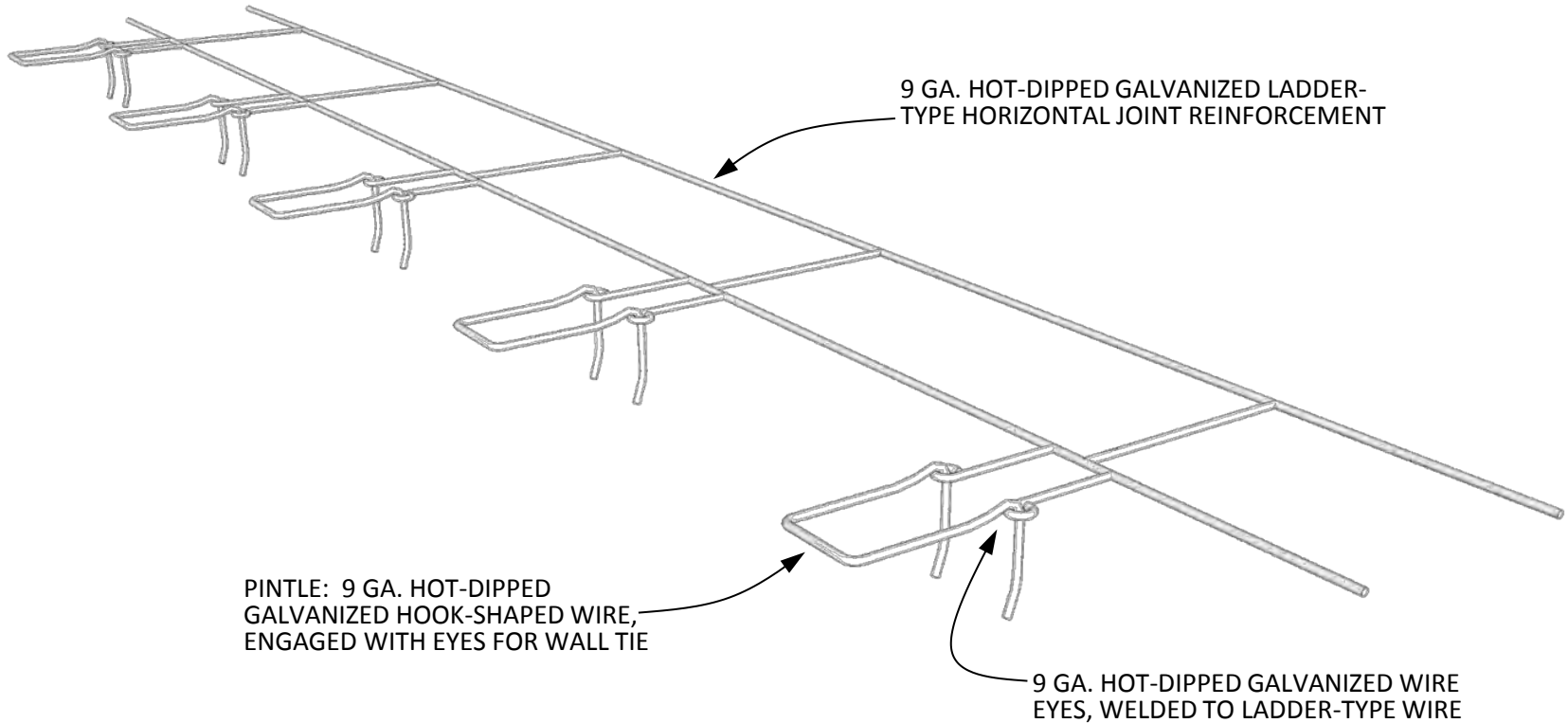
anchors & wall ties



masonry cavity wall



common horizontal joint reinforcement



HORIZONTAL JOINT REINFORCEMENT W/ INTEGRAL WALL TIES

DETAIL 14.102

REV. 07/08/08

International Masonry

Institute



MASONRY
DETAILING
SERIES

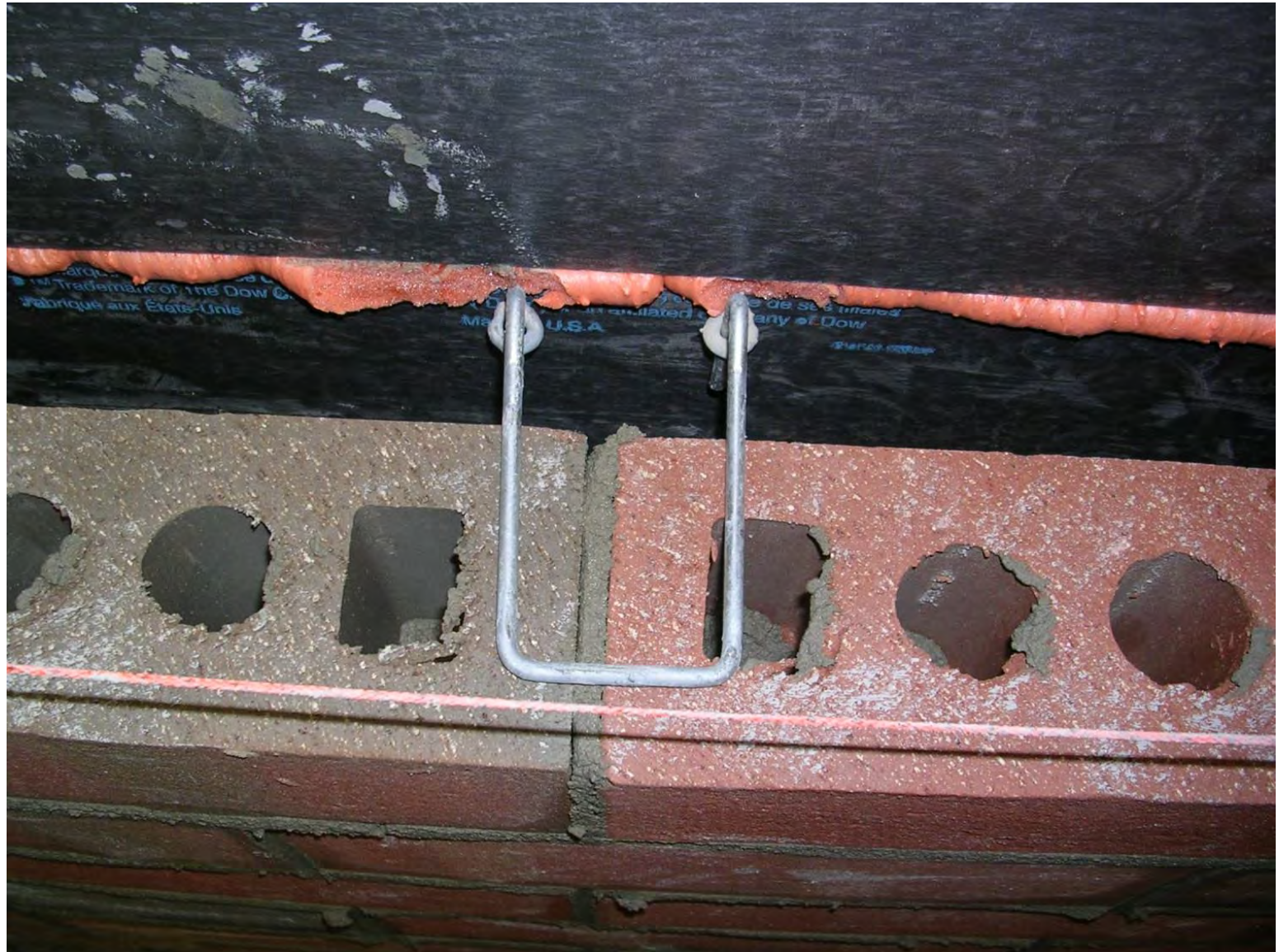
800-IMI-0988 www.imiweb.org

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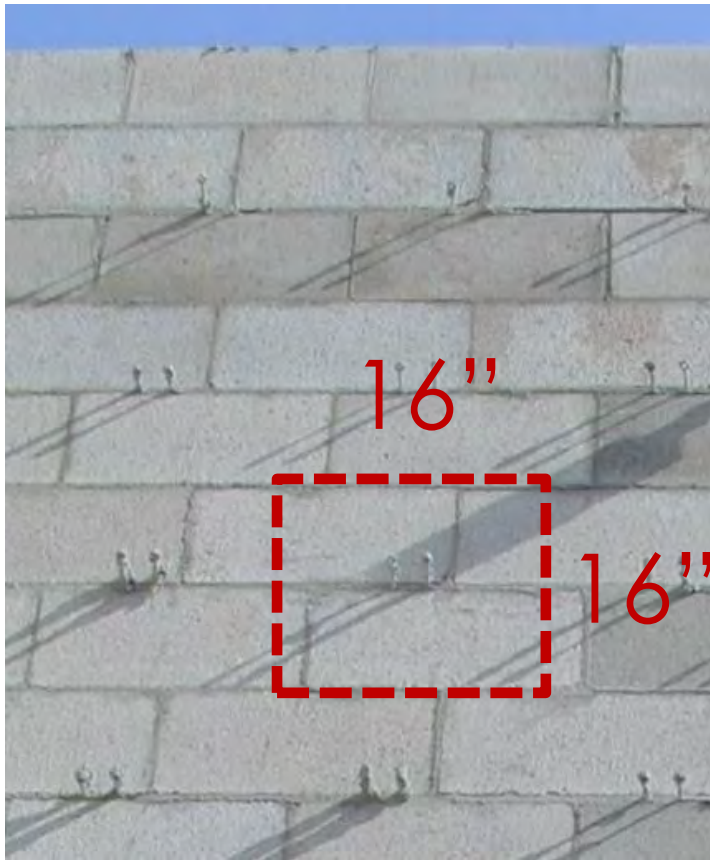
typical masonry cavity wall veneer ties



typical masonry cavity wall veneer ties



eye & pintle veneer ties



*For adjustable two-piece anchors, wire anchors of wire size W1.7, and 22 gage corrugated sheet-metal anchors, provide at least one anchor for each **2.67 SF** of wall area. ⁽¹⁾*

