



new masonry ideas

- ❑ semi-automated mason (SAM)
- ❑ masonry design & f'm update
- ❑ masonry control joints
- ❑ masonry lintels
- ❑ 6" CMU applications
- ❑ Insultech CMU
- ❑ prefabricated masonry
- ❑ interior partitions
- ❑ storm shelters



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International Masonry Institute (IMI)



non-profit



labor/management strategic alliance

funded by

International Union of Bricklayers & Allied Craftworkers
and the Contractors who employ them



IMI Training Center, located in Bowie, MD

International Masonry Institute



National Training Center - Bowie, Maryland



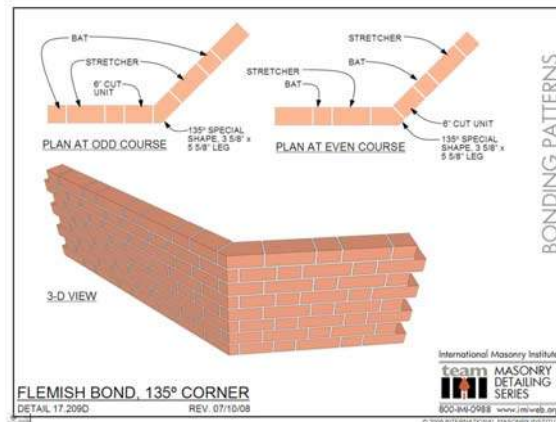
IMI masonry crafts



- artificial masonry
- brick
- block
- concrete
- plaster
- refractory
- restoration
- stone/ marble
- terrazzo
- tile



design assistance



800-IMI-0988
www.imiweb.org

student education



Masonry Days

job site assistance



(800) 291-2128

In f t

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INTERNATIONAL MASONRY INSTITUTE

The International Masonry Institute (IMI) is a strategic alliance between the International Union of Bricklayers and Allied Craftworkers and the contractors who employ those members. Through education, technical support, research and training the IMI works to provide a more efficient construction delivery system.

STRUCTURAL SOLUTIONS
Structural masonry software, tools and education providing access to a high value / low cost structural system
[LEARN MORE](#)

MASONRY DETAILING SERIES
Details, Technology Briefs, Tool Kits and more, explaining how to use masonry to the highest value on your project.
[LEARN MORE](#)

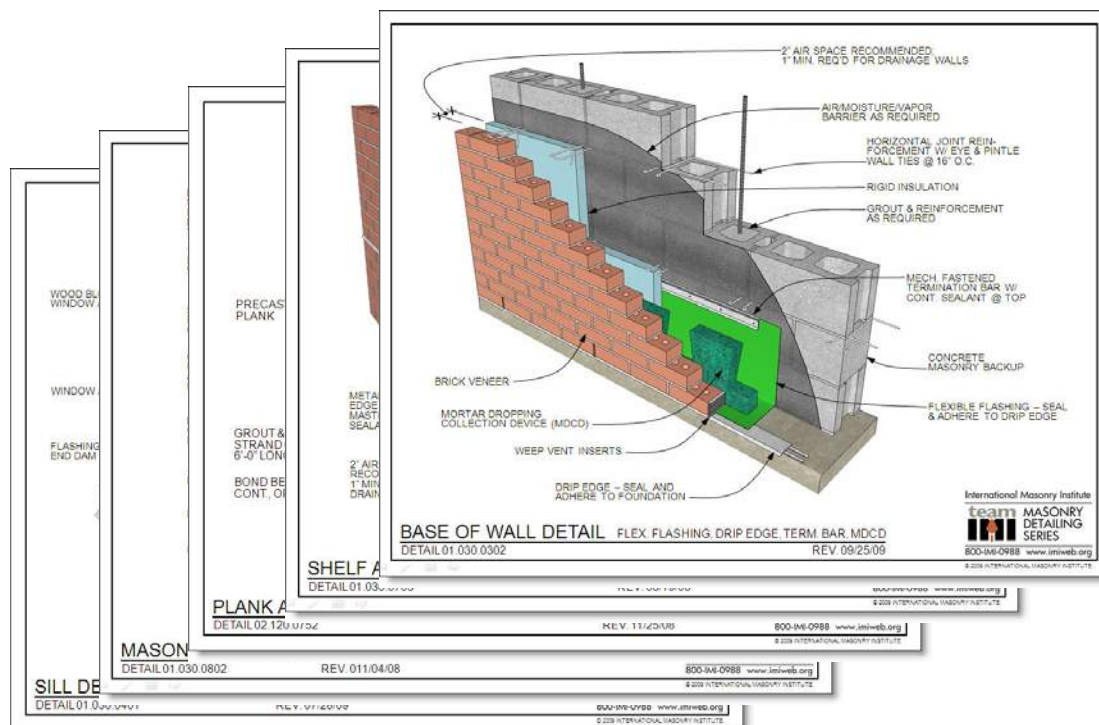
SYSTEM THINKING
Building enclosure performance, control of air, moisture, vapor, sound, fire – thermal control and solutions.
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IMI "Masonry Detailing Series"



www.masonrydetails.org

IMI "Masonry Detailing Series"



free technical assistance (1)



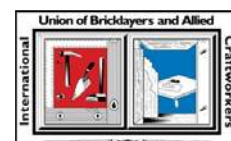
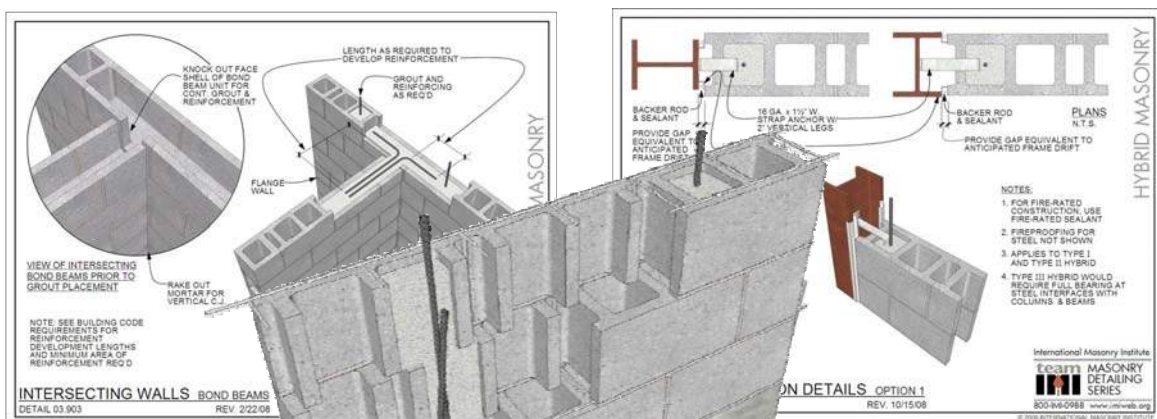
- seminars
- code & standard development
- design guides & details
- new product research
- cost & schedule support
- **conceptual structural engineering**
- drawing & detail review
- job site assistance
- troubleshooting

(1) check with your local IMI representative to verify which services are available in your area

structural masonry promotion



(Structural Masonry Coalitions)



semi-automated mason (SAM)

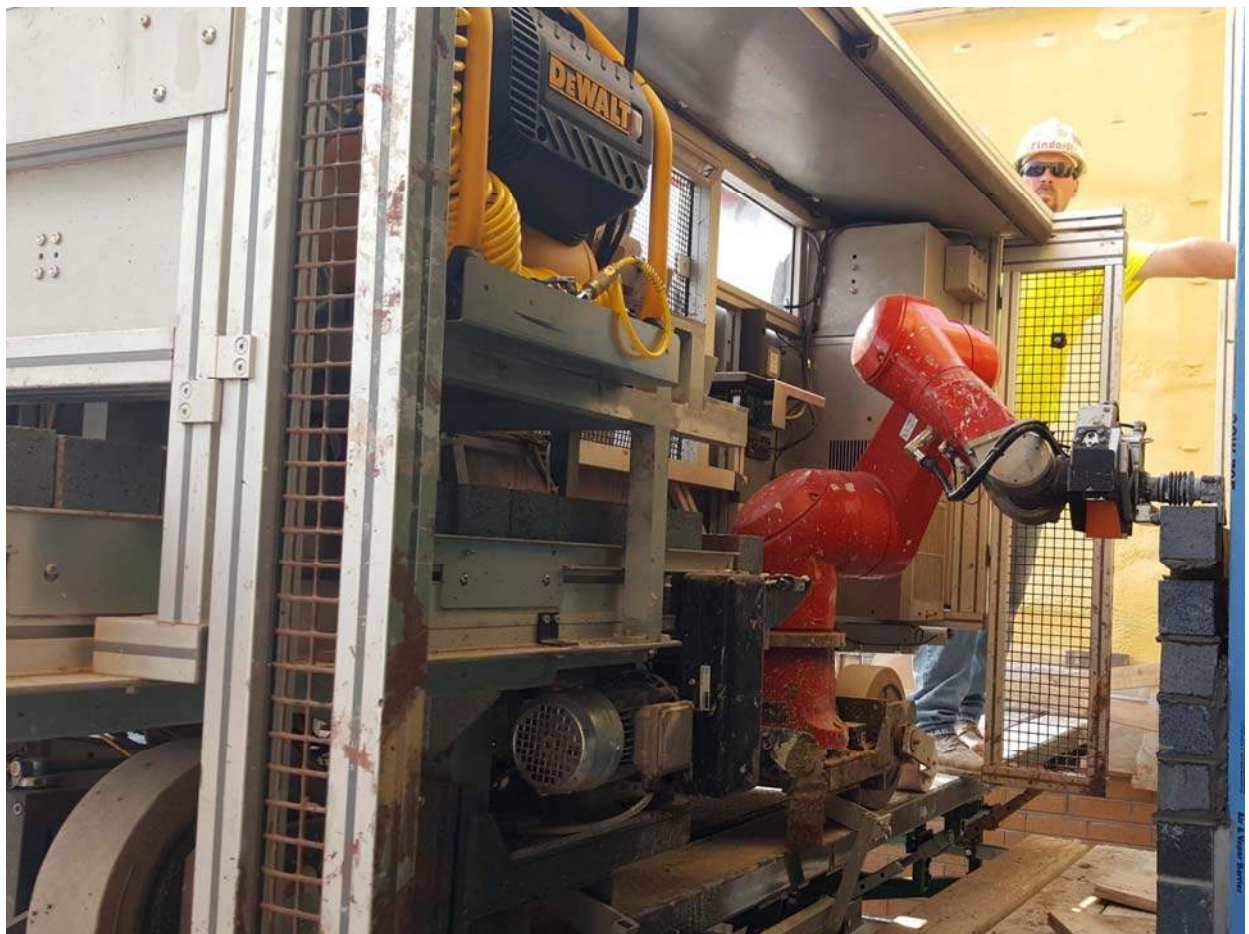


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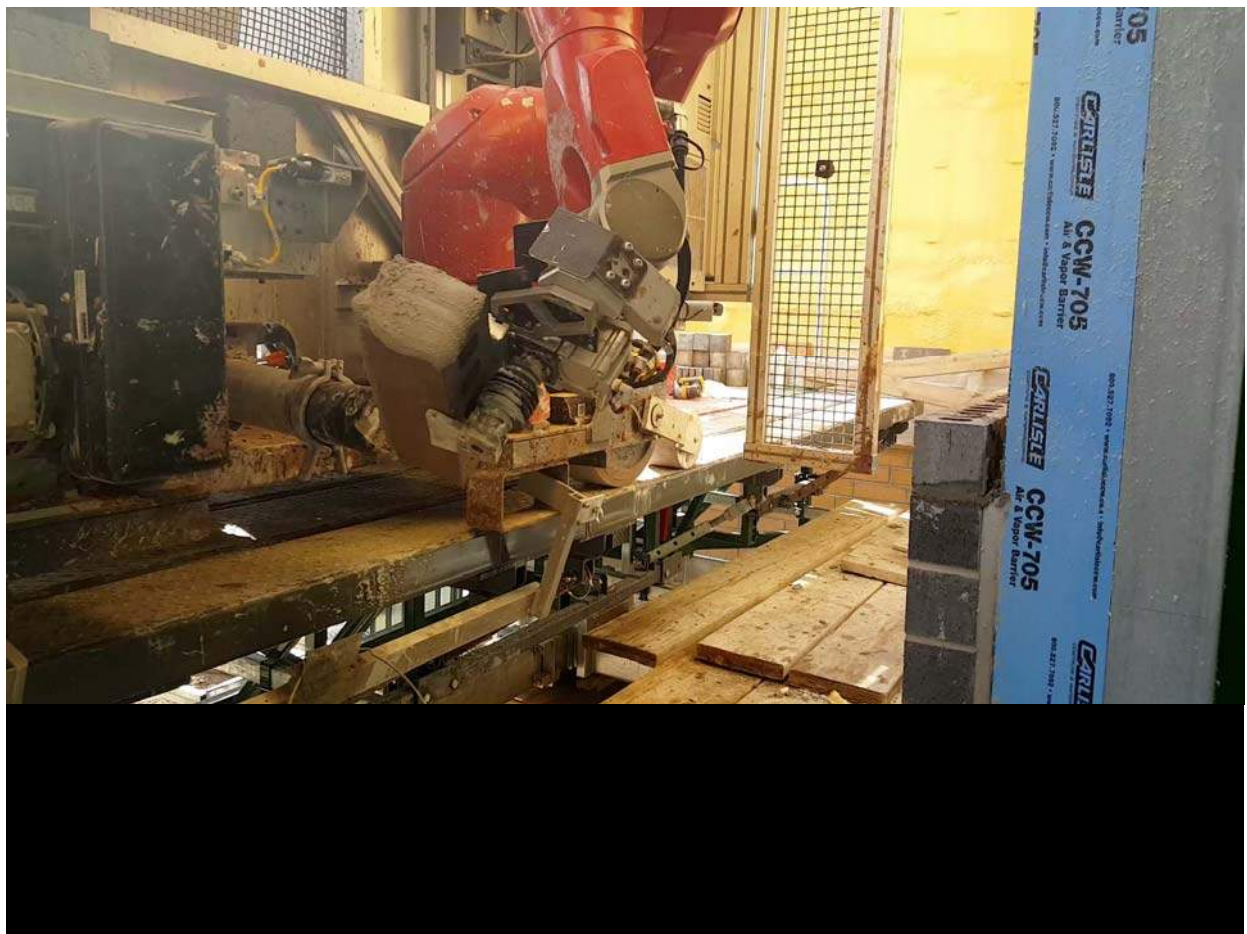


Findorff Construction
photos taken 9.15.16







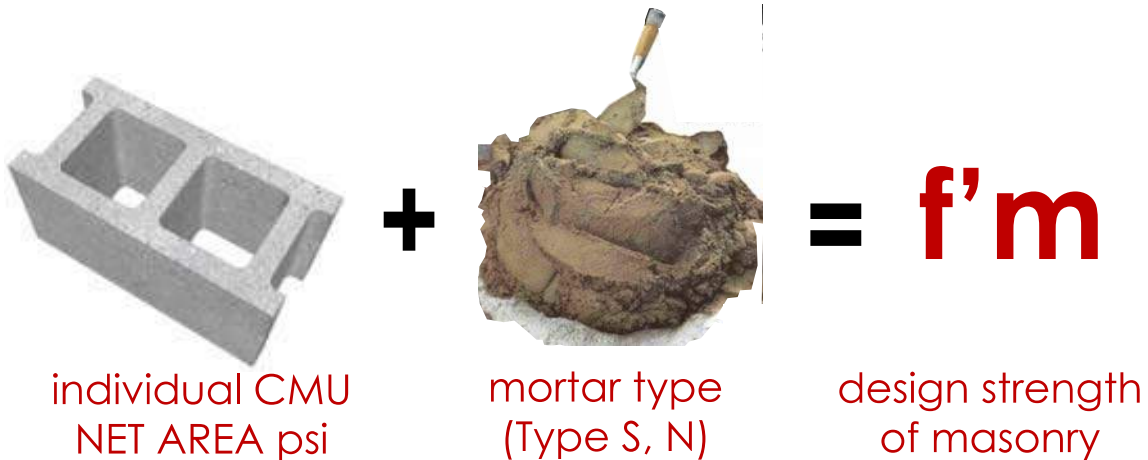


f'm & masonry design updates



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What is **f'm** ?



individual CMU
NET AREA psi

+

mortar type
(Type S, N)

= **f'm**

design strength
of masonry

~~1,900 psi~~

1) actually **NOT** available

~~= 1,500 psi~~

3,750 psi

2) available everywhere in **Midwest**

= 2,500 psi

4,800psi

3) also available (not as common)

= 3,000 psi

What is $f'm$?