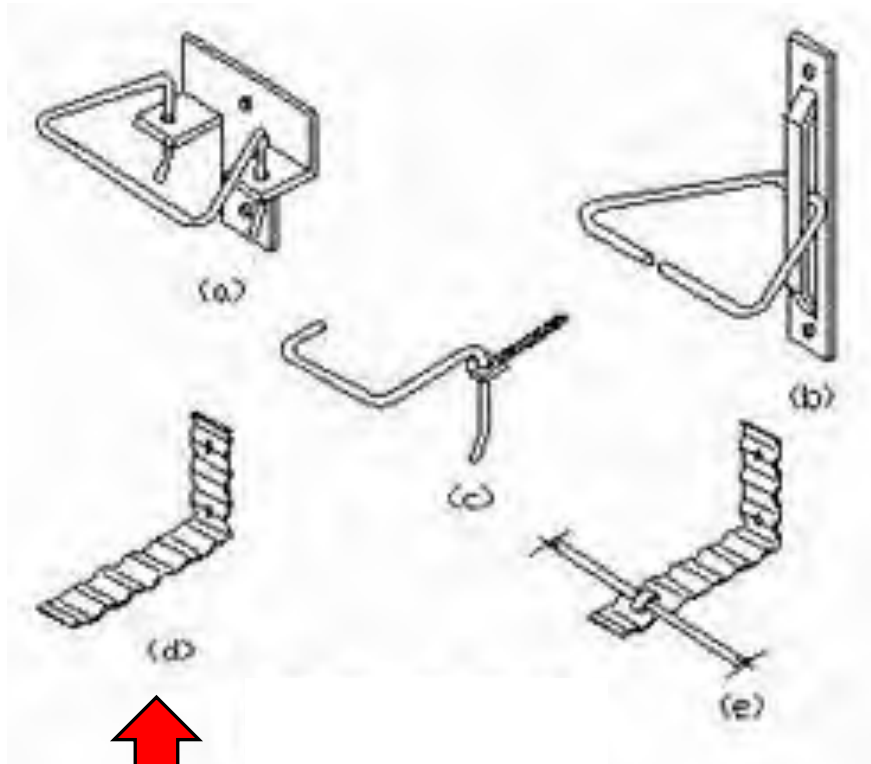
veneer tie tributary area

$$16'' (1.33) \times 16'' (1.33) = 1.77 \text{ SF}$$

(1) Masonry Standards Joint Committee code, Section 6.2.2.5.6.1

veneer ties

masonry veneer shall be anchored to the supporting wall with corrosion-resistant metal ties. (1)



can only be used with wood stud support wall^(1, 2)

(1) Masonry Standards Joint Committee code

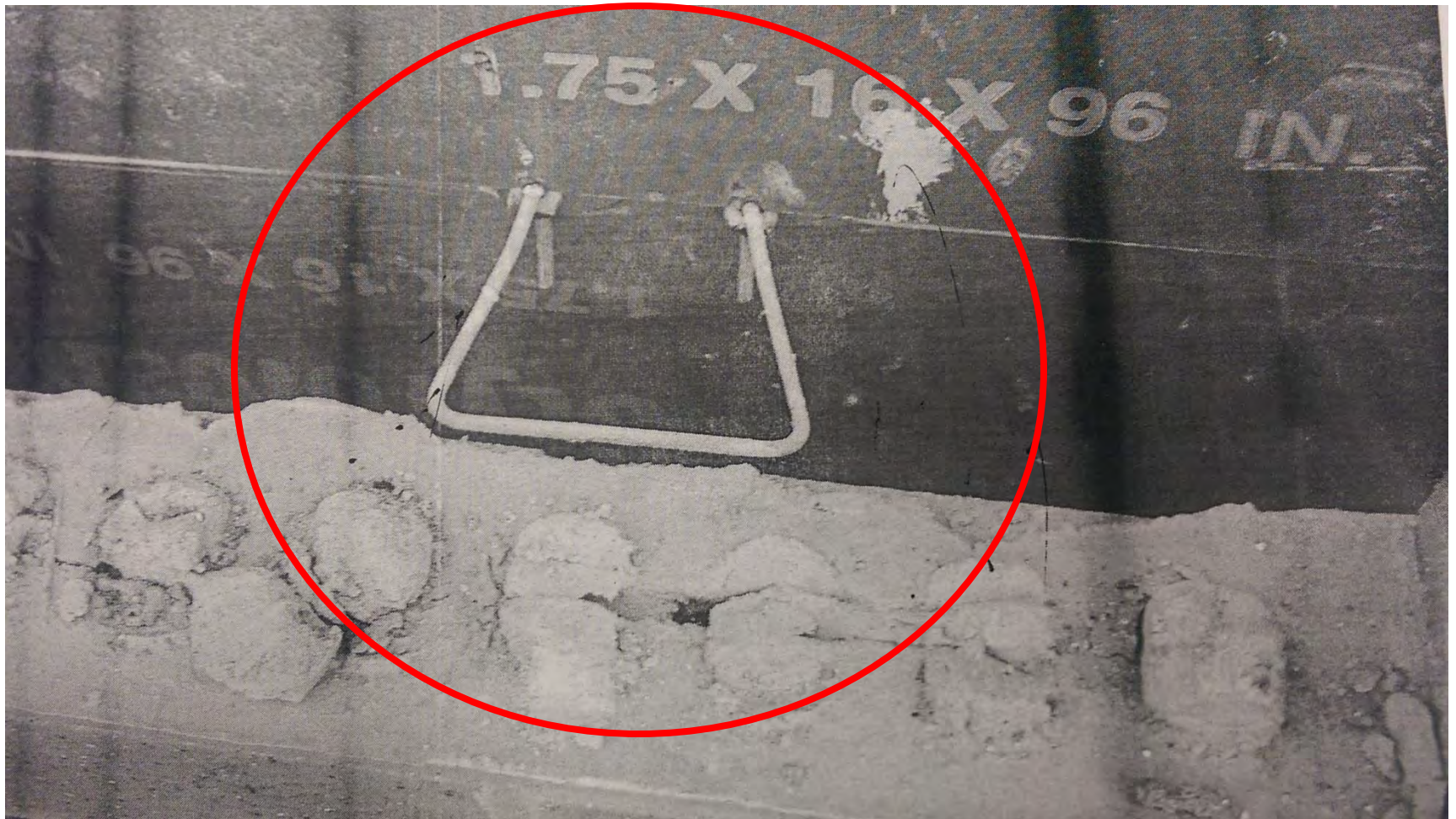
(2) BIA recommends 20 ga., code 22 ga. Min., 28 ga. not permitted