+



= $f'm$

NEW VALUES IN
MSJC 2013

individual CMU
NET AREA psi

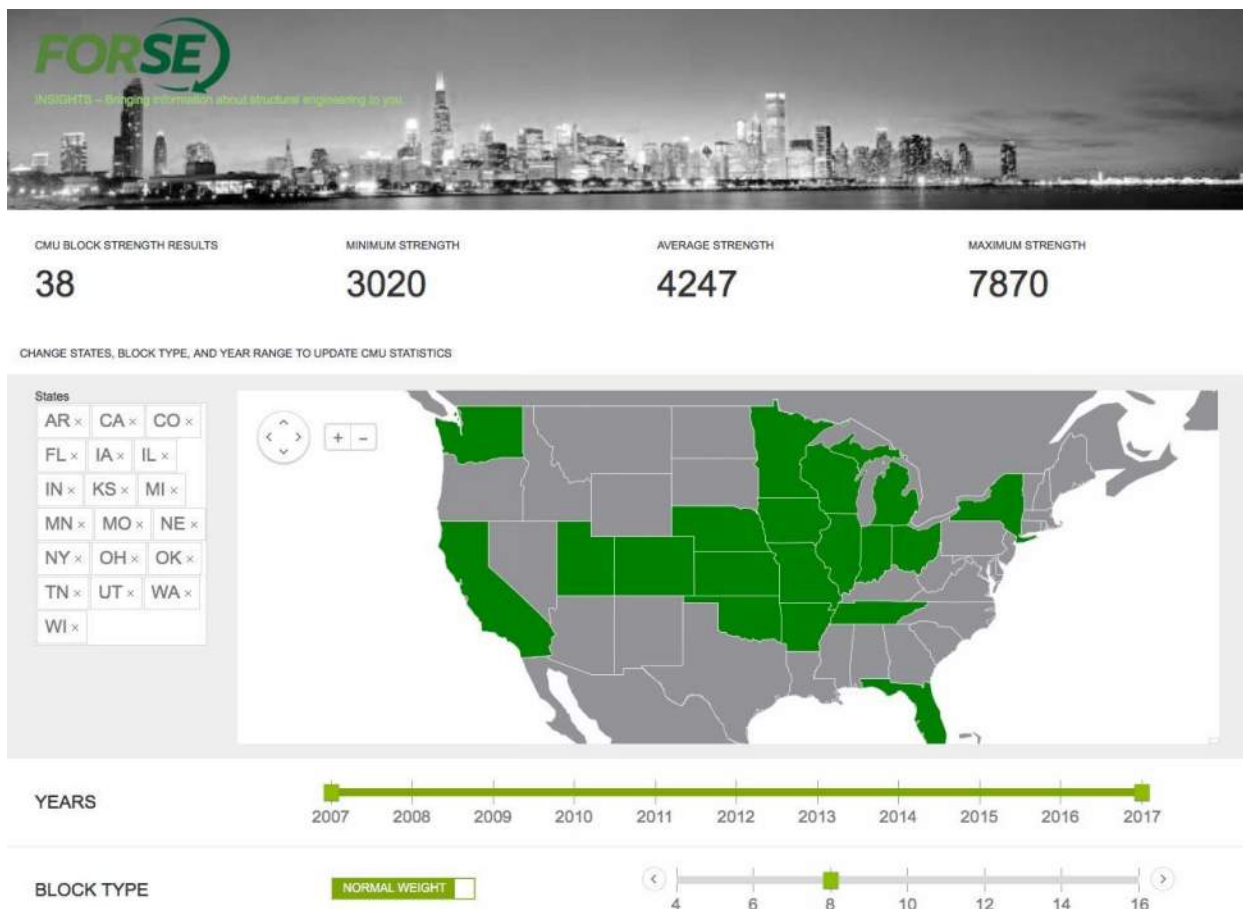
mortar type
(Type S, N)

design strength
of masonry

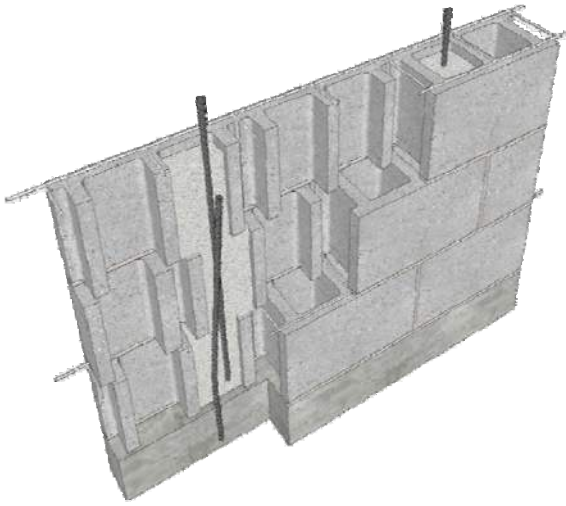
~~2,000 psi~~ **1) actually NOT available** = ~~2,000 psi~~

3,250 psi **2) available everywhere in Midwest** = 2,500 psi

4,500 psi **3) also available (not as common)** = 3,000 psi



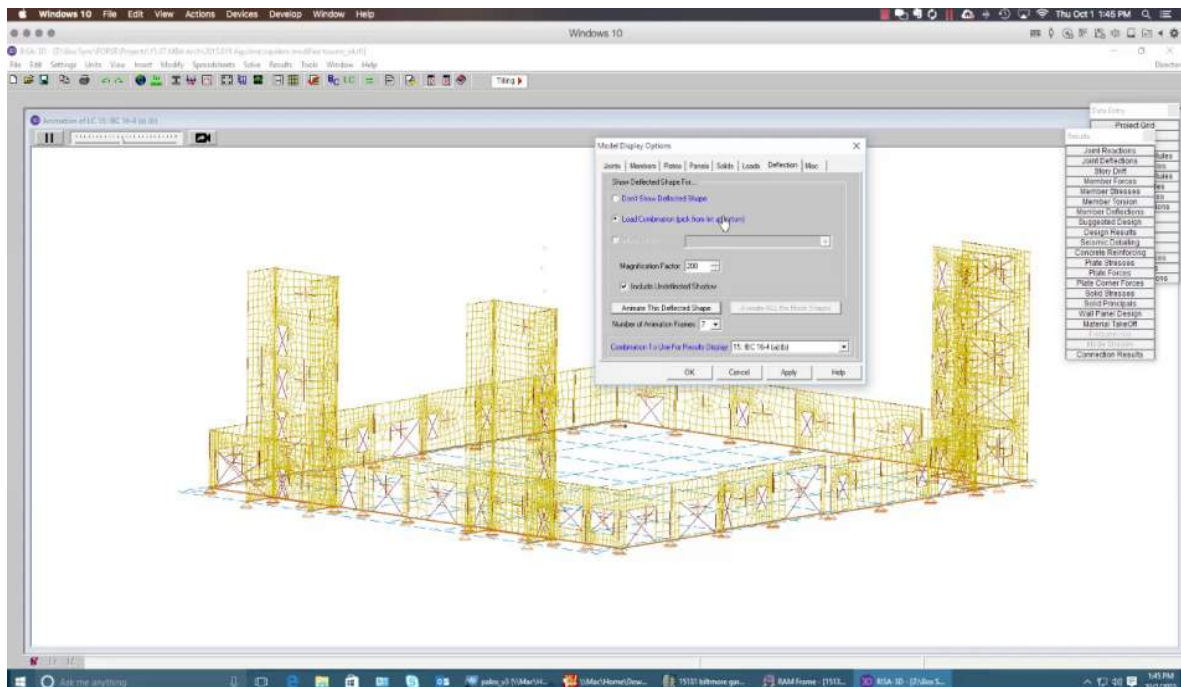
why is **f'm** so important?

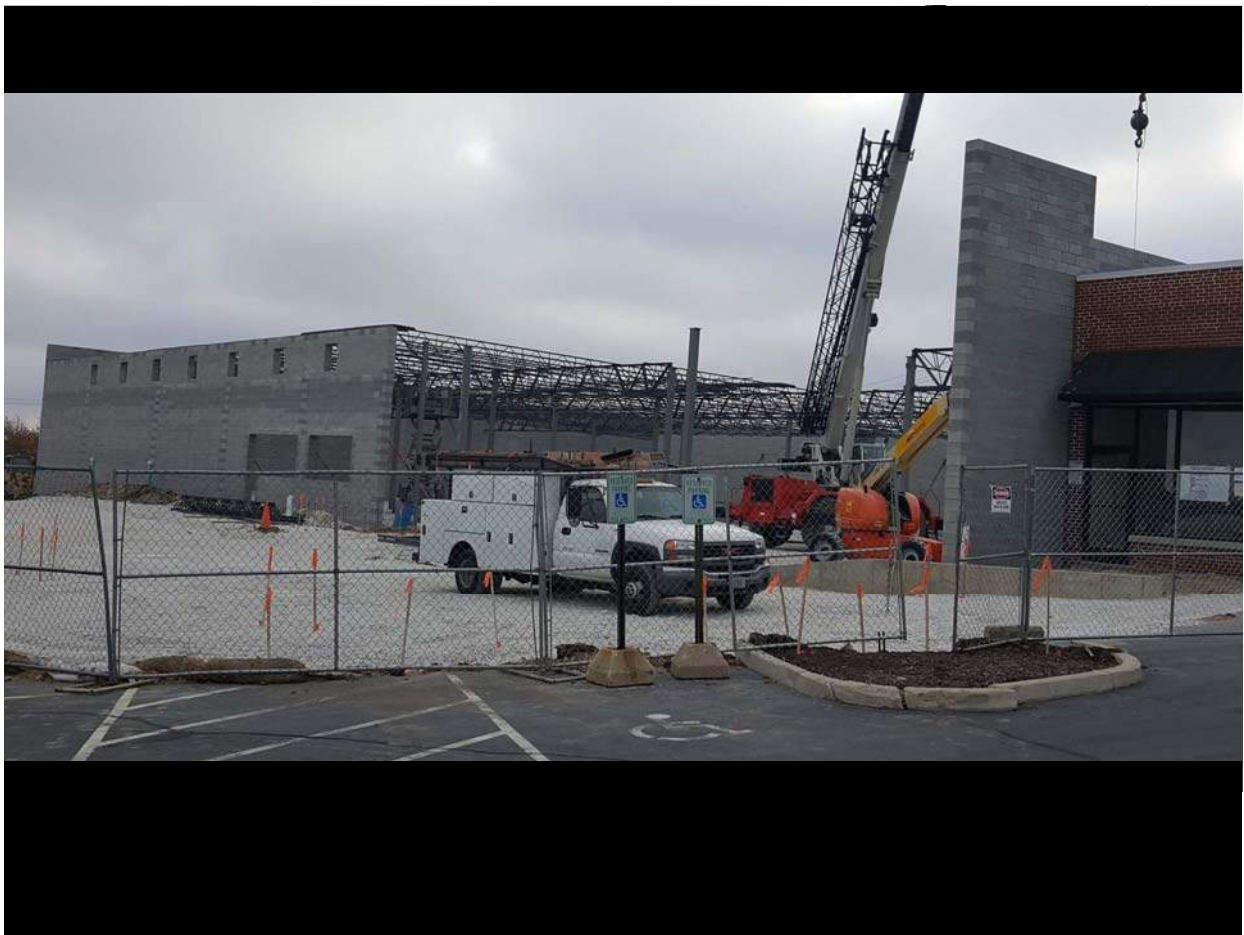


more efficient design w/
higher f'm

- **wall**
 - bearing wall
 - non-bearing wall
 - shear wall
- **intel**
- **column/pilaster**
- **lap lengths**
 - much shorter
- **connections to masonry**
 - will be much more efficient
 - embed plates
 - post-installed anchors