electro-galvanized corrugated wall tie

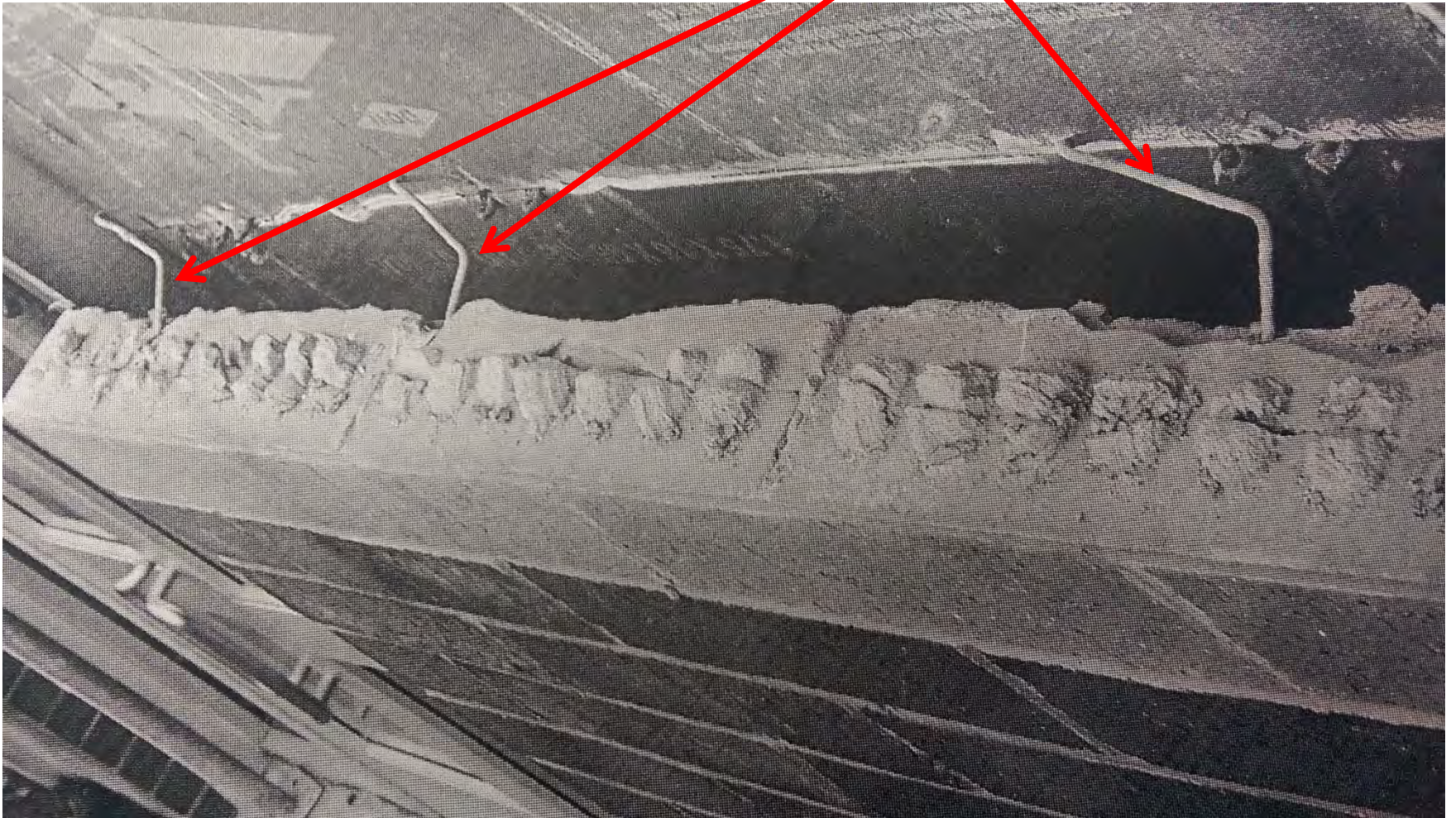




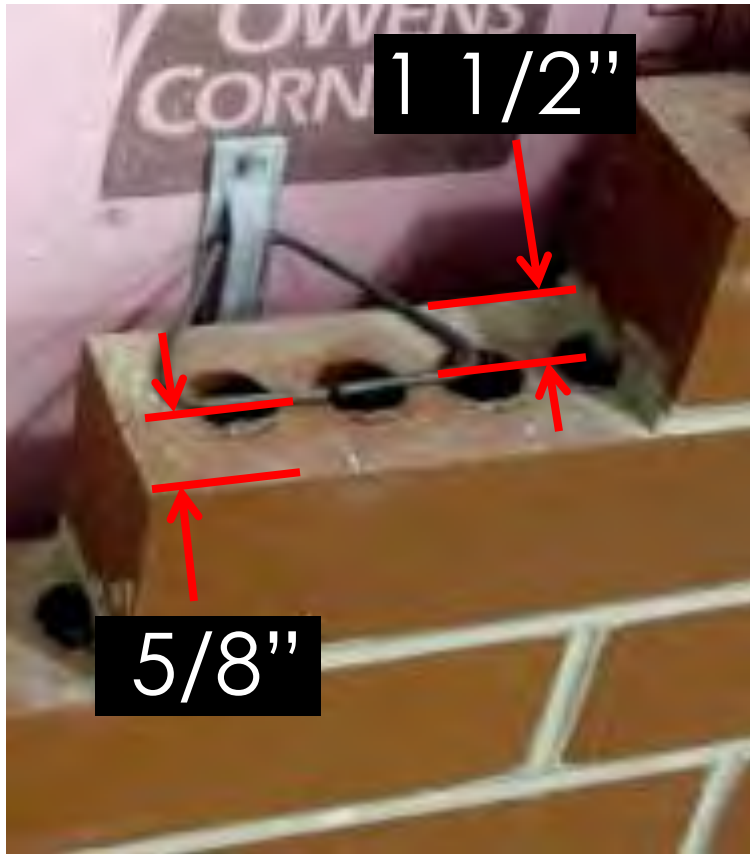
do we even have to ask?



do we even have to ask?



tie embedment/cover

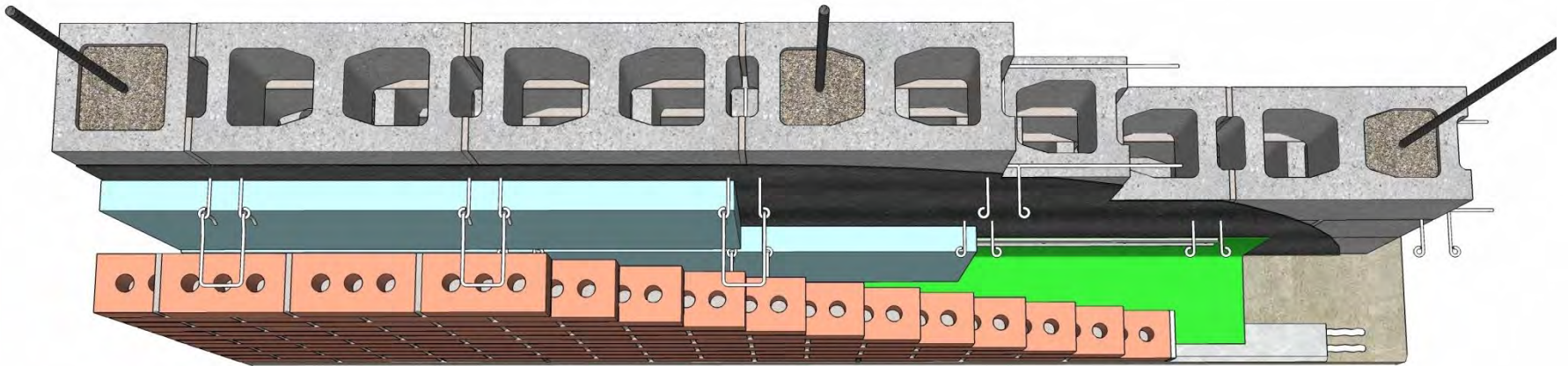


embed anchors
in the mortar
joint and extend
into the veneer a
minimum of **$1\frac{1}{2}$ "**

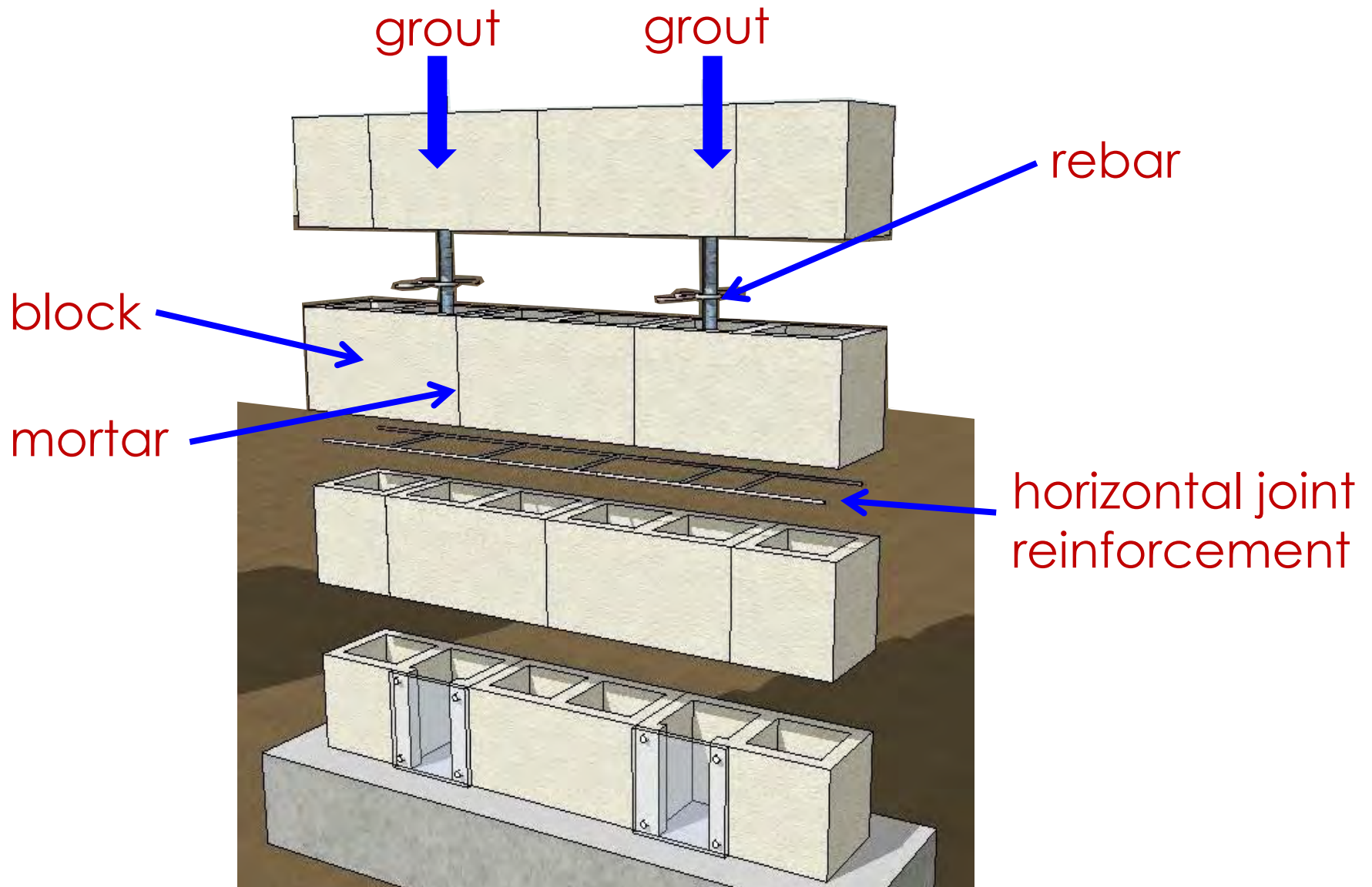
with at least **$\frac{5}{8}$ "**
mortar cover to the
outside face ⁽¹⁾