3D finite element software model



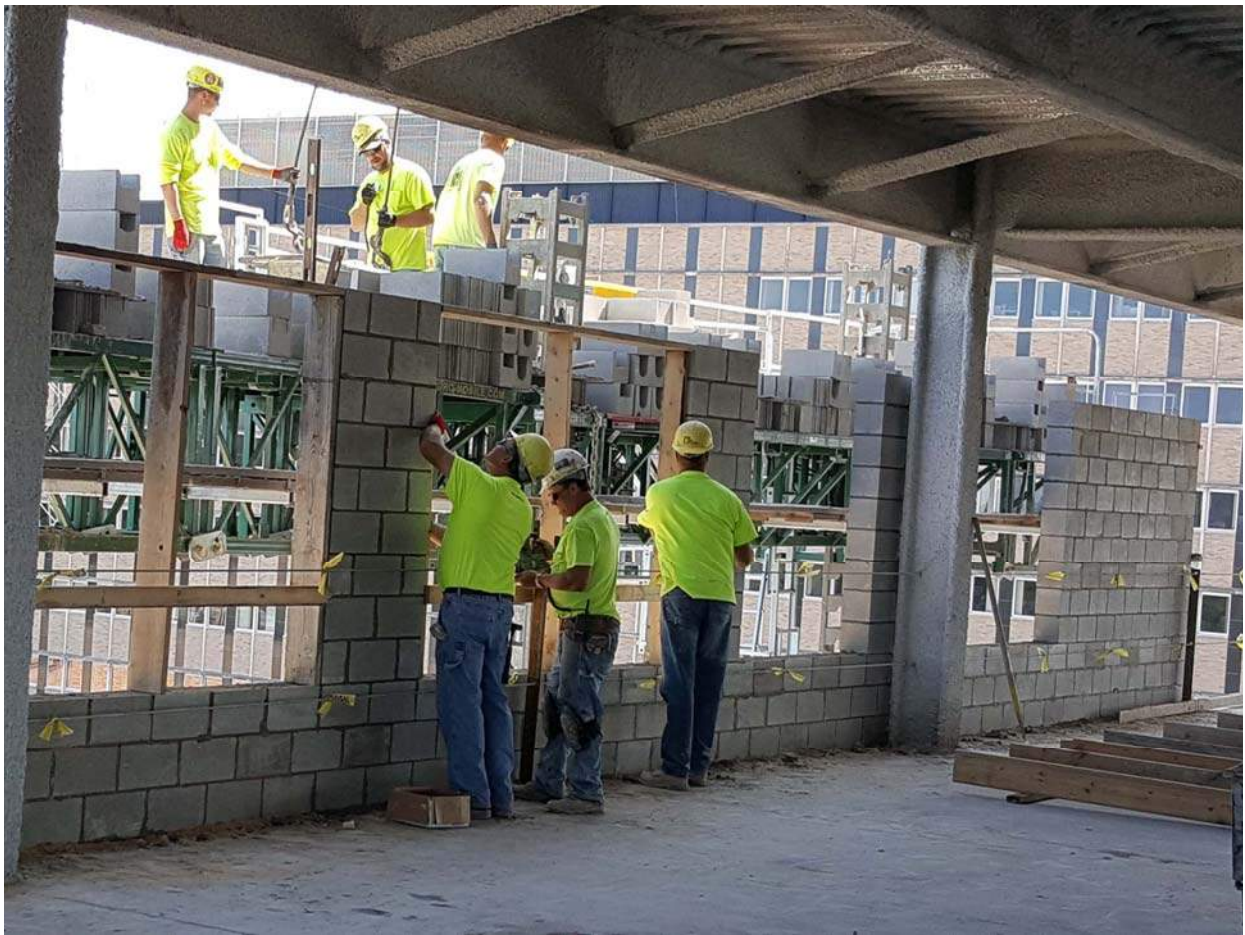


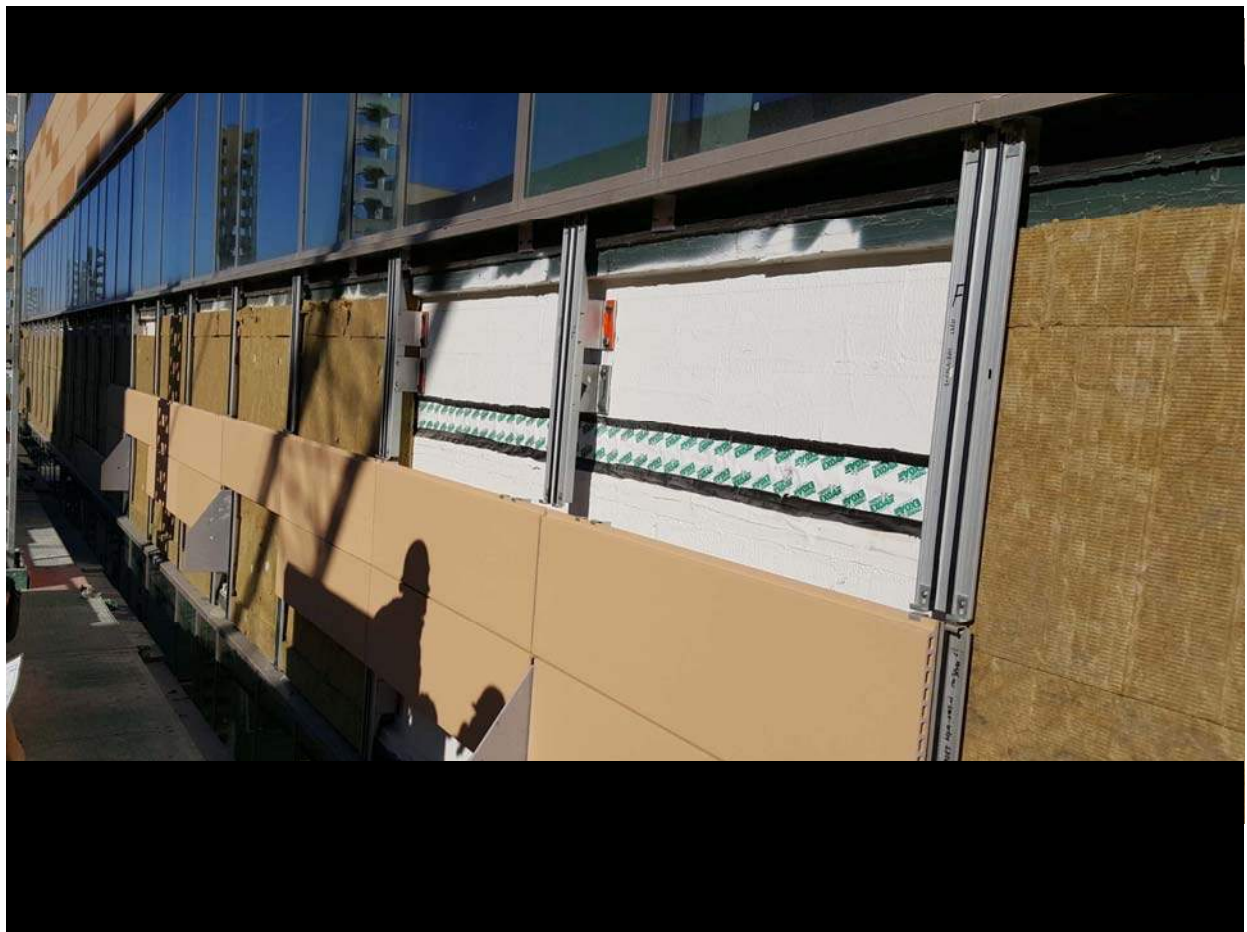
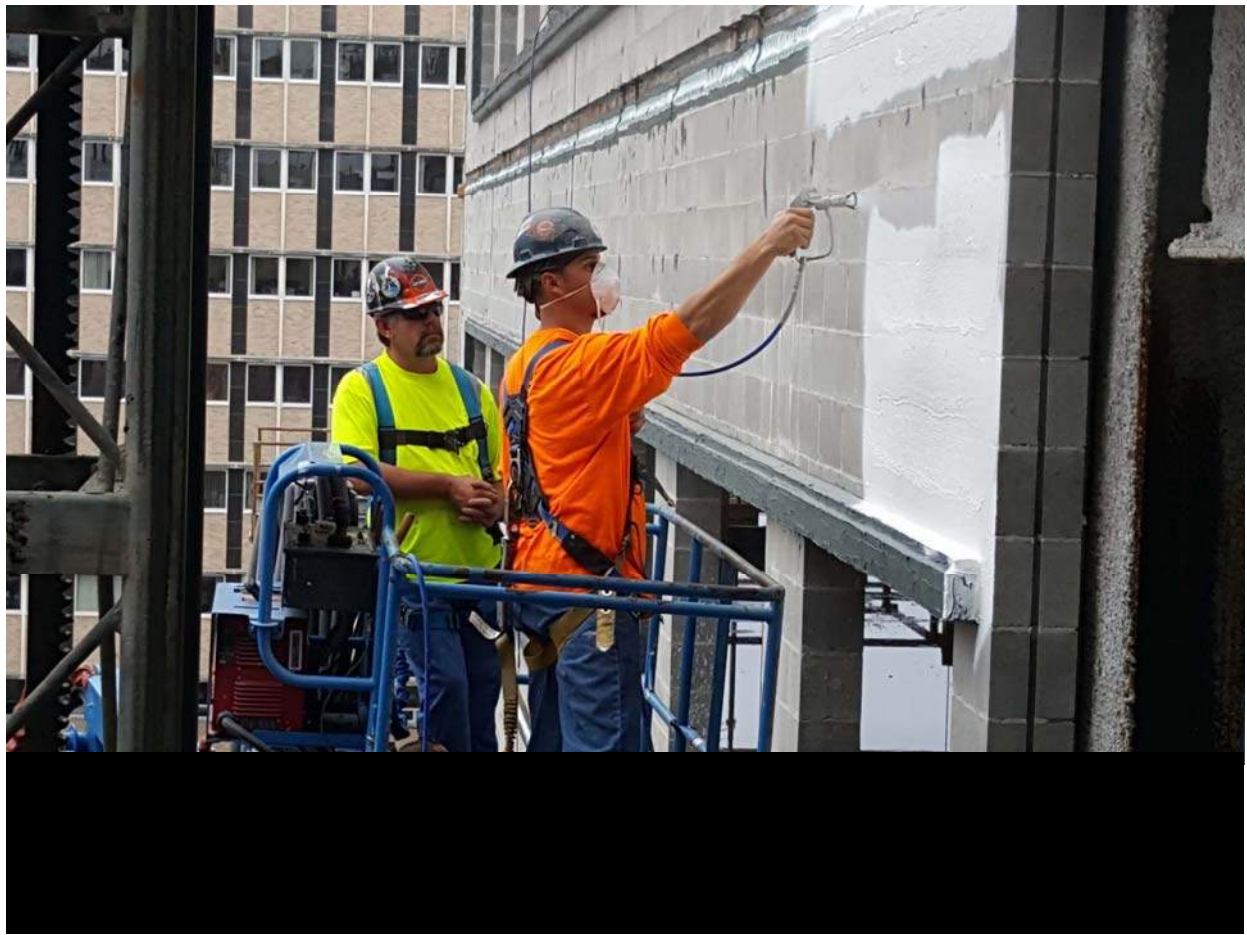
“hybrid” masonry wall w/ steel frame



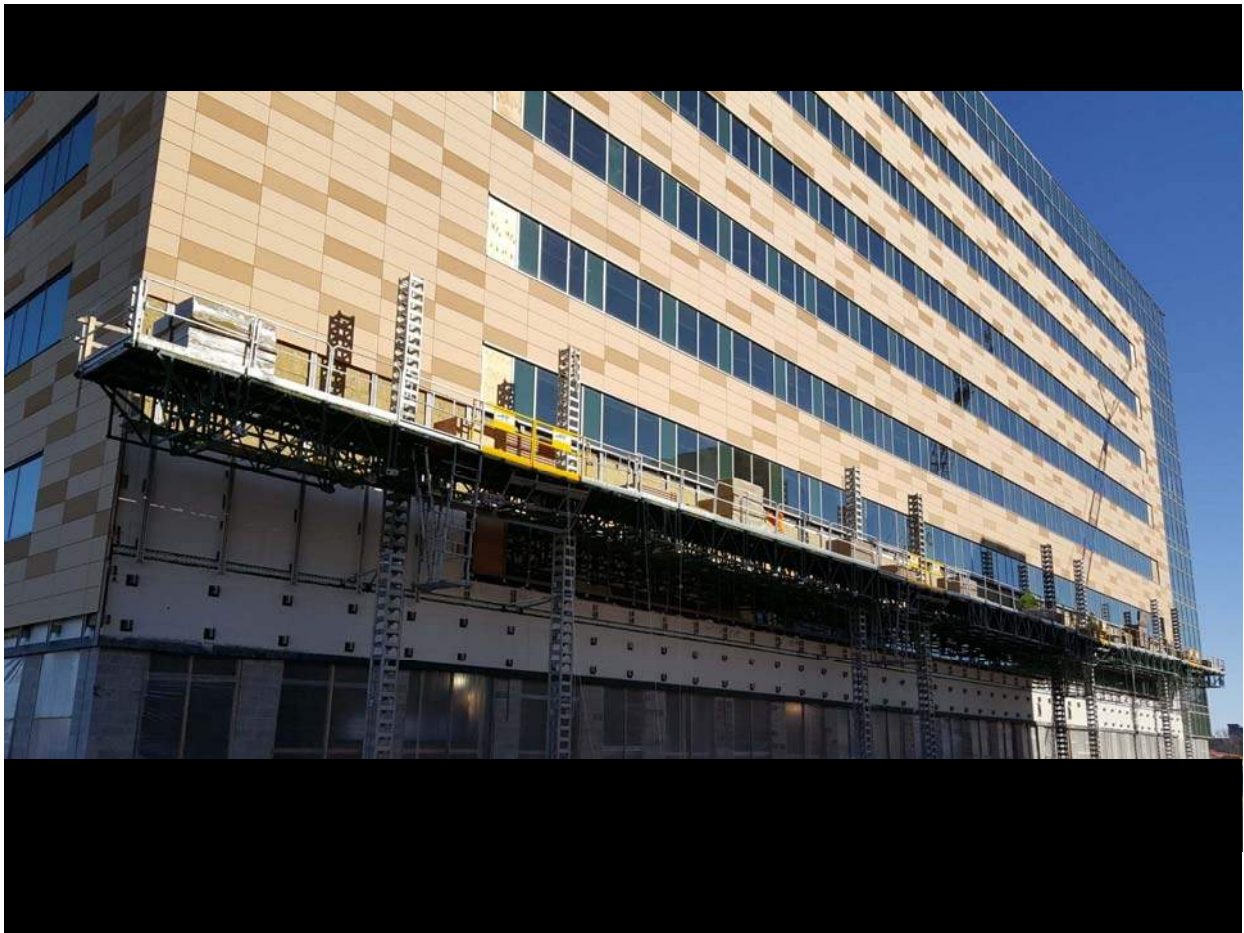












contemporary RSW



channel-anchored masonry recladding



re-clad of existing building



11-story high rise masonry loadbearing structure



St. Ann's Terrace Housing - Bronx, NY (2012)



St. Ann's Terrace Housing - Bronx, NY (2012)

frost wall case study⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾

CIP concrete

- 12" thick
- 22 days
- **\$223,000** (\$106 lin/ft)



CMU

- 12" CMU
- 12 days (proposed)
- **\$145,000** (\$69 lin/ft)

\$78,000 savings

35%



cold weather construction

- + 3 days
- + 7,000
- **\$152,000** (\$72 lin/ft)

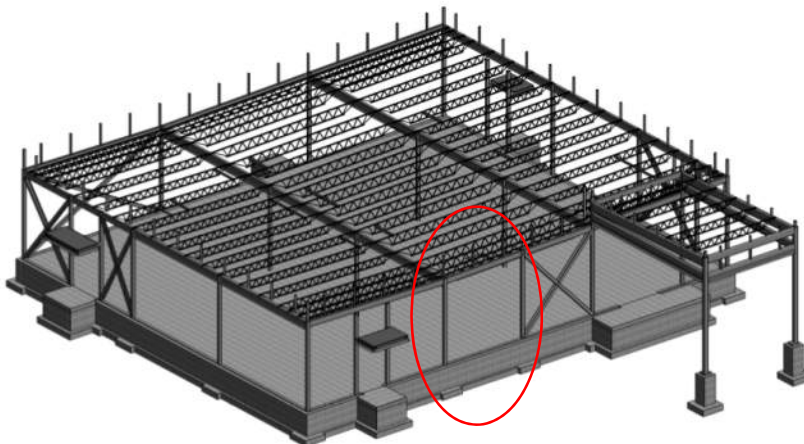
\$71,000 savings

32%

- (1) assisted living project, Brookfield, WI (2013)
(2) 2,100 lin/ft
(3) cold weather construction (January)
(4) wood frame walls, adhered masonry veneer



the real initial cost steel studs v. CMU



Metal Stud Backup Wall Initial Cost

- 1) Cost of column pads
- 2) Cost of column piers
- 3) Cost of poured-in-place concrete foundation
- 4) Cost of steel columns & beams
- 5) Cost of steel cross bracing
- 6) Cost of additional insulation

Loadbearing Masonry Backup Wall Cost

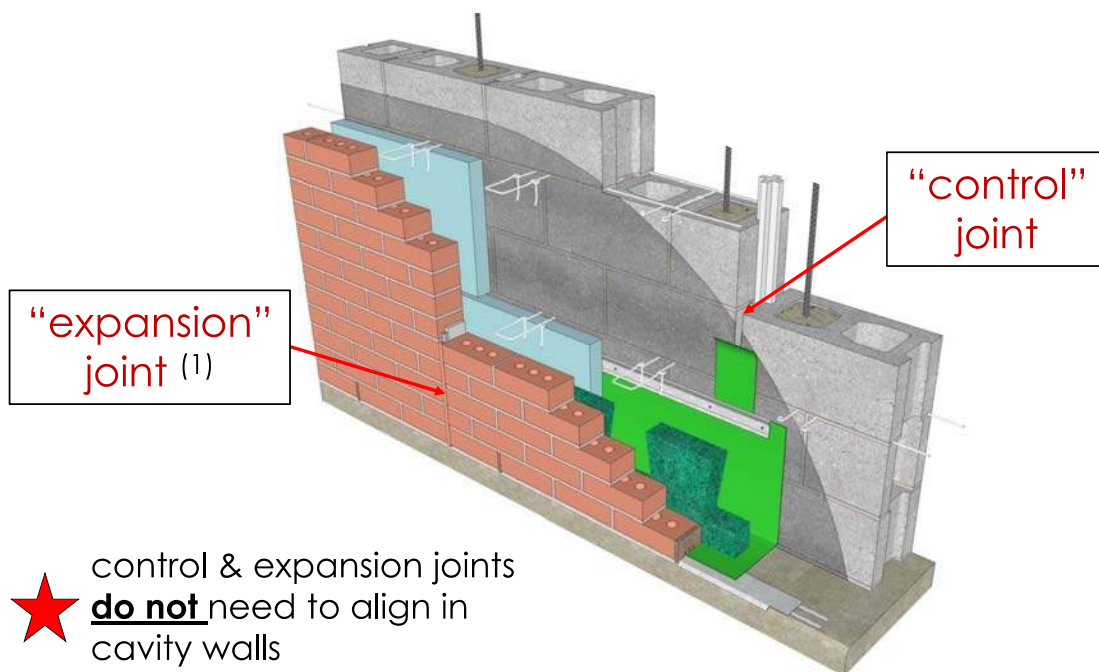
- 1) Straight/simple footings
- 2) CMU foundation walls (5 courses)
- 3) Cost of 6" or 8" CMU
- 4) possible interior furring/sheathing

CMU control joints



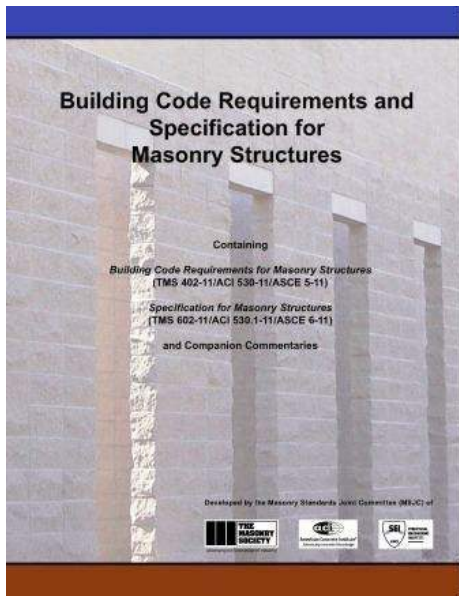
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masonry cavity wall



(1) in clay brick veneers

Who is responsible for locating movement joints?



MSJC, Section 6.1.6.3

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

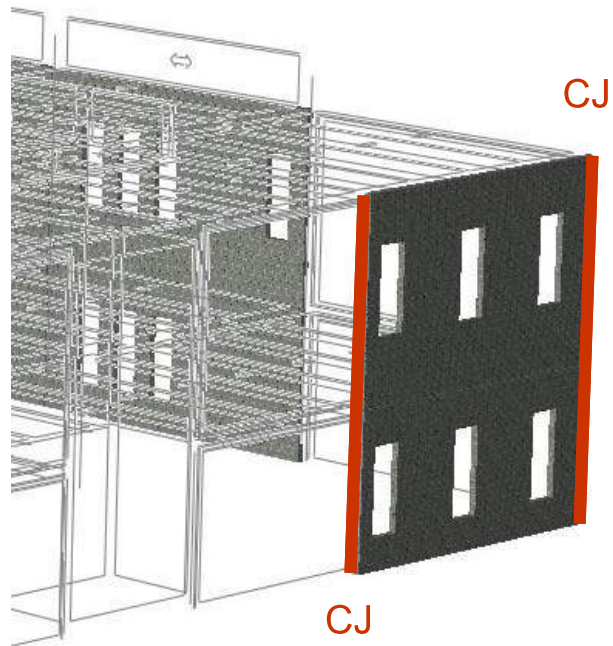
MSJC Mandatory Requirements Checklist – “Notes to Architect / Engineer”, Part 3, 3.3 D.6, page S-73

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

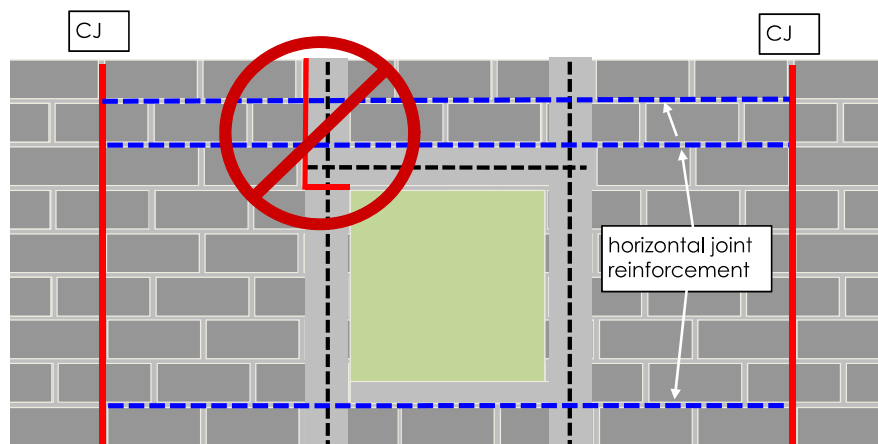


isolate structural element?