(1) Masonry Standards Joint Committee code

joint reinforcement



the structural CMU system



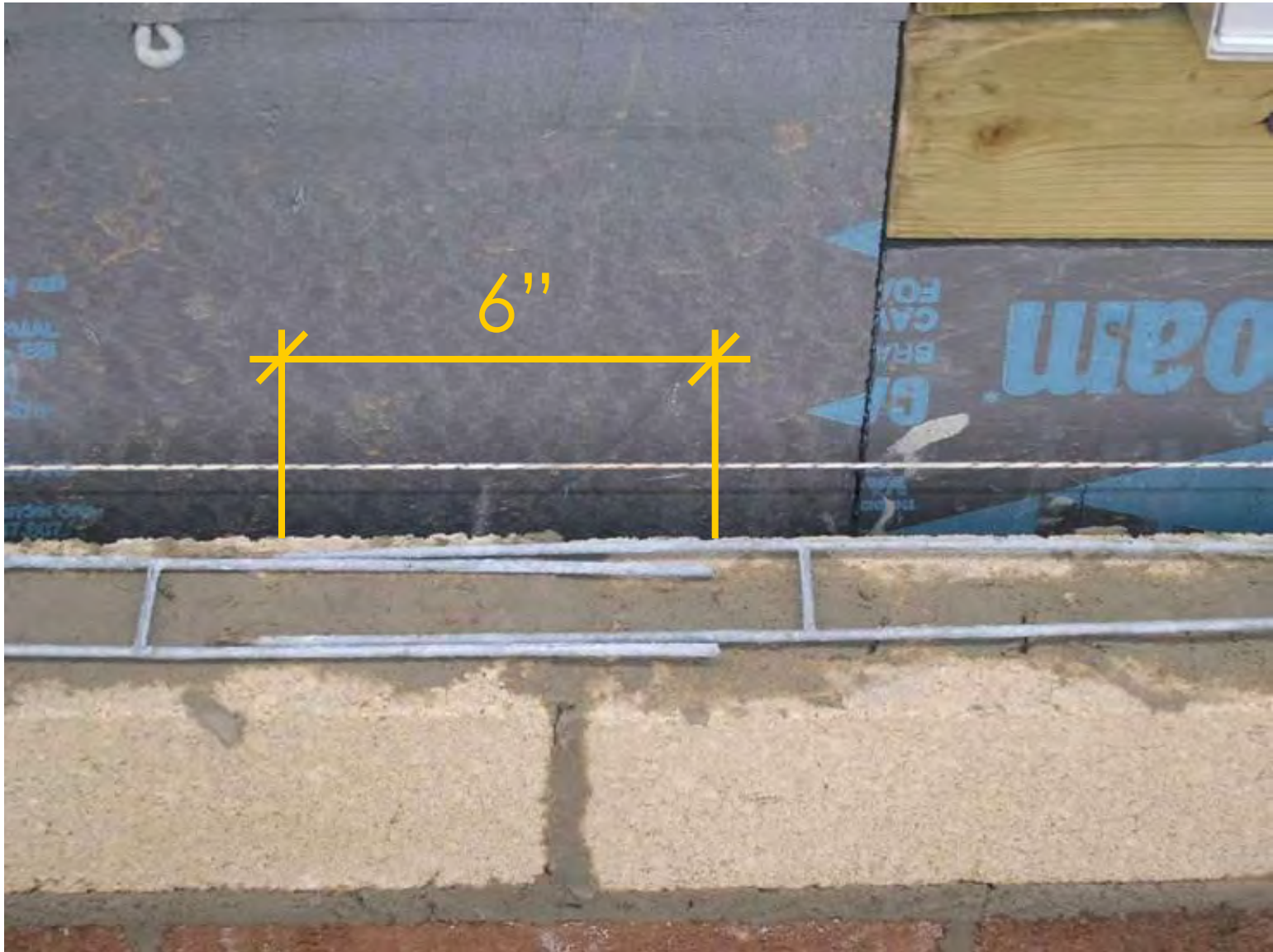
horizontal joint reinforcement

restrain with
joint
reinforcement

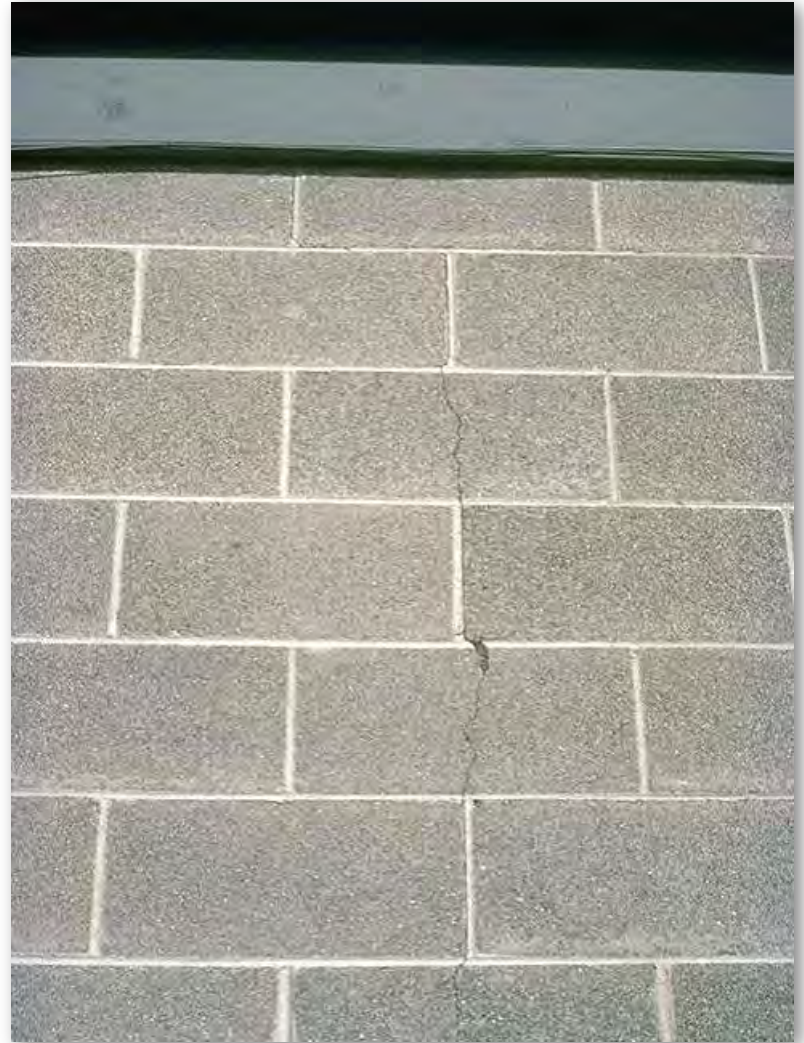
minimum lap
6"



veneer reinforcement



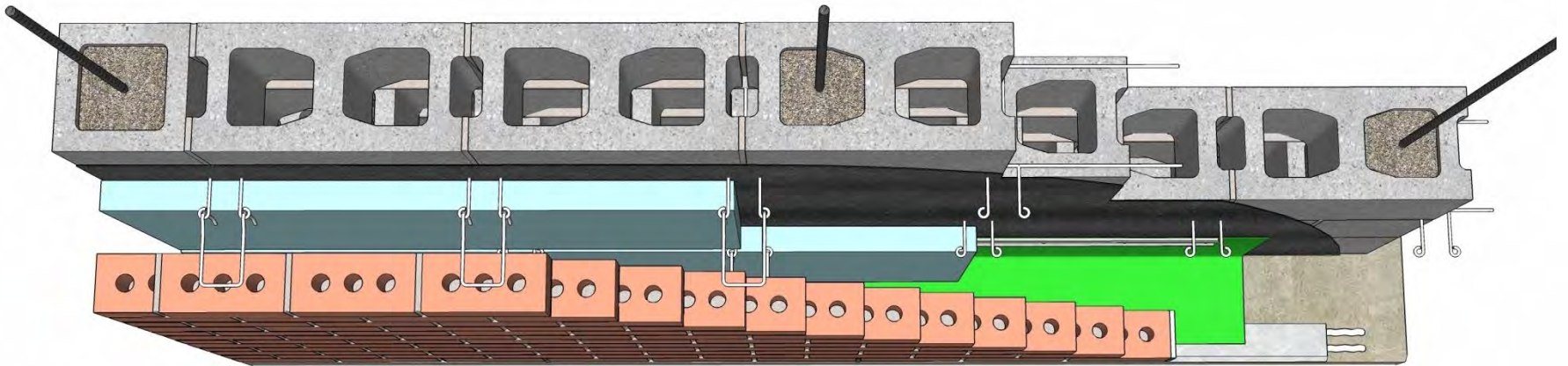
classic shrinkage cracks



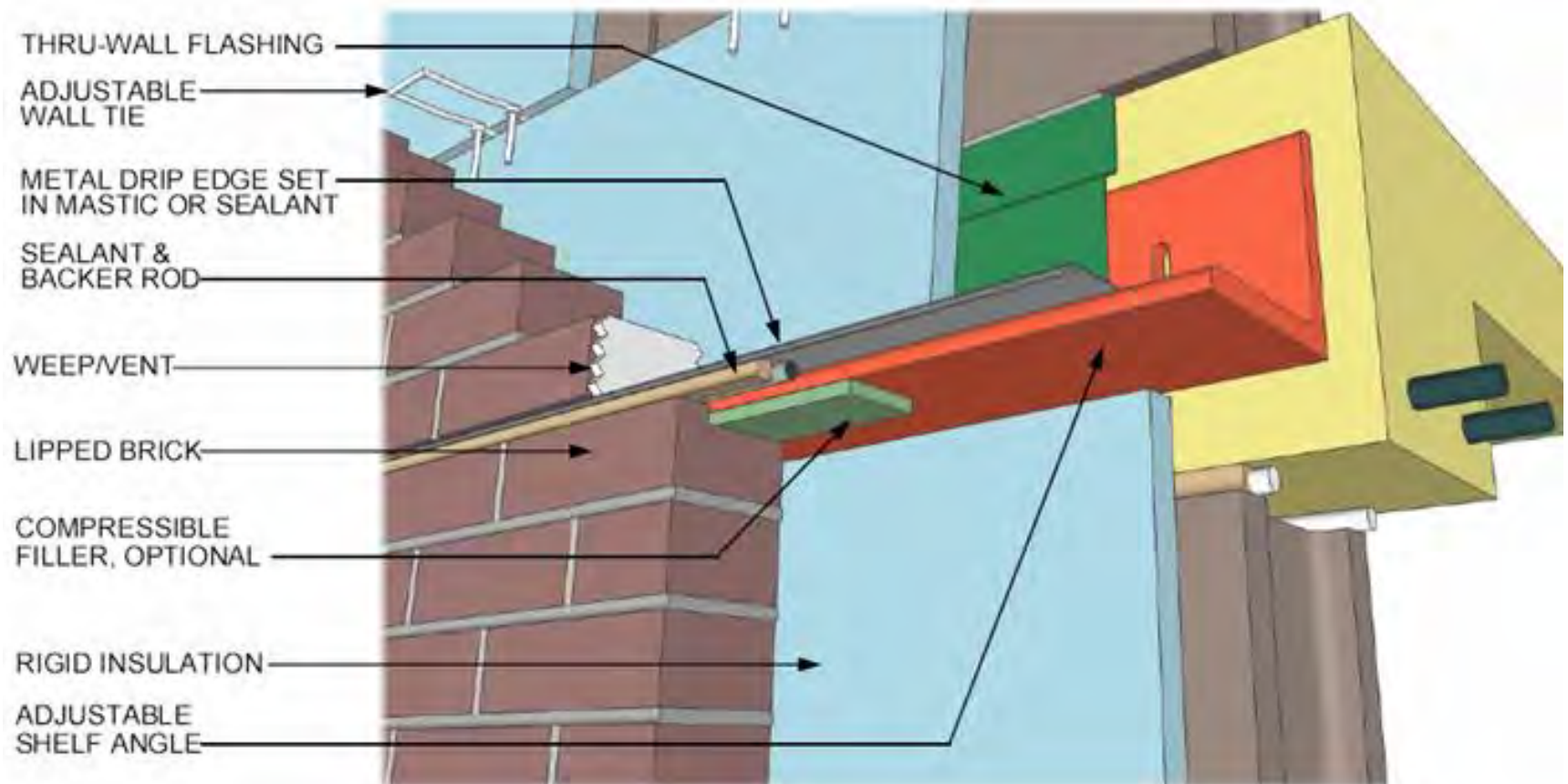
veneer reinforcement



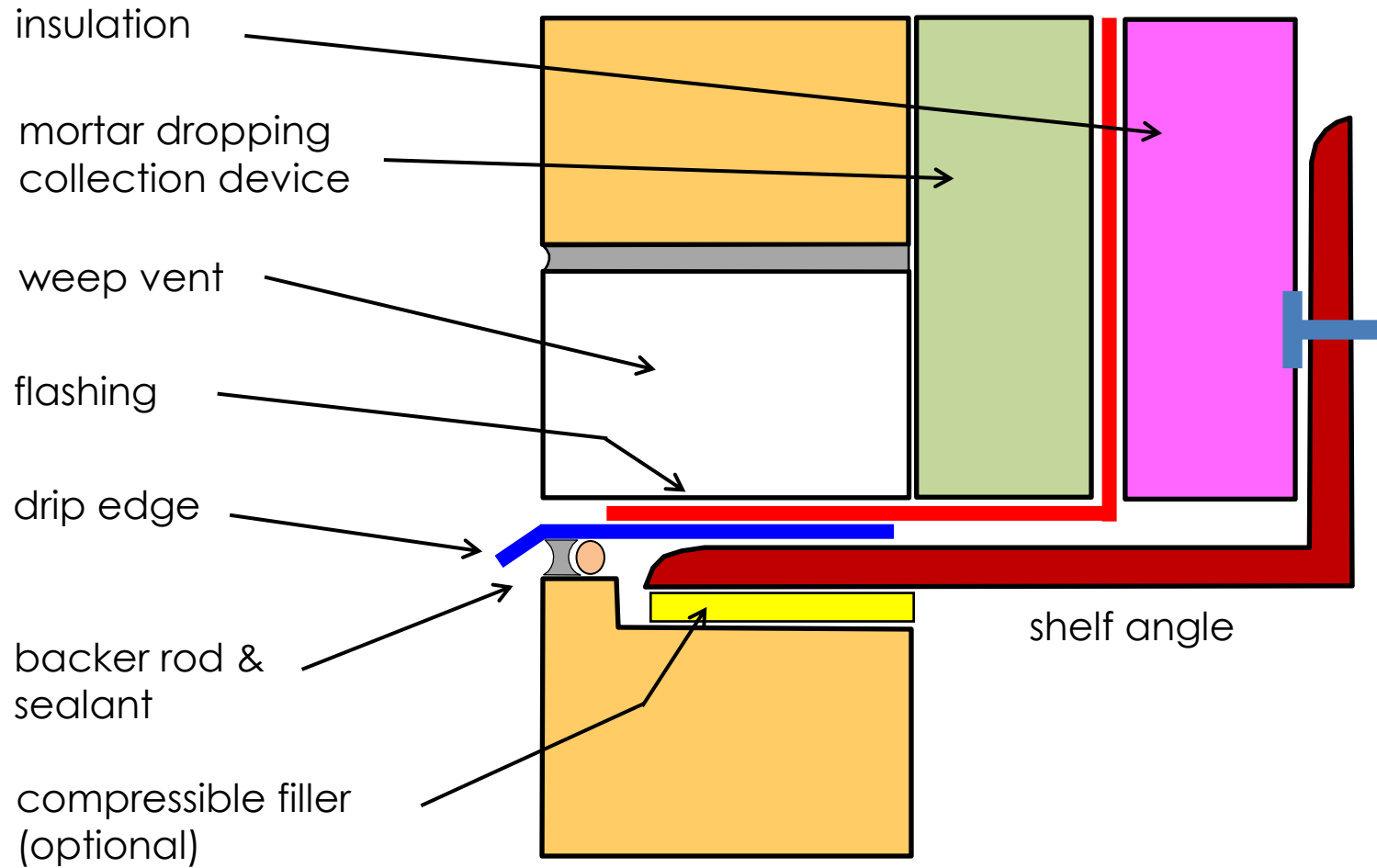
shelf angles



horizontal movement joint



up-lipped brick @ shelf angle



vertical spacing



- check codes
- veneer type
- back-up system
- formula
- empirical

mid-wall shelf angle



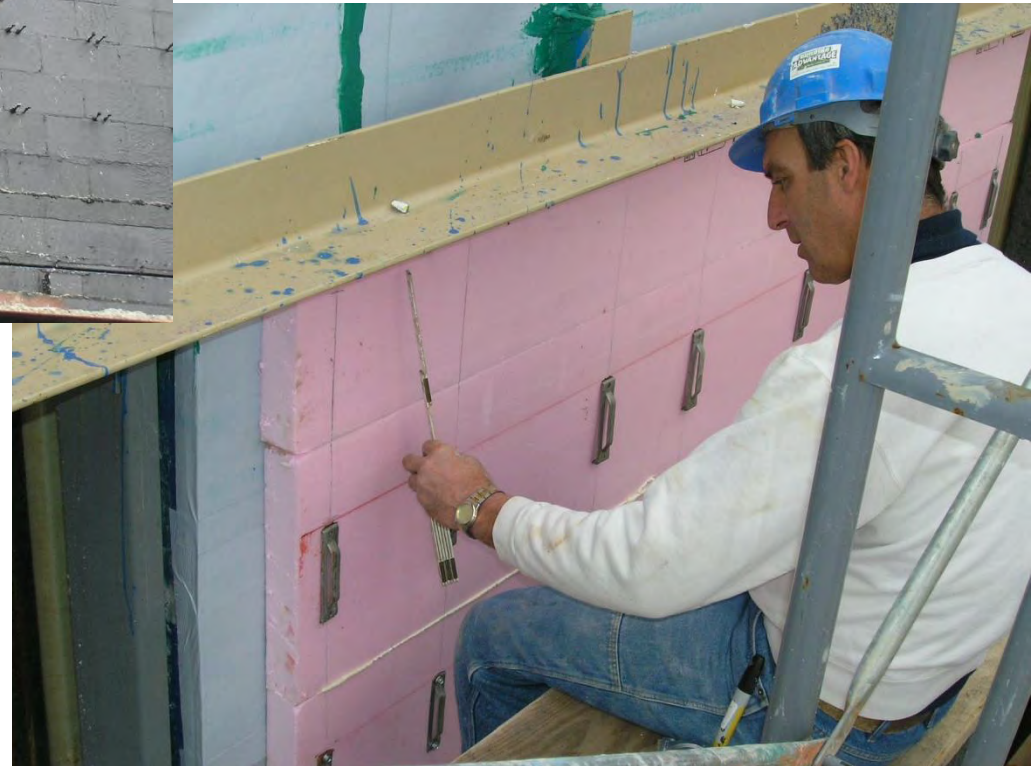
mid-wall shelf angle – what's wrong?