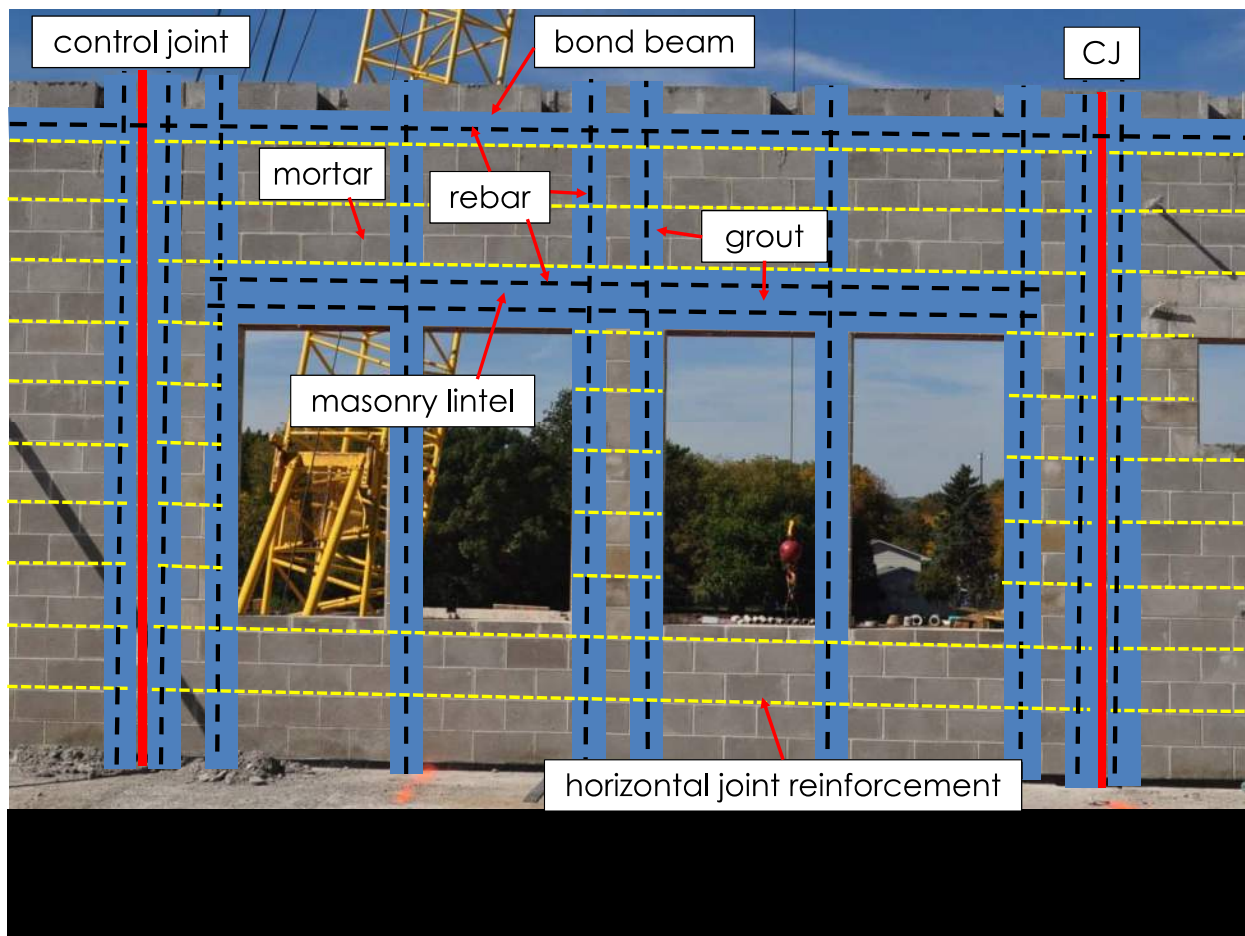
- bearing wall, not shear...
- vs
- shear wall
- also, isolate L-shaped (around corners) and t-sections more complicated



control joints in reinforced wall



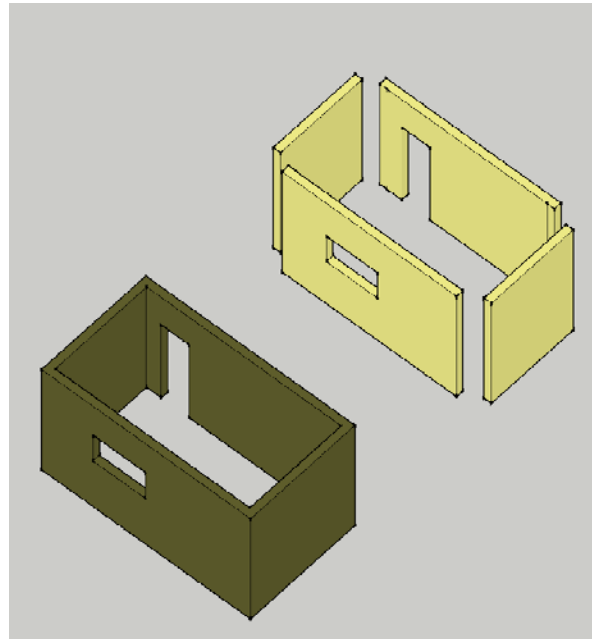
- opening strengthened with joint reinforcement, first two courses over opening and under sill
- potentially takes advantage of arching action





so use wall groups

- ❖ boxed wall groups
- ❖ (stair towers and elevator shafts)
 - ❖ have double the lateral load capacity over individual walls







masonry lintels



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masonry lintels



- fast
- economical
- matches wall
- moves at same rate of wall
- built-in-place or prefabricated
- easy to 6 - 10 feet
- longer spans possible
 - 12'-0" common in recent Detroit school prototype
 - recent example in WI: 52'-0"! long @ 12 courses high !

masonry lintel



masonry lintel



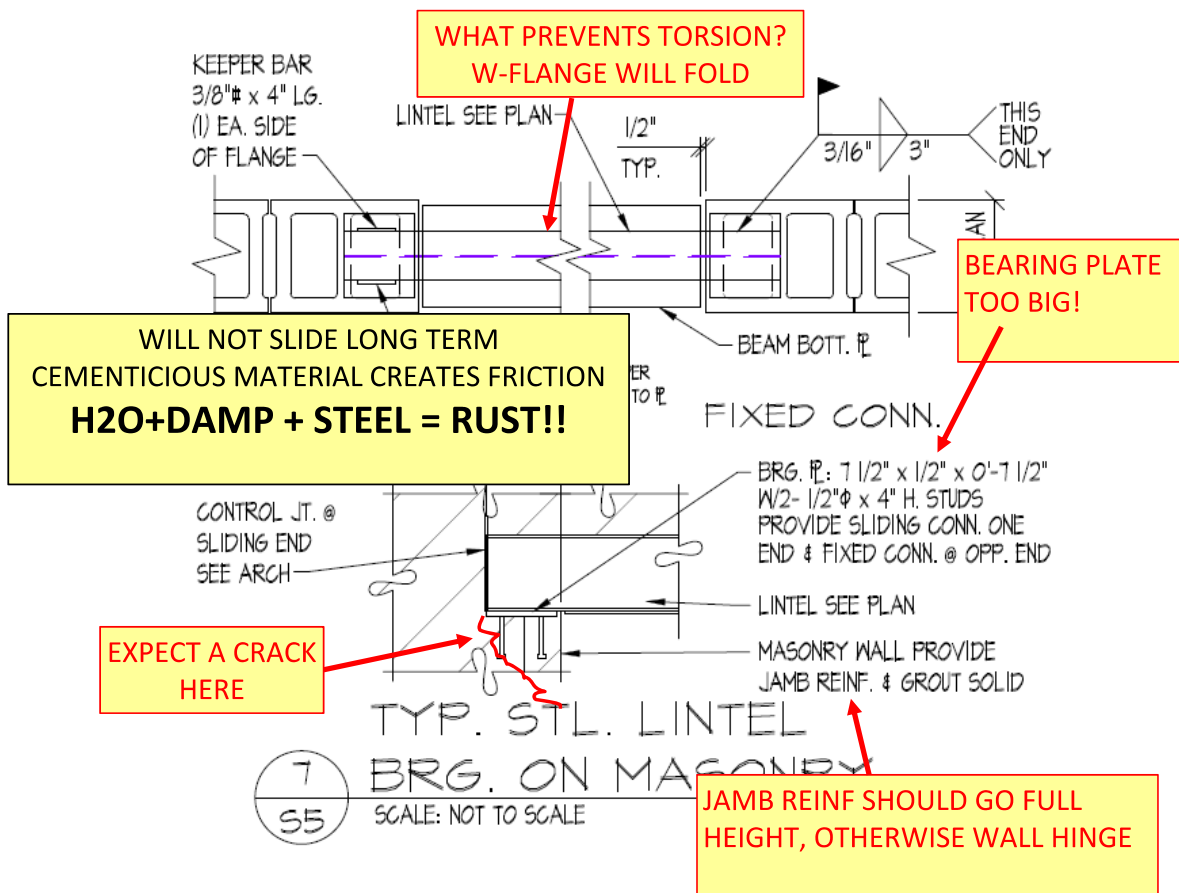
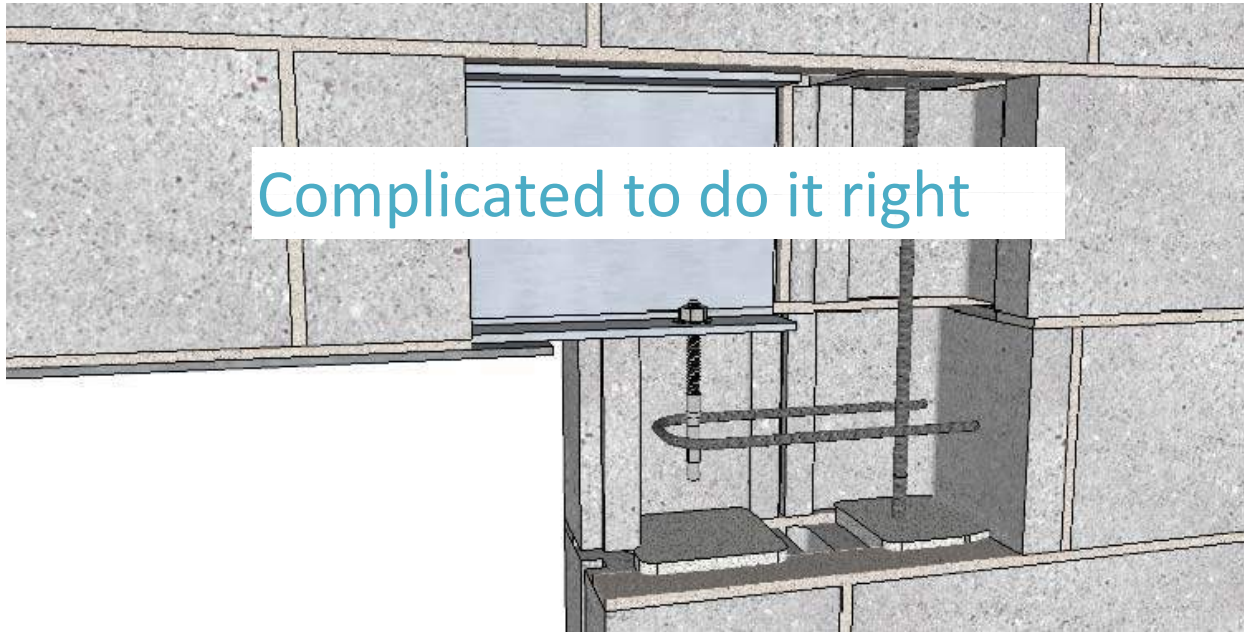
masonry lintel temporary support

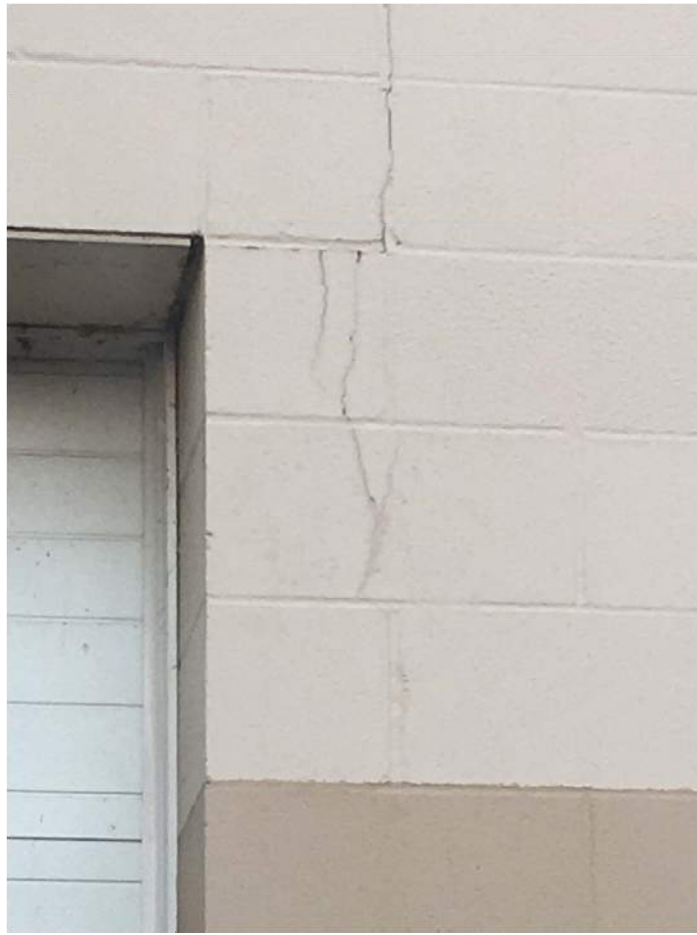


CJ not needed here!



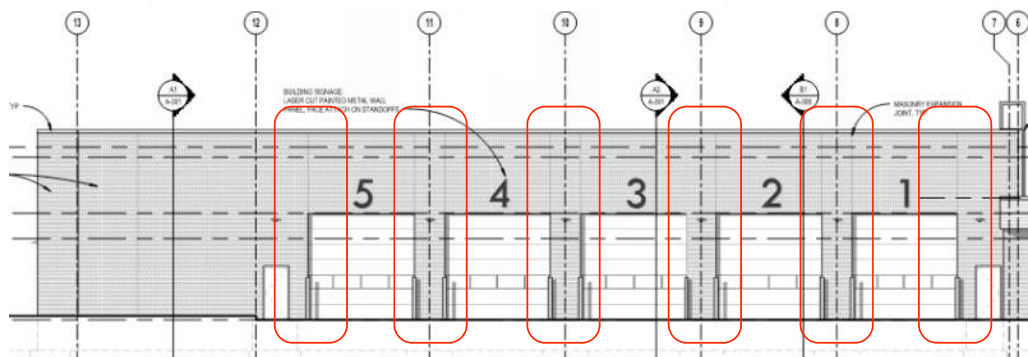
masonry lintels are integral with
masonry wall, creates a robust
efficient design





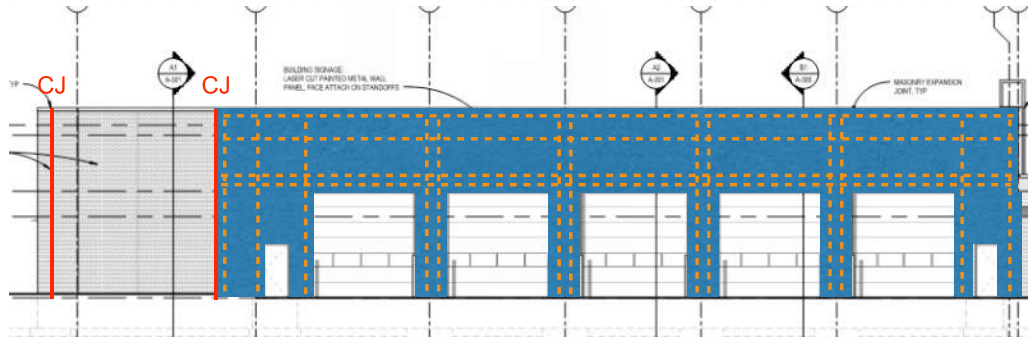
tips for control joints

MINIMAL AREA AT PIER TO PLACE CONTROL JOINTS



tips for control joints

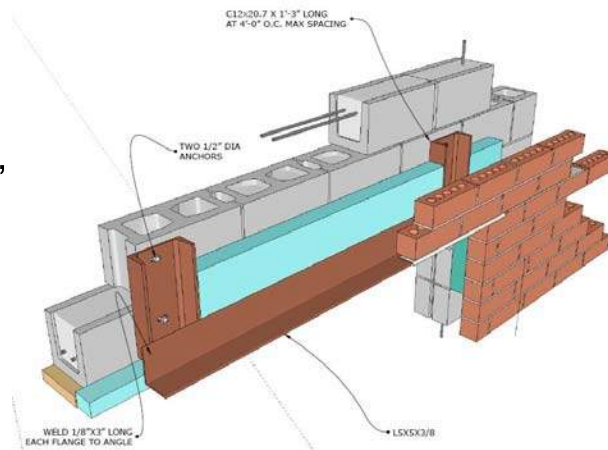
DESIGN AREA AROUND DOORS WITHOUT CONTROL JOINTS



THEN RESUME STANDARD PRACTICE FOR THE REST OF THE BUILDING

Lintel with thermal break

- With torsional capacity, masonry lintels allow us to use thermal "friendly" lintels





new products & solutions

- ❑ 6" CMU
- ❑ Insultech CMU
- ❑ prefabricated masonry



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6" CMU

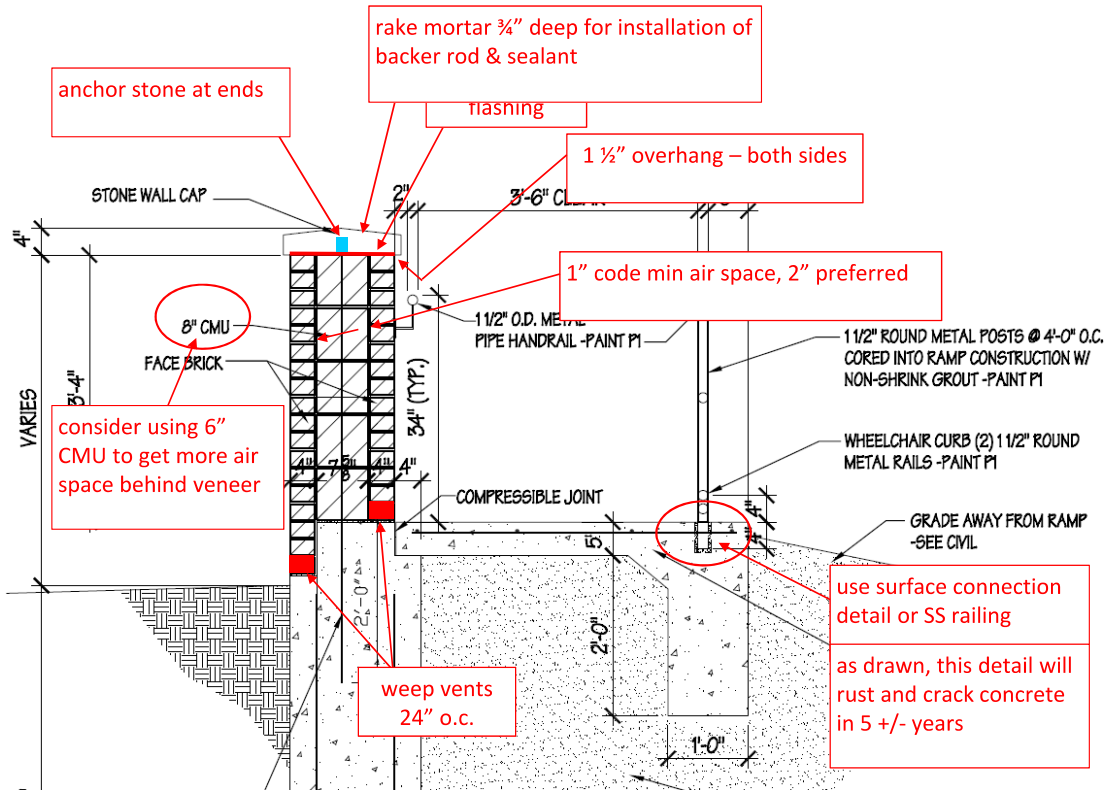


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6" CMU



- **thinner** wall profile
 - (interior space gains)
- **thinner** foundation
- **lighter** wall
- **lighter** for masons
- **more** room for insulation
- **more** air flow
- **sustainable** use of materials
- **less** material cost