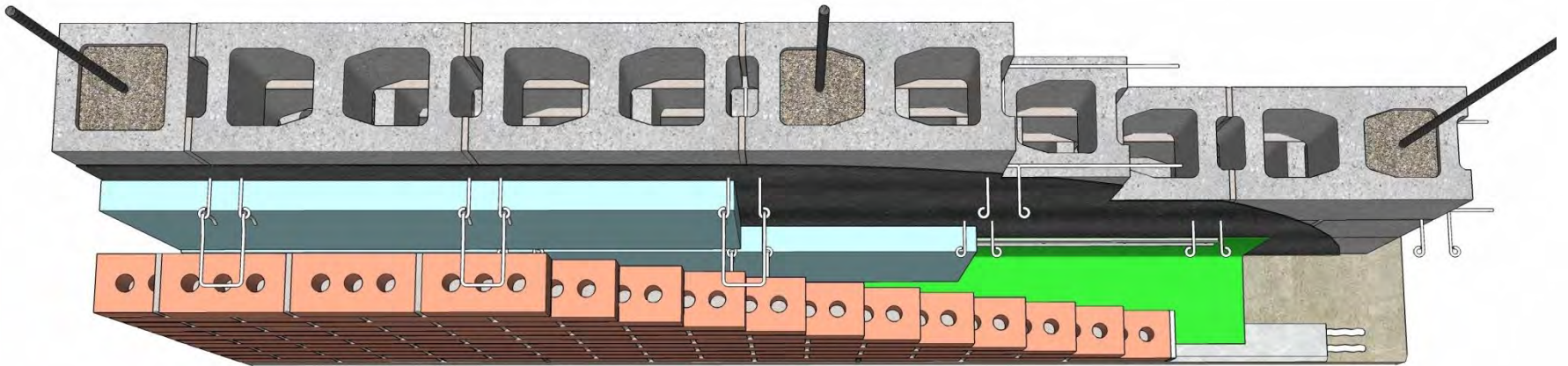
energy efficient shelf angle



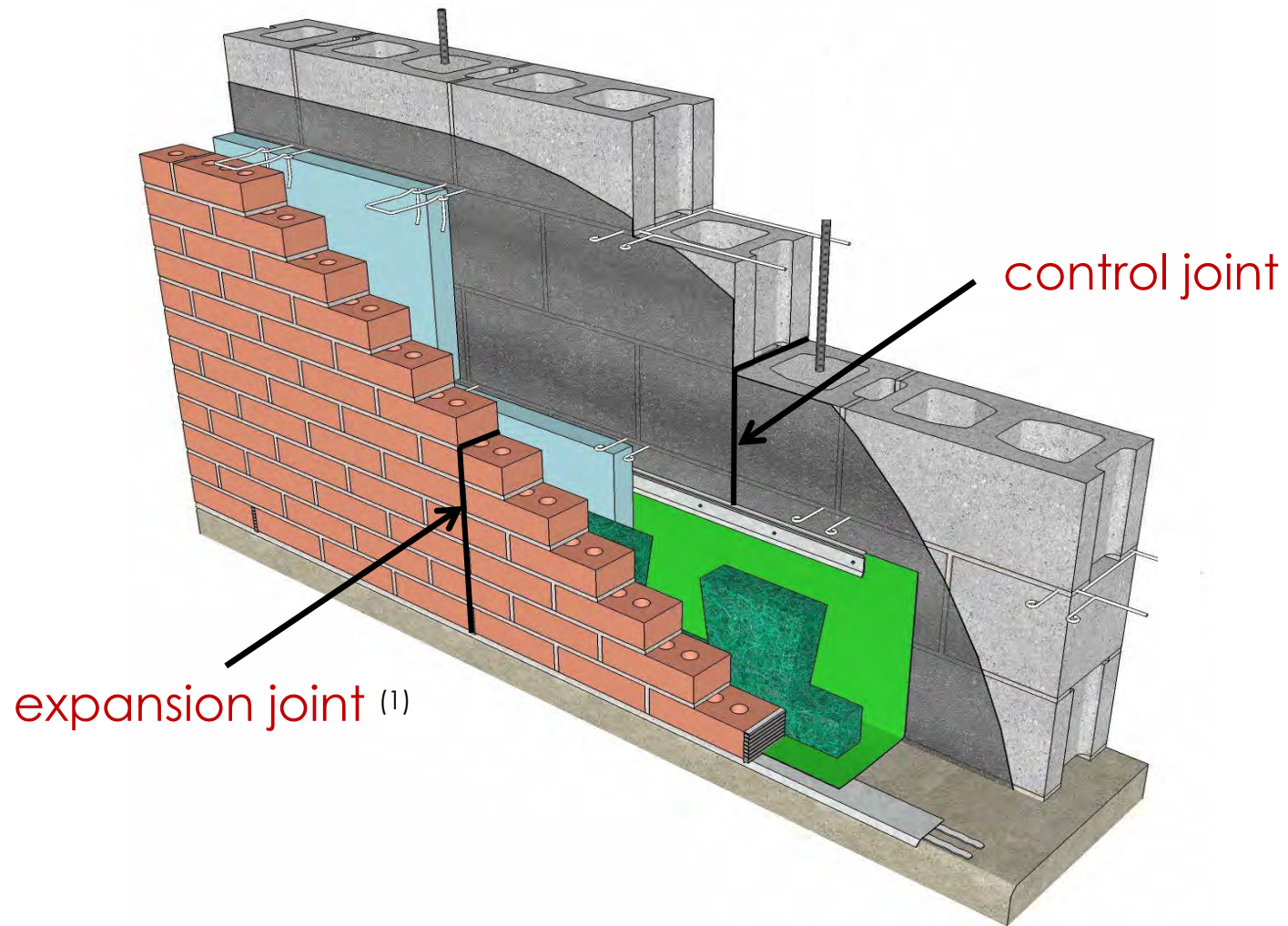
energy efficient shelf angles



movement joints



masonry cavity wall



(1) if veneer material is expansive

movement joint basics



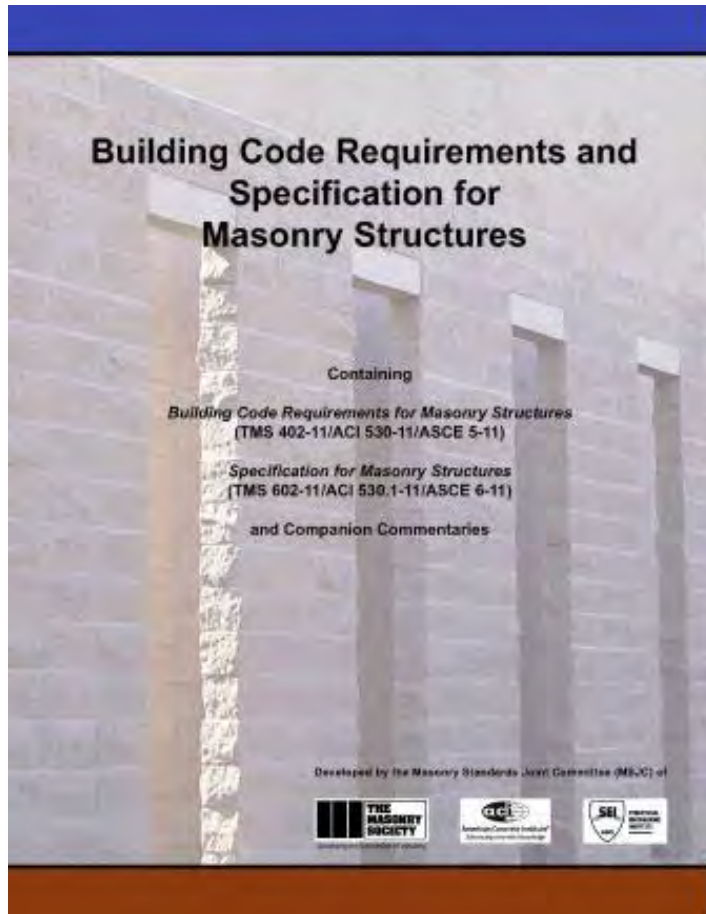
- all buildings move
- **CMU** shrink
- **bricks** expand
- accommodate
- restrain
- both

movement joint terminology



- expansion joint (EJ)
- control joint (CJ)
- movement joint (MJ)
- building expansion joint
- isolation joint

who is responsible for locating movement joints?



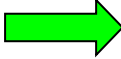




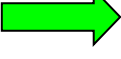

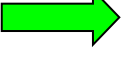
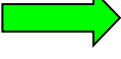
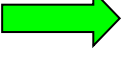
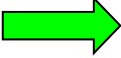


MSJC, Section 6.1.6.3

“Design and detail the veneer to accommodate differential movement.”

MSJC Mandatory Requirements Checklist – “Notes to Architect / Engineer”, Part 3, 3.3 D.6, page S-73

“Indicate type and location of movement joints on the project drawings.”

expansion or shrinkage test

autoclaved aerated concrete (AAC)		shrink
adhered veneer		shrink or expand ⁽¹⁾
architectural precast		shrink
brick (clay)		expand
brick (CMU)		shrink
brick (fly ash)		shrink
calcium silicate		expand
cast stone		shrink
concrete masonry unit (CMU)		shrink
EIFS		shrink
natural stone		expand ⁽²⁾
terra cotta		expand
tile (ceramic)		expand

(1) depends if it is manufactured or natural stone

(2) natural stone may expand but is essentially inert, MJ's recommended because building structure will move

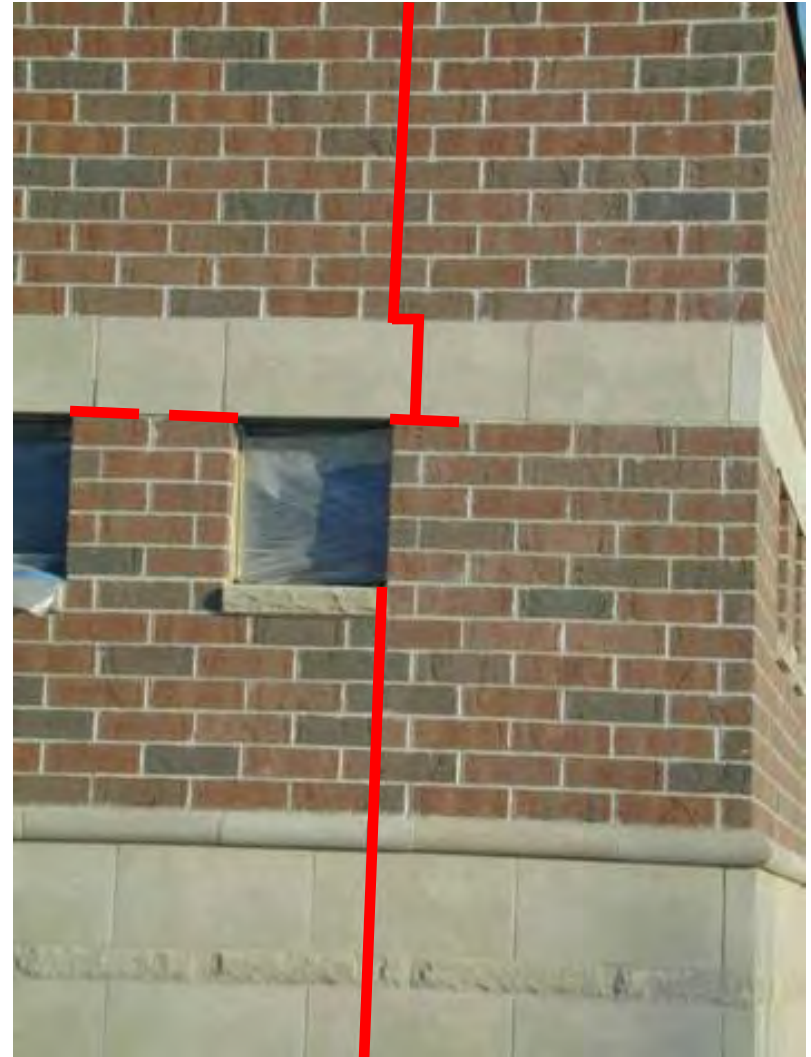
MJ's at openings

3 options

- 1) end of lintel
- 2) aligned with jamb
- 3) between openings



movement joint offsets



movement joint width



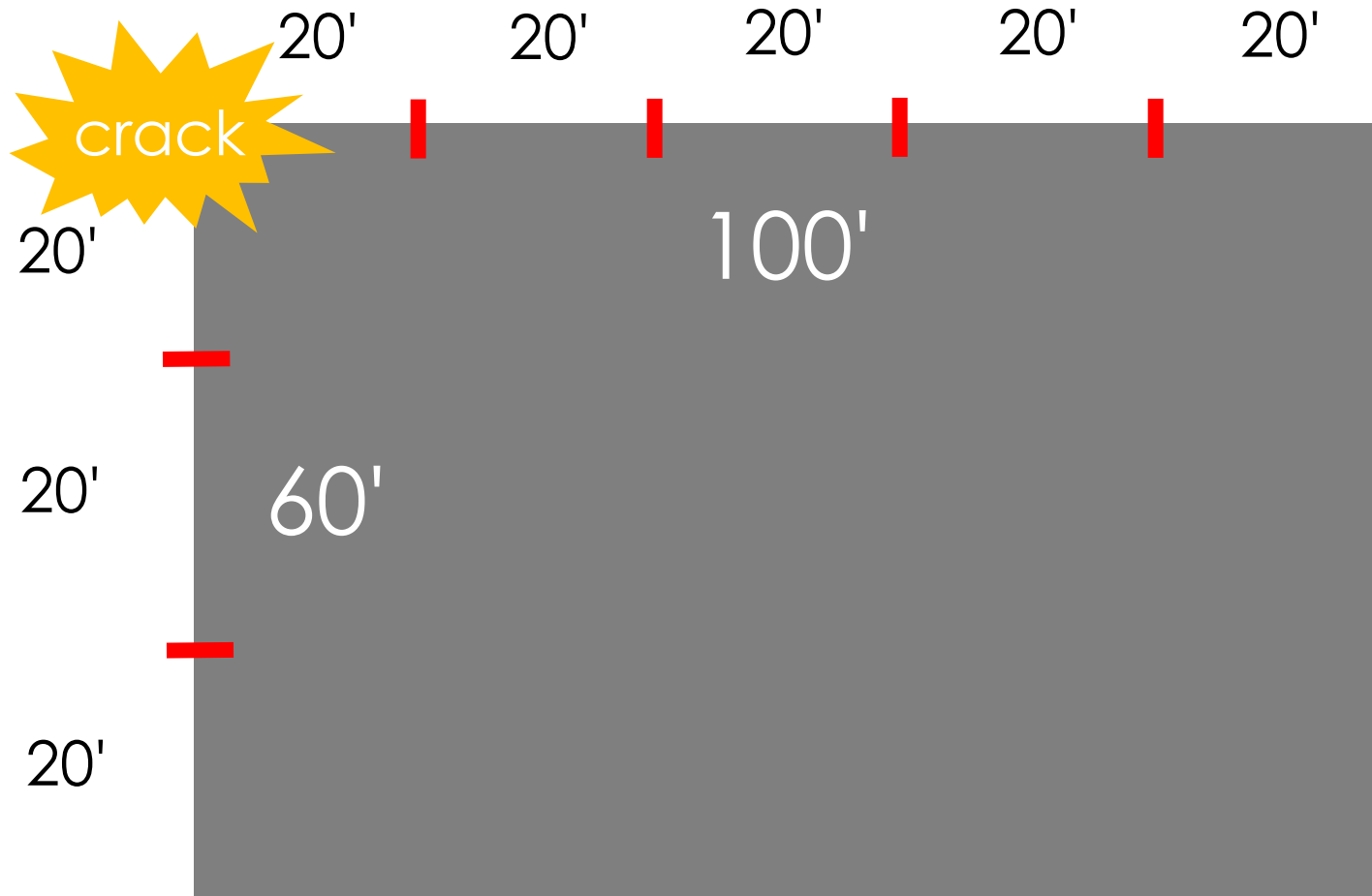
brick (ej)

- 3/8" to 1/2" wide

CMU (cj)

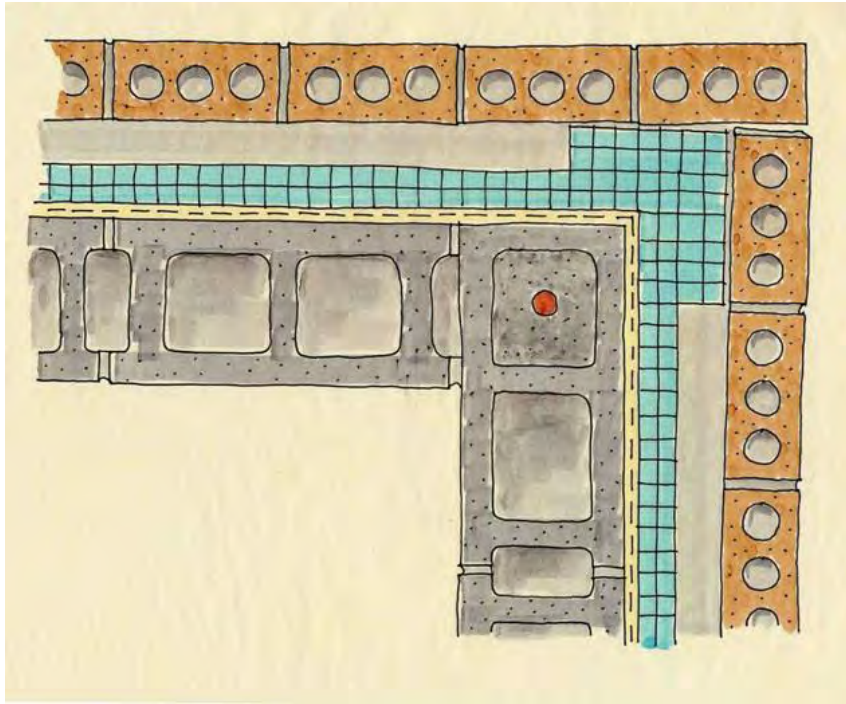
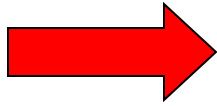
- 3/8" wide

improper MJ locations

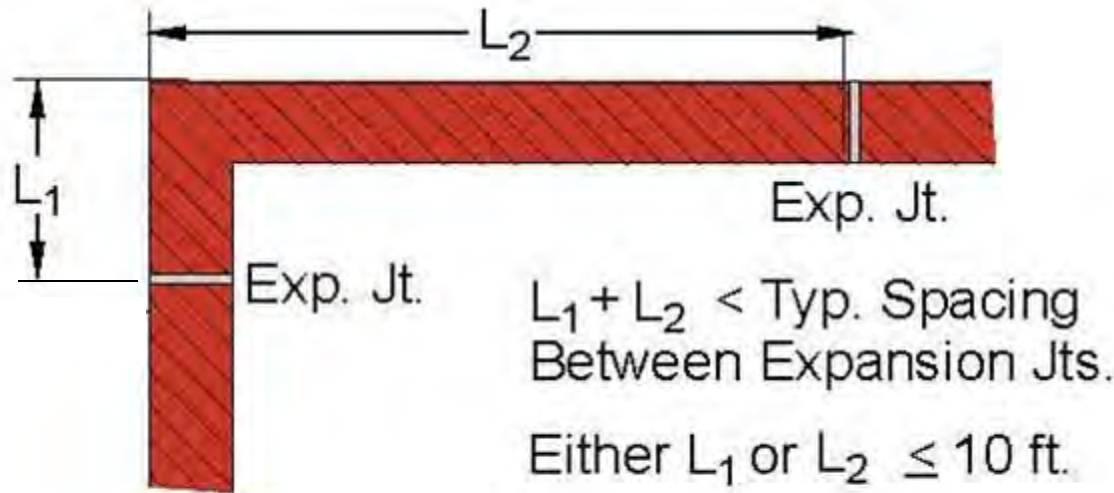


miscellaneous building plan

corner crack (mother nature's ej)



corner MJ rule-of-thumb (1)