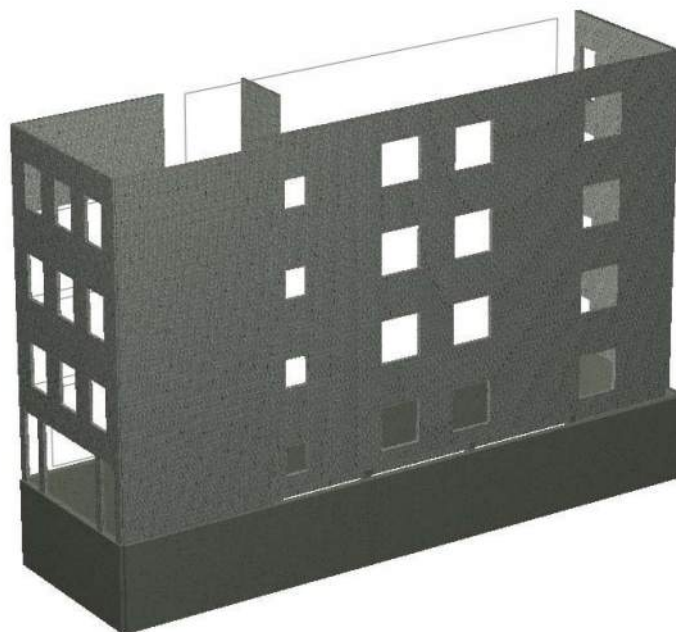


This plan and specification review is not intended to be comprehensive of all masonry details on this project. This document is intended for the use of industry professionals who are competent to evaluate the significance and limitations of the information provided herein. This publication should not be used as the sole guide for masonry design and construction, and IM disclaims any and all legal responsibility for the consequences of applying the information. It is important to note that details and construction methods are very site or geographic specific and area conditions may vary. The reviewer has not been able to visit the project site and therefore cannot verify the accuracy of the information provided. The reviewer has not been able to verify the accuracy of the information provided. The reviewer has not been able to verify the accuracy of the information provided. There are many typical details and practices, however, designers and contractors need to coordinate each detail with the unique elements of the building.

Masonry Detail Review for: [REDACTED] MN
by: International Masonry Institute



6" CMU @ Chicago rowhouse

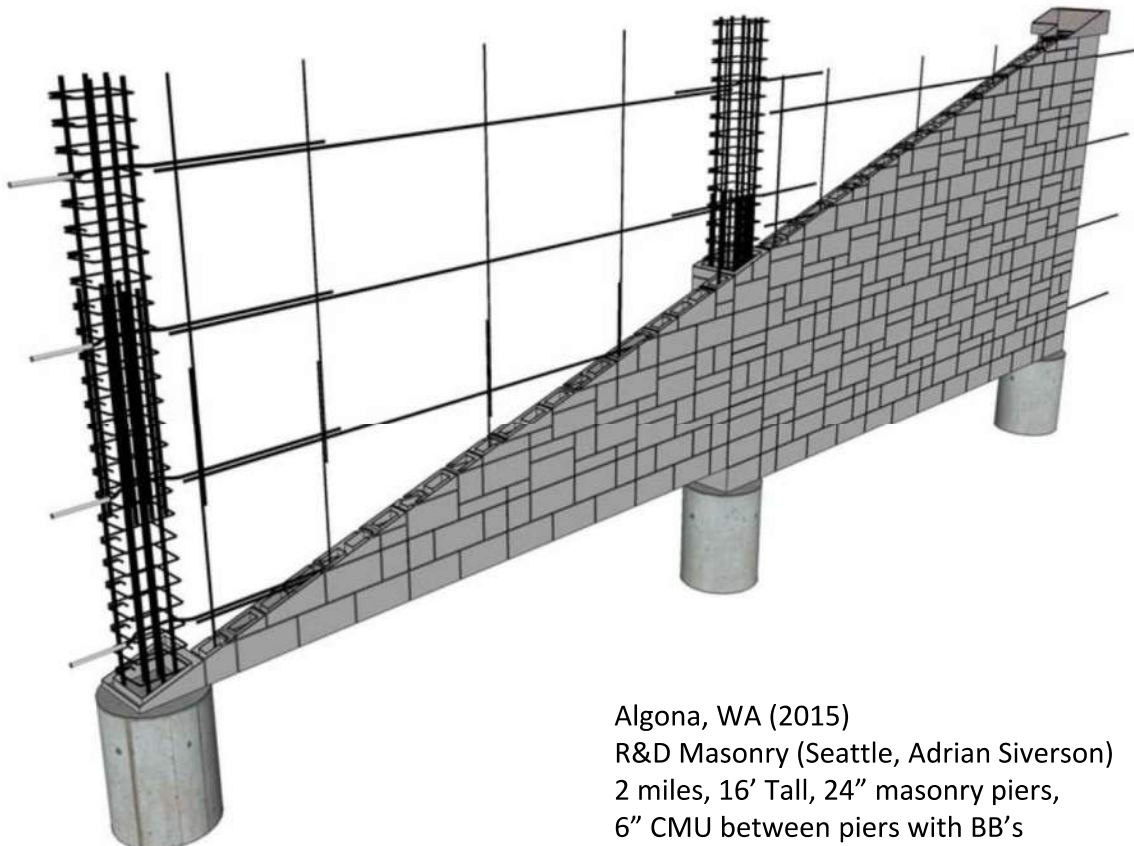
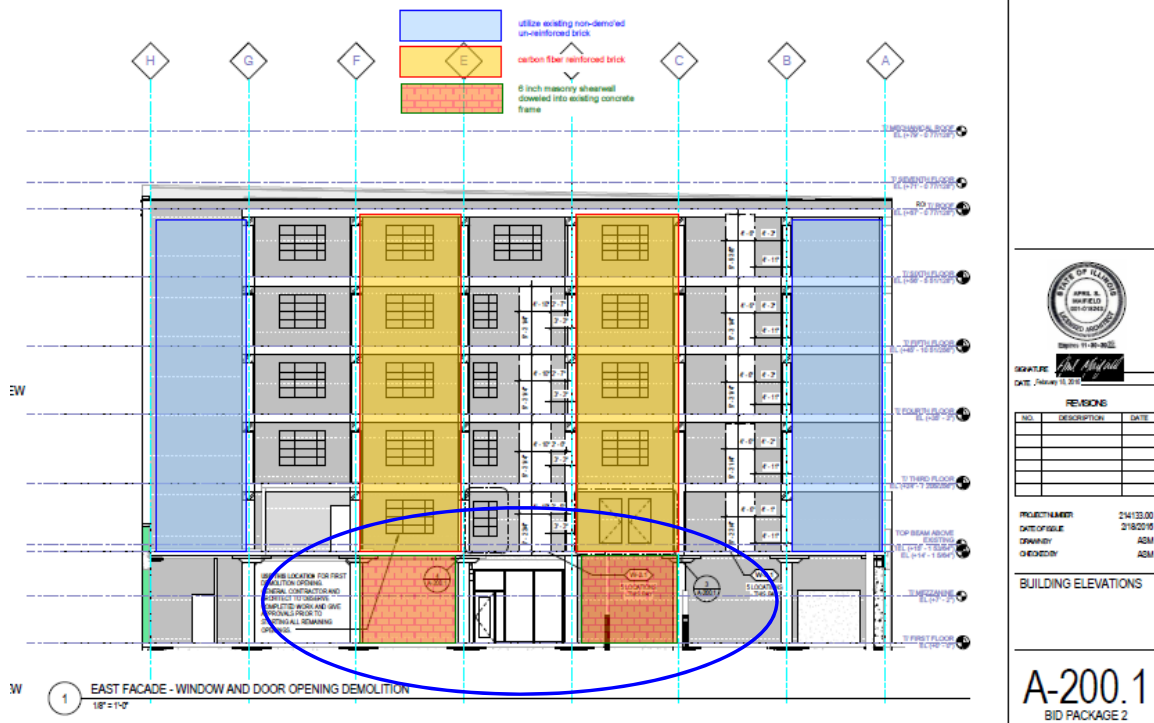


- 25' x 88', cavity wall front, single-wythe sides & back,
- 12'-0" floor-to-floor, precast plank bearing on wall
- #4 @ 72", multi-course masonry lintels



(May 2016)

retofit 6" CMU shear walls



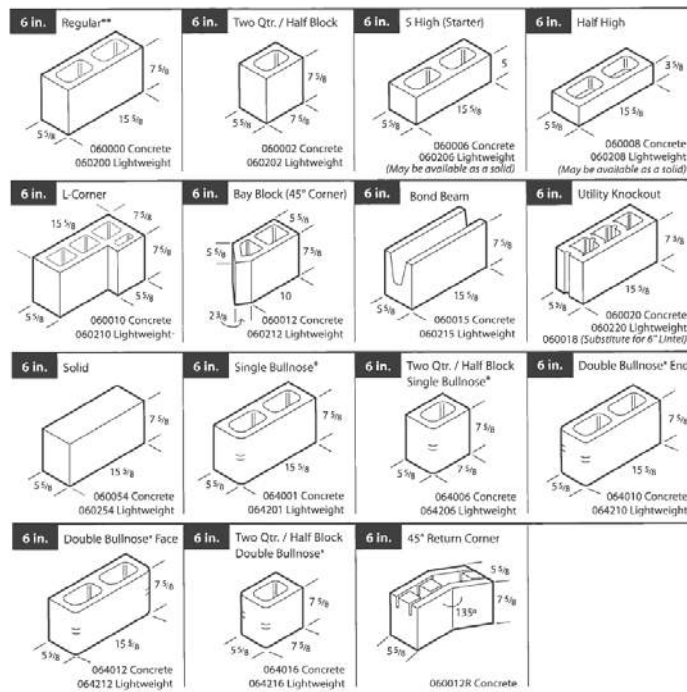
Algona, WA (2015)
R&D Masonry (Seattle, Adrian Siverson)
2 miles, 16' Tall, 24" masonry piers,
6" CMU between piers with BB's



6" CMU partition



SHAPES AND SIZES



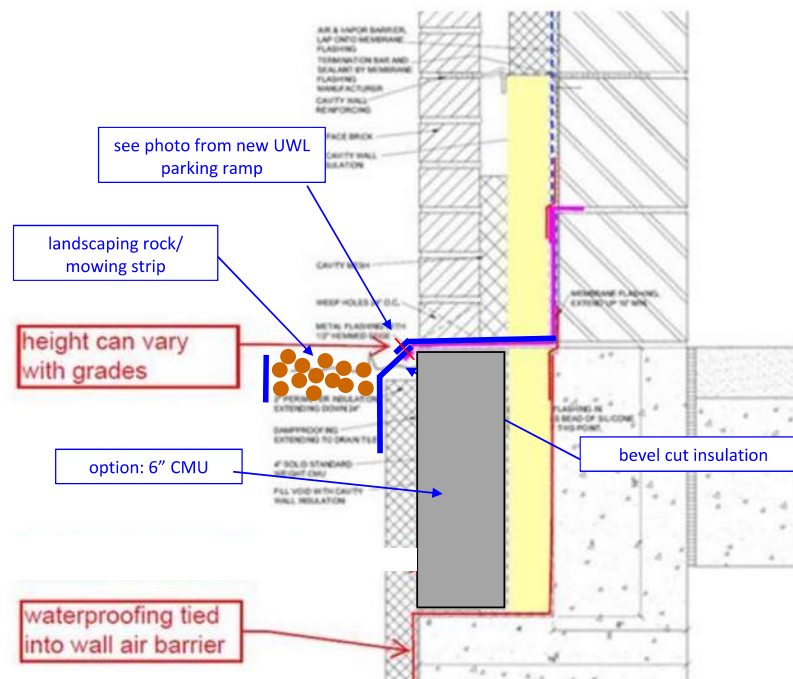
* All Bullnose have 1" radius.

Note: Not all block immediately available at all County Materials locations.

**** Full 6" high units available in select markets. Contact your sales representative.**



CONCRETE MASONRY PRODUCT GUIDE • www.countymaterials.com



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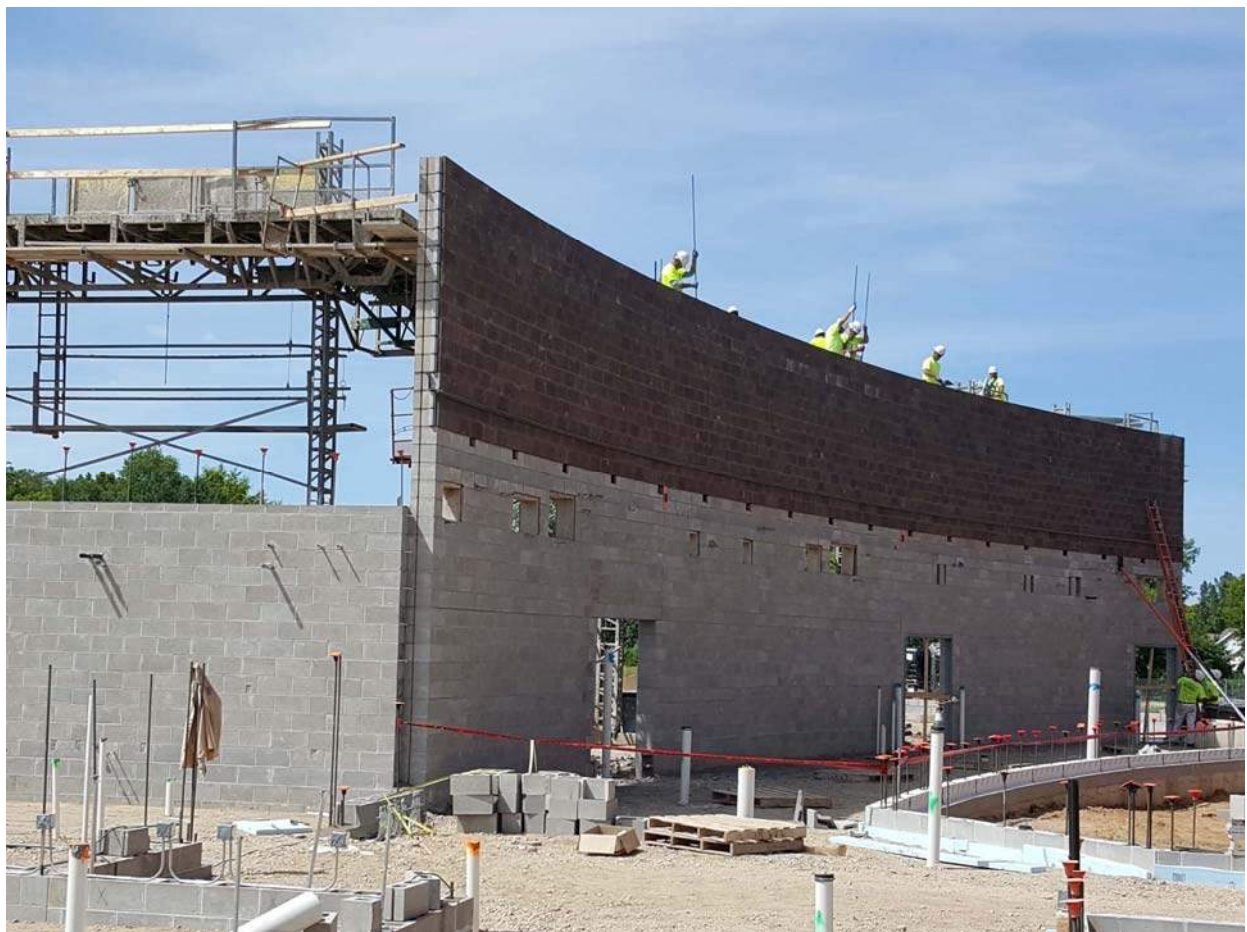
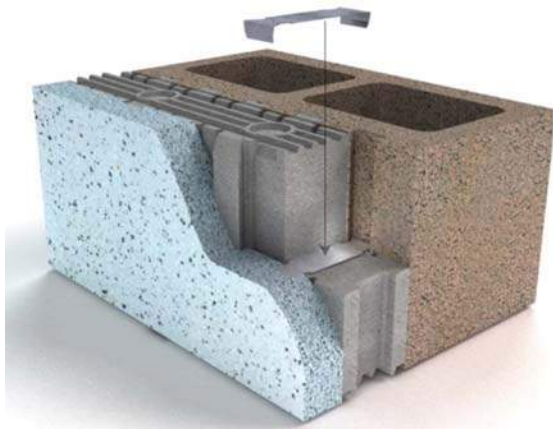
Insultech CMU

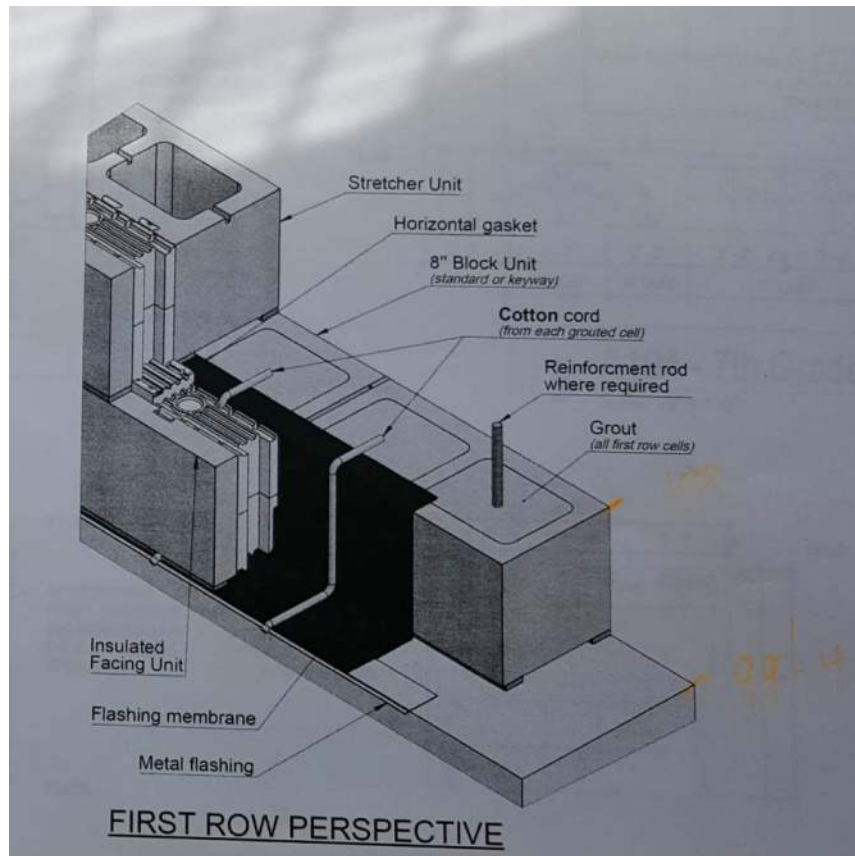


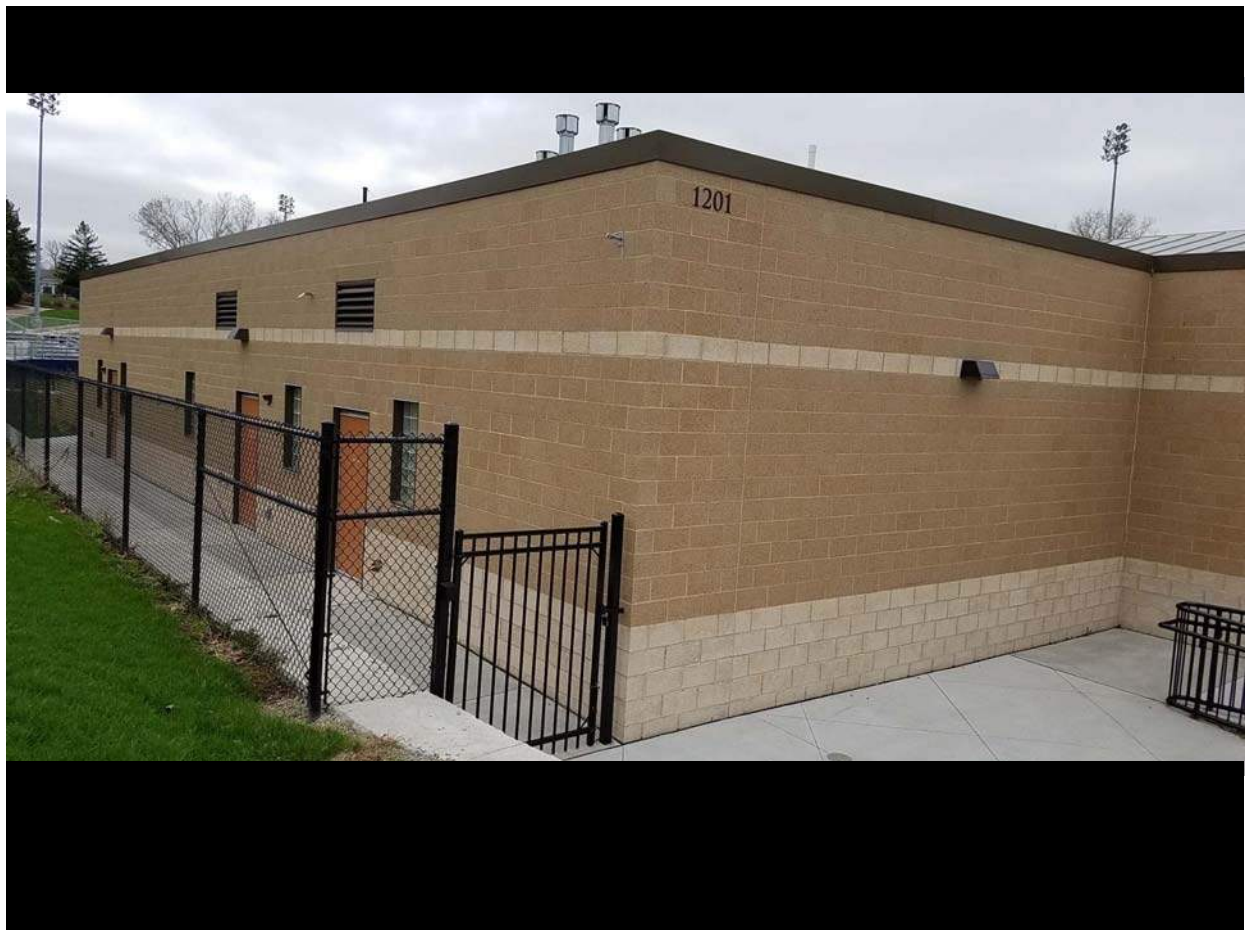


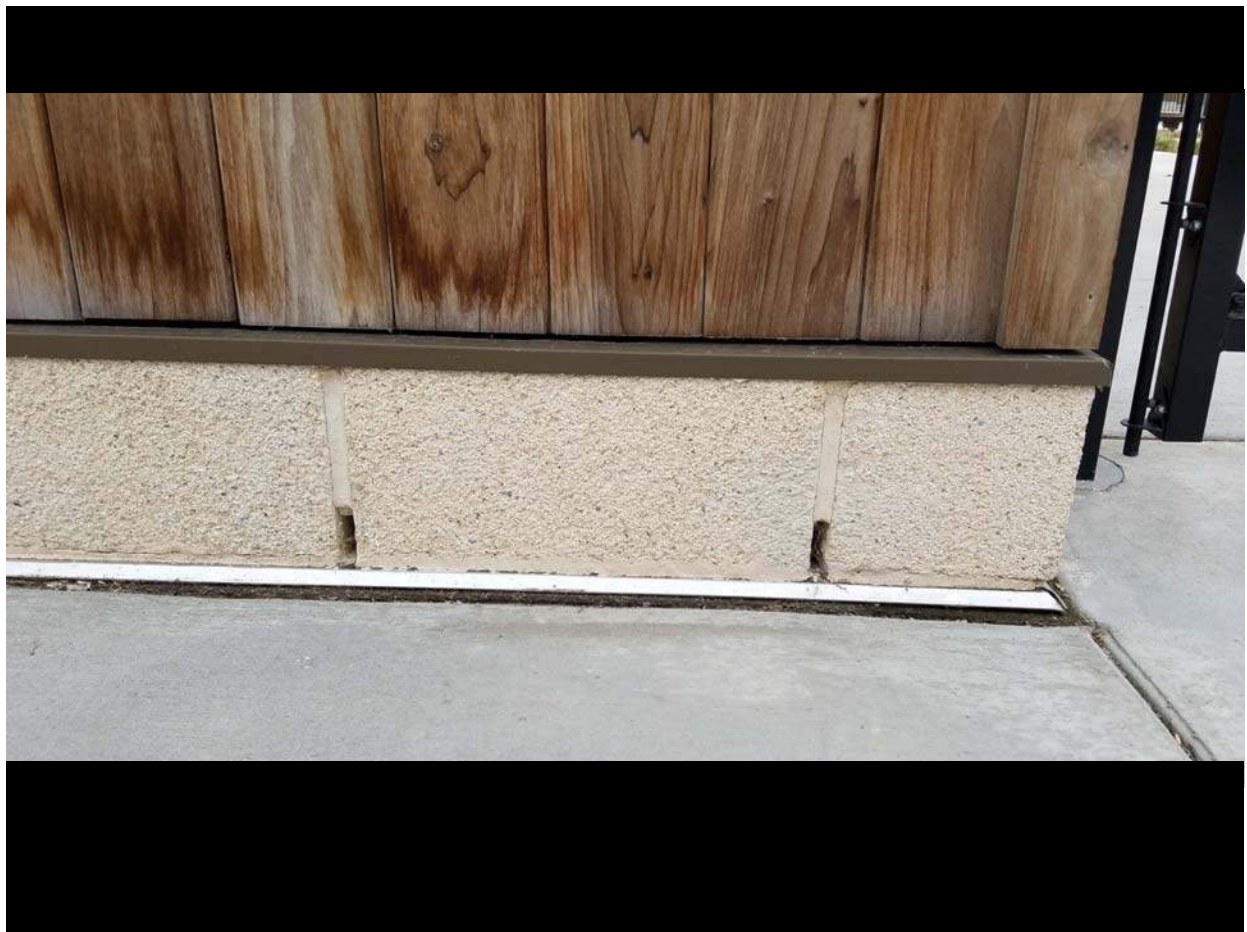
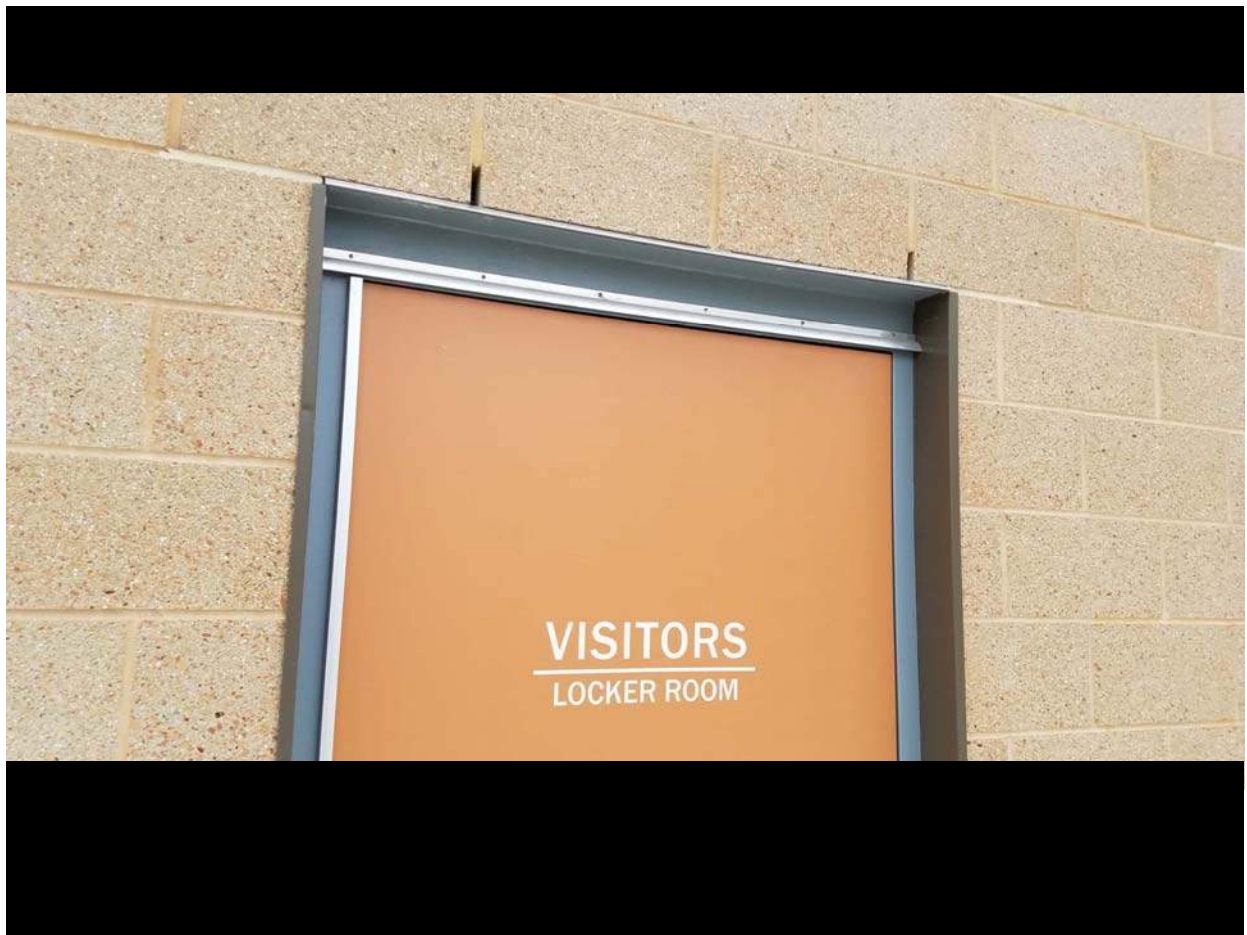
Lawrence University Banta Bowl Support Facility – Appleton, WI (2015)











prefabricated masonry



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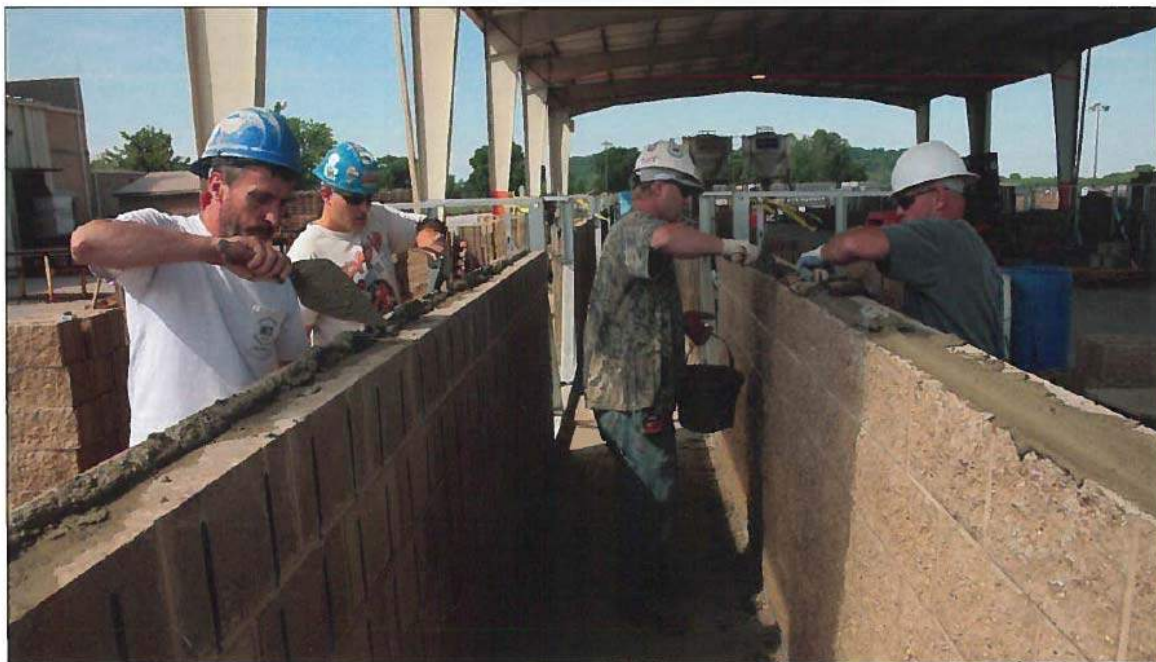
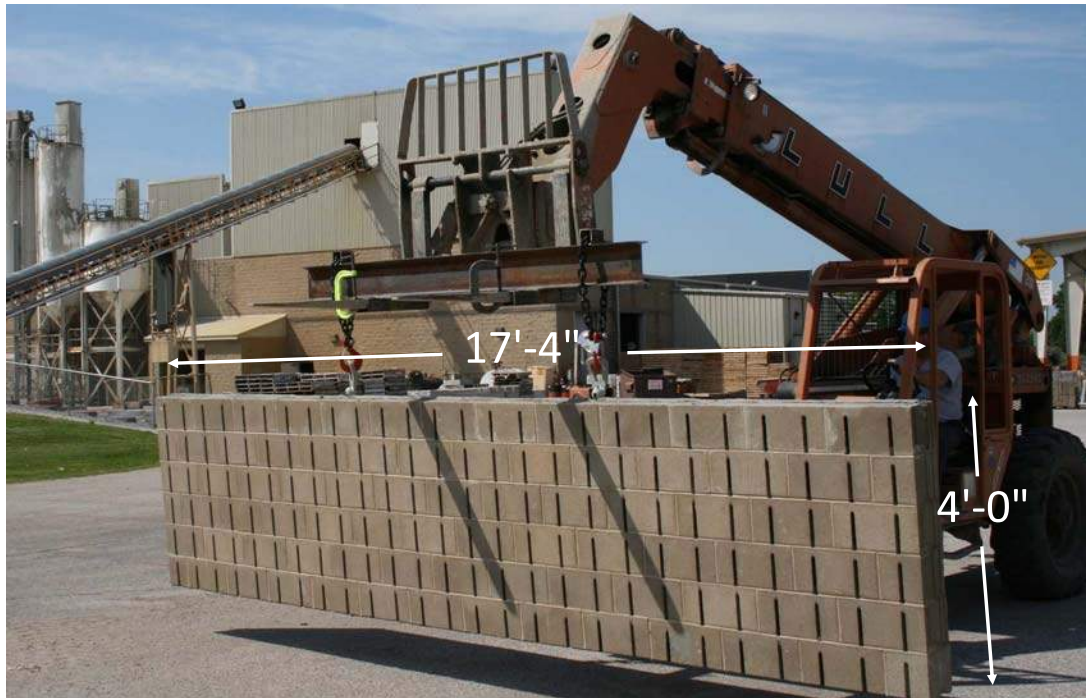