(b)

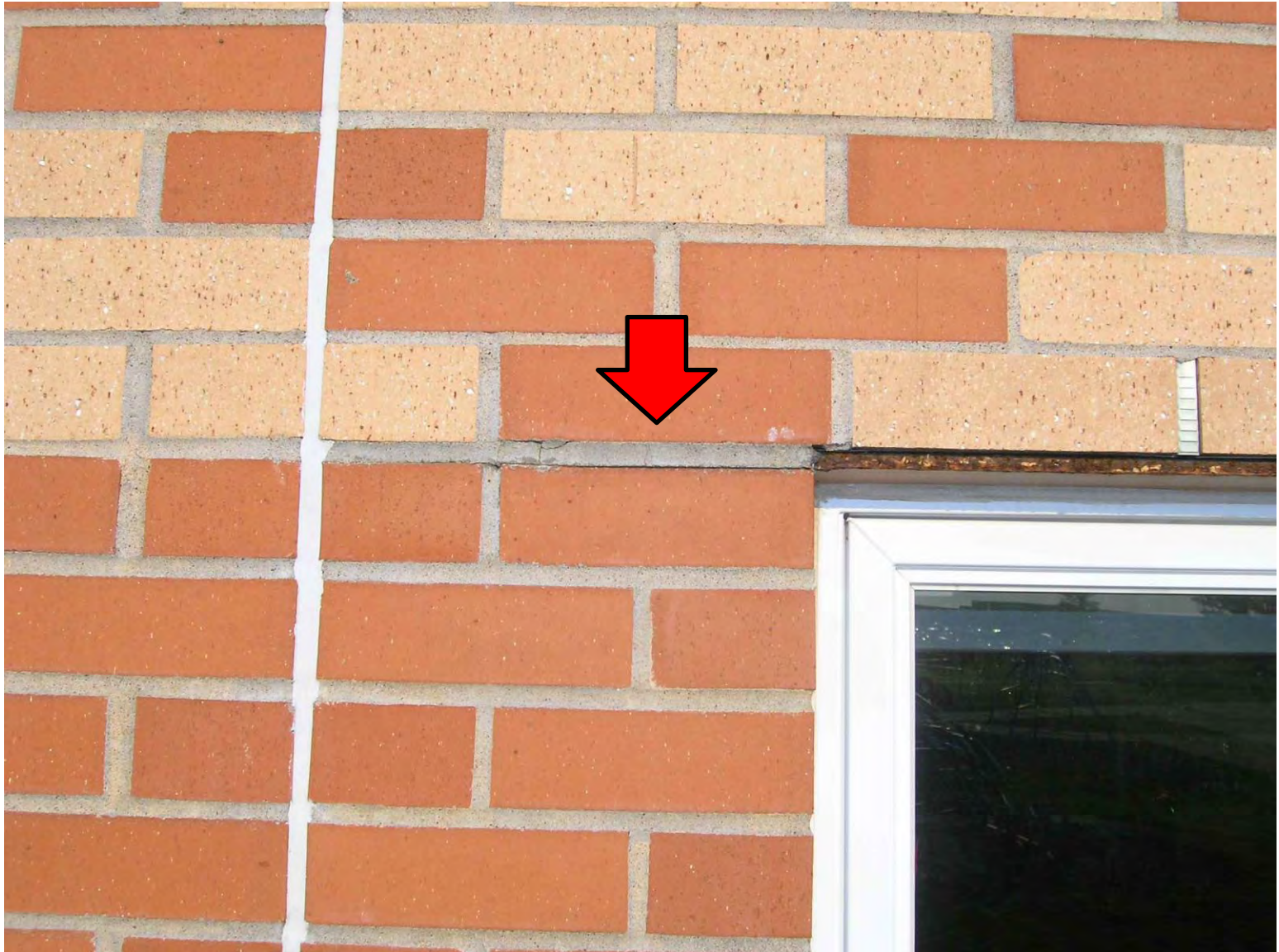
Proper Expansion Joint Locations at Corner

Note from International Masonry Institute (IMI) (2010). L_1 or L_2 4-feet +/- when bricks are: new, dark colored, large sized, exposed to abundant heat gain, used in facades multiple openings.

corner MJ rule-of-thumb



do not install mortar at lintel



L-shaped movement joints



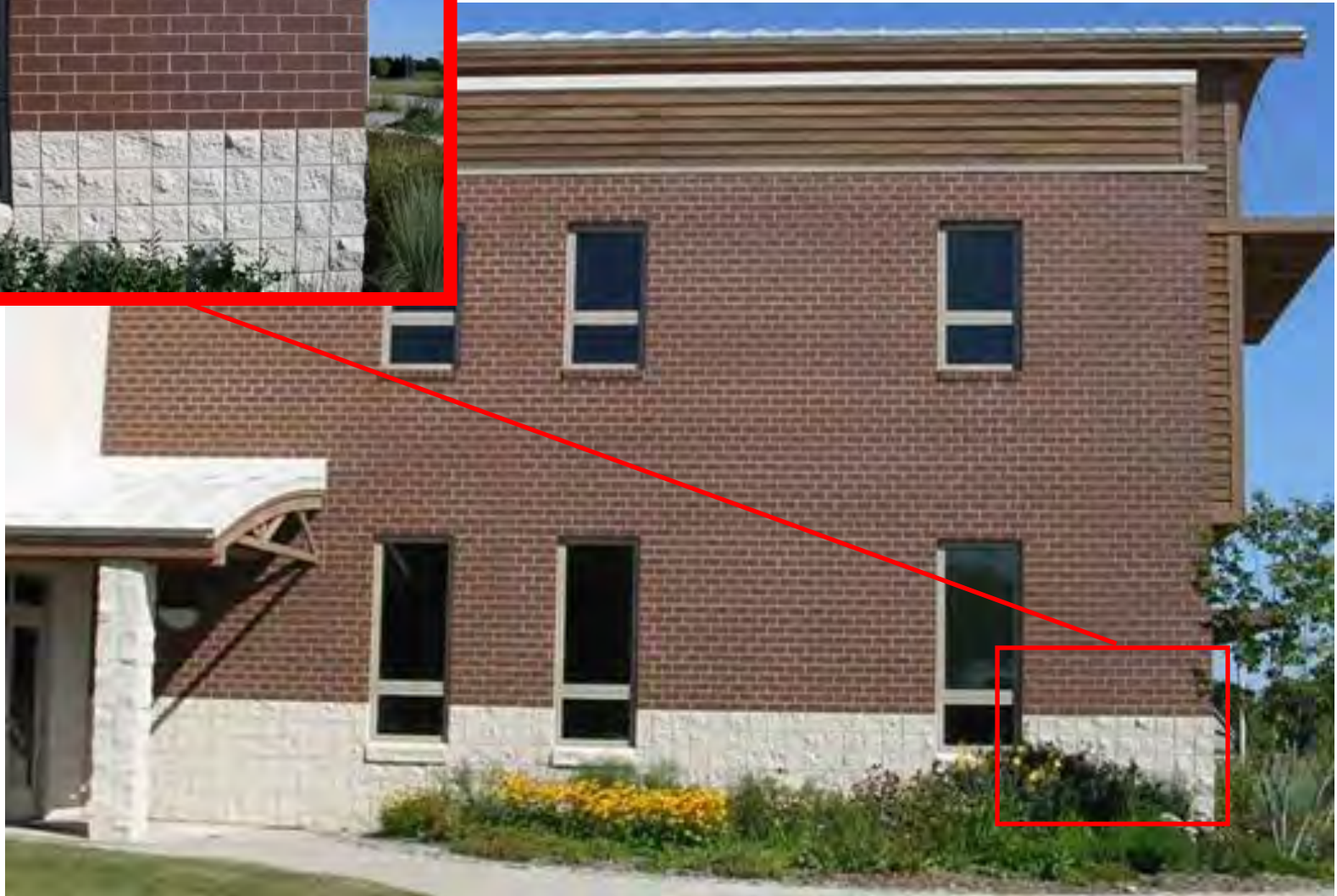
improper joint sealant color



proper sealant color



proper sealant colors



masonry geeks (& proud of it)



thank you for your time



this concludes the AIA CES program





masonry job site troubleshooting