prefabricated masonry wall panels

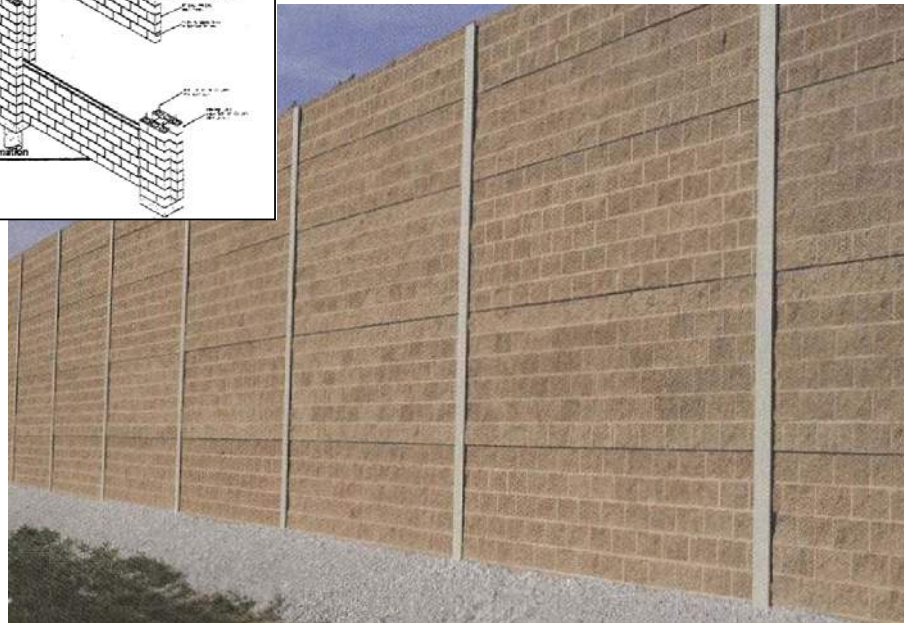
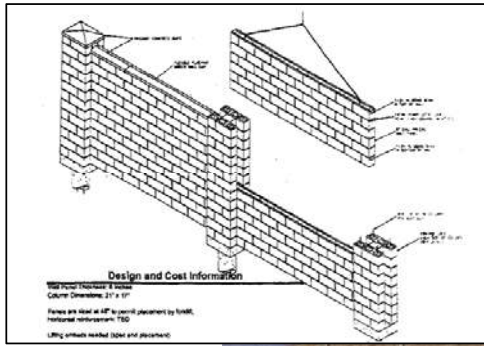


prefabricated CMU



Local 4 IN/KY members Wendell J. Flake and Eric Bowser, on the left wall, David Stierwalt, center, and Joe Myers assembling the walls.

prefabricated sound barriers (Indiana)



prefabricated CMU panels



prefabricated CMU panels



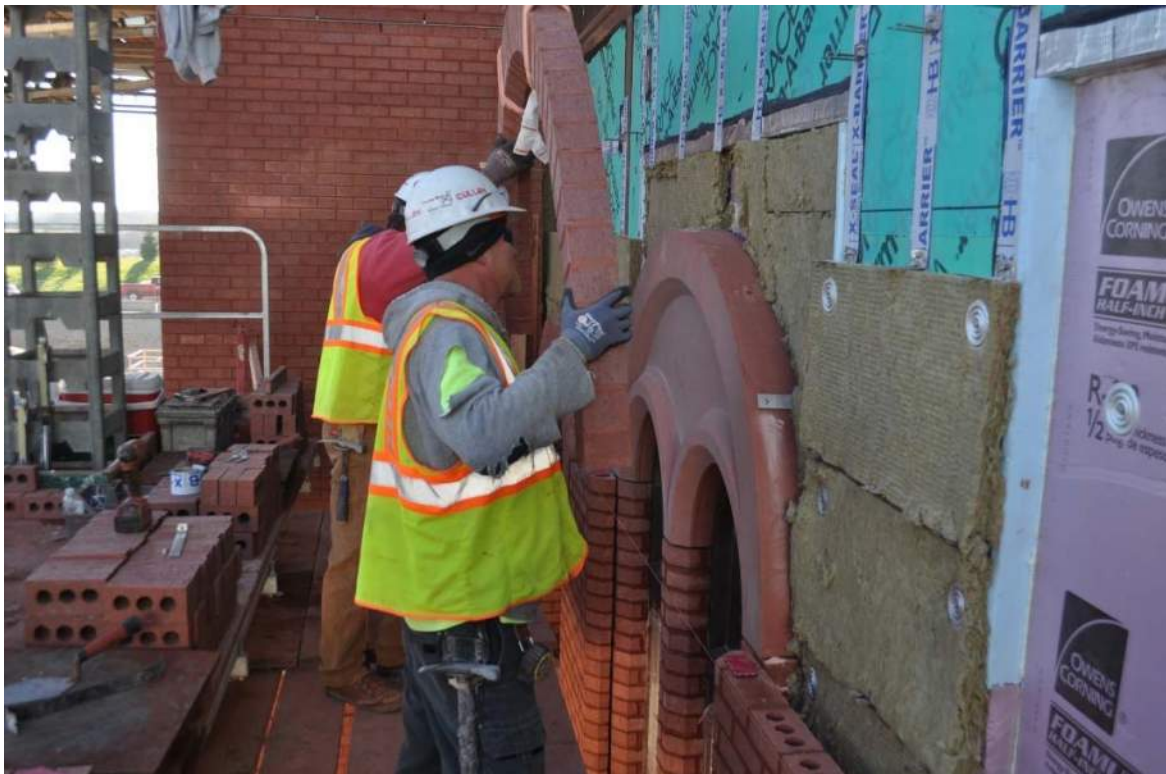
prefabricated masonry arches



prefabricated masonry arches



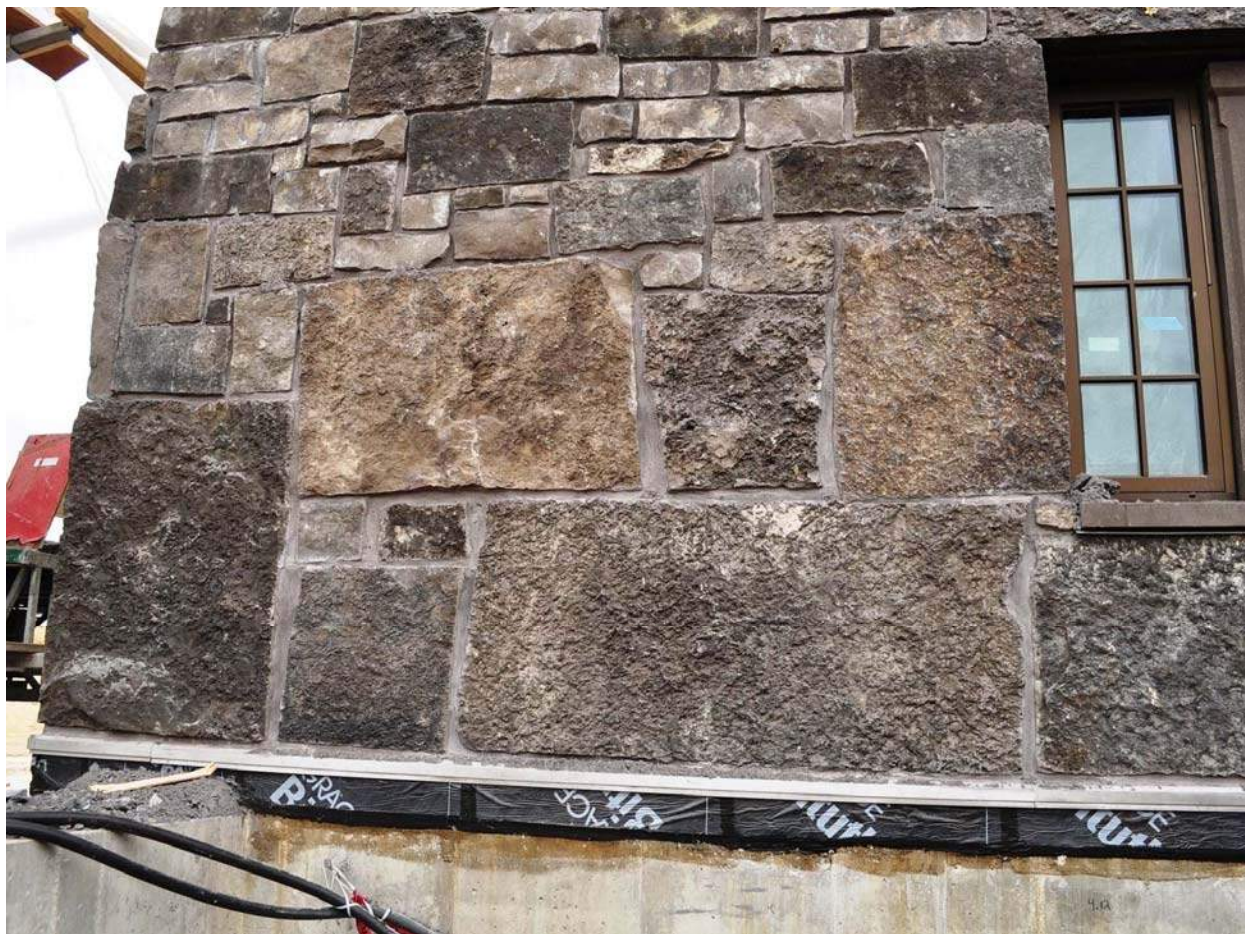
prefabricated masonry arches

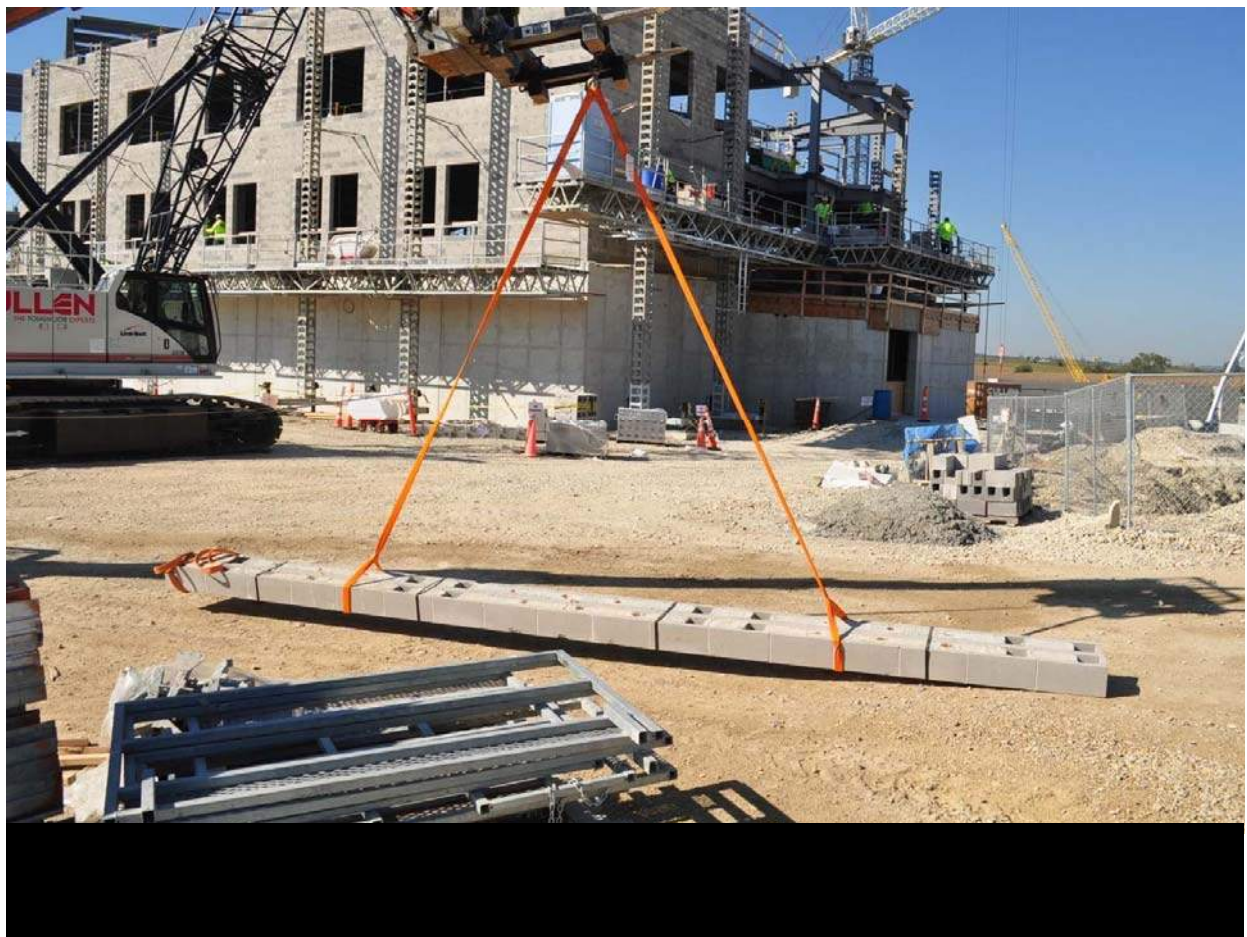


prefabricated masonry arches









prefab stair towers







prefabricated masonry chimney



interior partitions



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IMI masonry partition software – v2

imiweb.org/structural-solutions/masonry-partition-wall-software/

Masonry Partition Wall Design

Provided by: **team** INTERNATIONAL MASONRY INSTITUTE EDUCATION PROVIDER

This program is intended as a preliminary design tool for design professionals who are experienced and competent in masonry design. This program is not intended to replace sound engineering knowledge, experience, and judgment. Users of this program must determine the validity of the results. The International Masonry Institute assumes no responsibility for the use or application of this program.

Wall Side View
 Concentrated Load
 Uniform Load
 Seismic Load
 Design Status: Good

Calculate/Report
 Set all parameters to default values

Information
 • Background
 • Reinforced Example
 • Unreinforced Example

Masonry Partition Wall Design

General:
 Project:
 Designer:
 Notes:
 Code:
 - 2015 IBC (2013 TMS 402/602)
 - 2012 IBC (2011 TMS 402/602)
 - 2009 IBC (2008 TMS 402/602)

Masonry Specifications

Masonry Type:
 Solid
 Nominal Thickness:
 4" 6" 8" 10" 12"
 Specified Masonry Compressive Strength (f_m): 2500 psi
 Automatic Uncheck Automatic for manual input
 Type N Masonry Cement
 Type S Masonry Cement
 Type N Portland Cement Lime or Mortar Cement
 Type S Portland Cement Lime or Mortar Cement

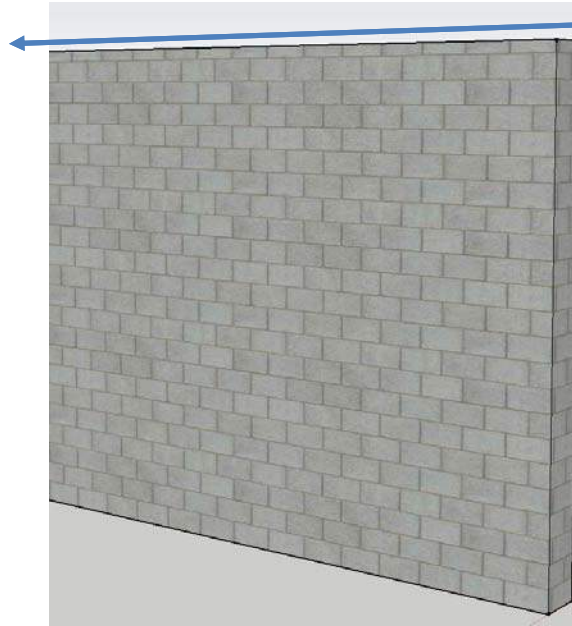
Wall Properties

Bond Pattern:	Running Bond	Not Running Bond
Grout Spacing:	none	inches
Rebar Spacing:	1/2	inches
Actual Thickness:	8.0	inches
Net Area:	8.0	ft ²
Section Modulus:	72	ft ³
Weight:	56	pcf
Check Automatic bond	Automatic	

shear wall

MSJC 2013

- resists shear in plane lateral shear loads
- in seismic regions, we need to classify as:
 - ordinary plain
 - detailed plain
 - ordinary, intermediate, or special reinforced shear walls



Masonry shear walls for seismic loads IBC – seismic wall characteristics

- **Ordinary Reinforced Section - 1.17.3.2.4 (summary)**
 - at least #4 vertical reinforcement within:
 - 16" of edge of opening and within last 8" of wall ends
 - 2-W1.7 horizontal joint reinforcement at 16" o.c.
 - reinforcement top and bottom of openings $\geq 16"$
 - extend 24" past opening, nor less than $40d_b$
 - reinforcement within 16" of top of walls
 - based on ASD or SD
- **Intermediate Reinforced - Section 1.17.3.2.4 (summary)**
 - all requirements of Ordinary Reinforced
 - and vertical reinforcement no further apart than 48" o.c.
- **Special Reinforced - Section 1.17.3.2.4 (summary)**
 - all requirements of Ordinary Reinforced
 - and reinforcement no further than 48" o.c. vertically and horizontally **and much, much more**

partition wall

MSJC 2013

- an interior wall without structural function
- based on MSJC 2013, new chapter 7, need to ensure no in-plane forces enter wall which are not accounted for



interior partition walls

$f'_m = 2250 \text{ psi}$, mortar cement
 IBC min load - 8psf in new code (5 psf loading old code)
 SDC A, B

	10 ft	12 ft	14 ft	16 ft	18 ft	20 ft	24 ft	30 ft
6 inch				#4 @ 96	#4 @ 96	#4 @ 72	#4 @ 40	#5 @ 24
8 inch						#4 @ 96	#5 @ 96	#5 @ 48
10 inch								#4 @ 96
12 inch								#4 @ 96
16 inch								

interior partition walls

f'm=2250psi, mortar cement
IBC min load - 8psf in new code (5 psf loading old code)

	10 ft	12 ft	14 ft	16 ft	18 ft	20 ft	24 ft	30 ft	
6 inch				#4 @ 96	#4 @ 96	#4 @ 72	#4 @ 40	#5 @ 24	
8 inch						#4 @ 96	#5 @ 96	#5 @ 48	
10 inch									#4 @ 96
12 inch									#4 @ 96
16 inch									

interior partition walls

f'm=2250psi, mortar cement
IBC min load - 8psf in new code (5 psf loading old code)

[illegible]

interior partition walls

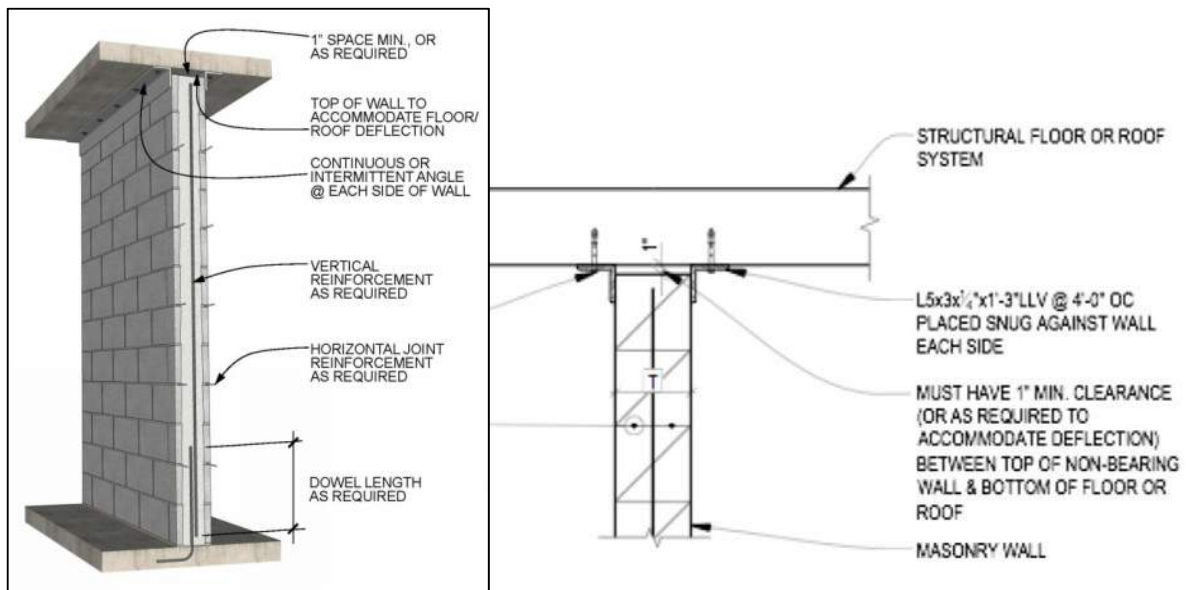
$f'm=2250$ psi, mortar cement
IBC min load - 8psf in new code (5 psf loading old code)

	10 ft	12 ft	14 ft	16 ft	18 ft	20 ft	24 ft	30 ft
6 inch	#4@48	#4@48	#4@48	#4 @ 48	#4 @ 48	#4 @ 48	#4 @ 40	#5 @ 24
8 inch	#4@48	#4@48	#4@48	#4@48	#4@48	#4 @ 48	#5 @ 48	#5 @ 48

solid grout and min horiz reinf at 24'

16 inch	#4@48	#4@48	#4@48	#4@48	#4@48	#4@48	#4@48	#4@48
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continuous light-gauge angle



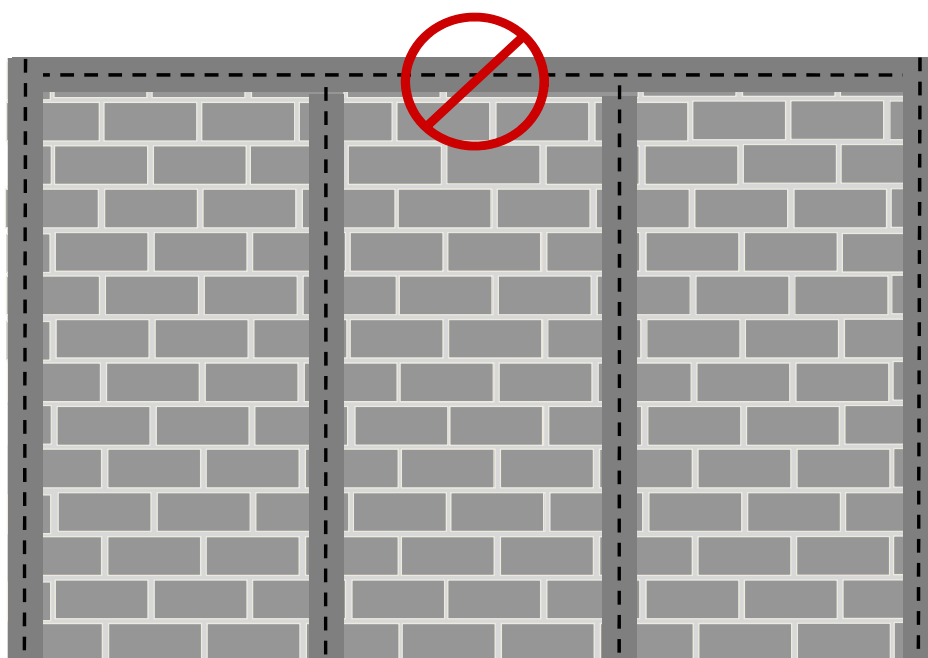
LATERAL SUPPORT OF NON-LOAD BEARING MASONRY PARTITION



SCALE : NTS

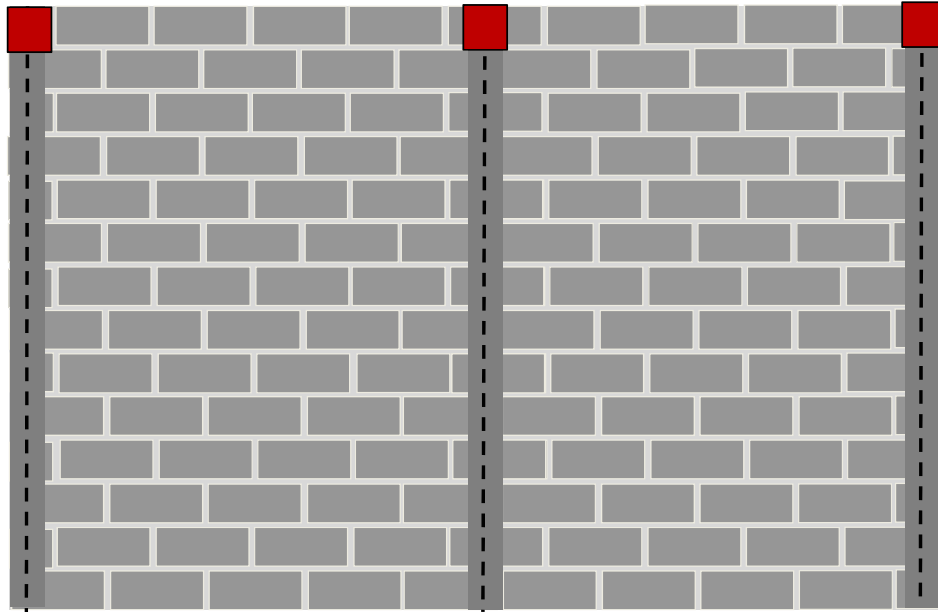


interior partitions



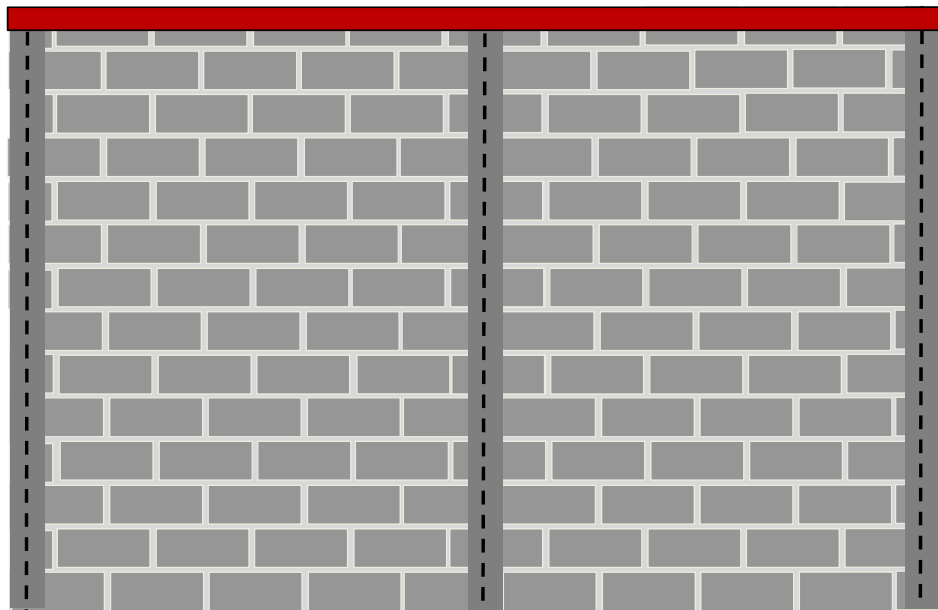
interior partitions

option #1: clip angles @ reinforced cells

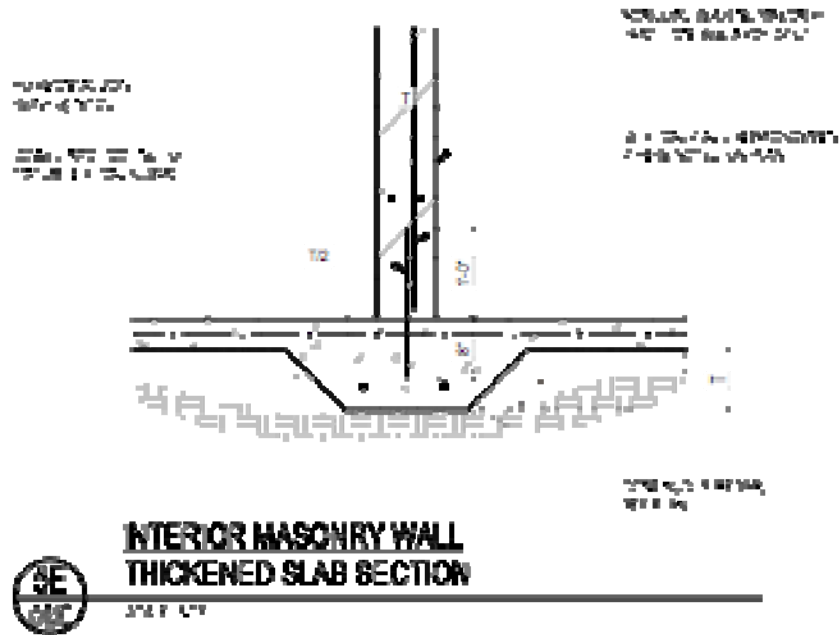


interior partitions

option #2: light-gauge continuous angle



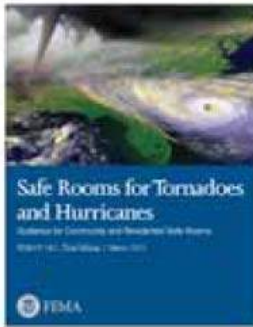
what's needed at the base?



storm shelters



FEMA P-361 & ICC 500



FEMA P-361 is a FEMA document providing guidance for safe room design –

“There has not been a single reported failure of a safe room constructed to FEMA criteria.”

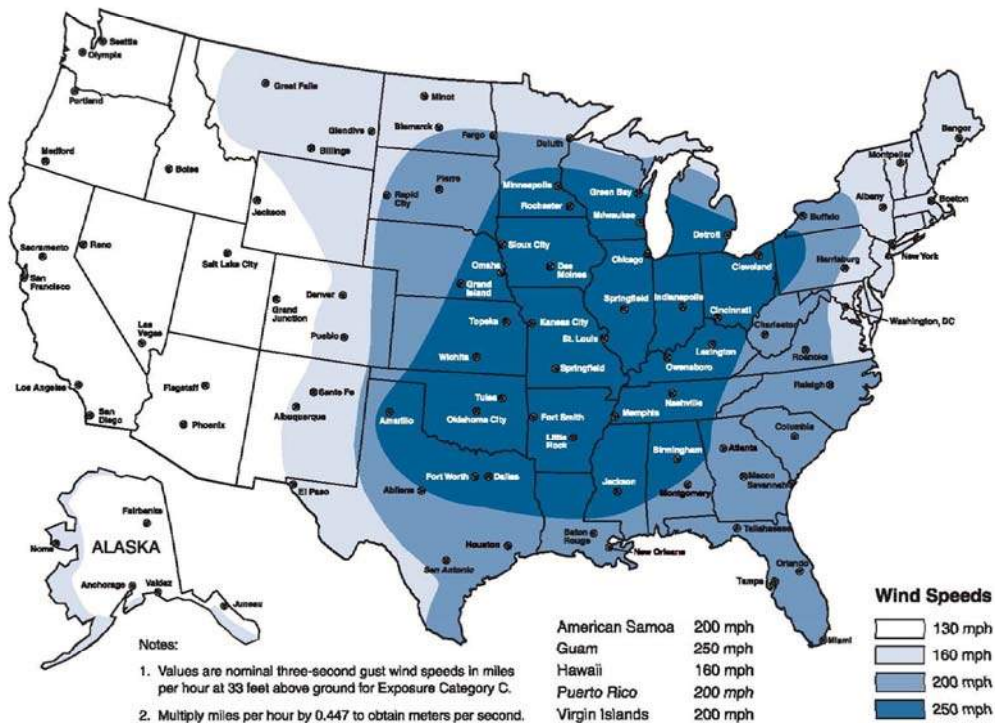
ICC 500 is a standard for storm shelter design and construction and is adopted by reference in the IBC.

- ICC 500-2014 is referenced in the IBC 2015
- Update to previous ICC 500-2008
- Contains the requirements for storm shelters



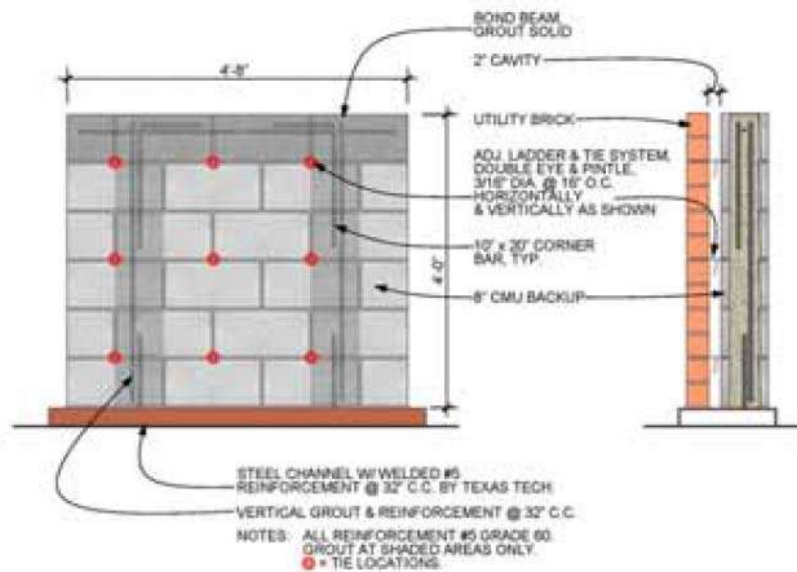
3-8

Figure 3-1. Tornado Safe Room Design Wind Speed Map (consistent with ICC-500 Tornado Hazard Map)

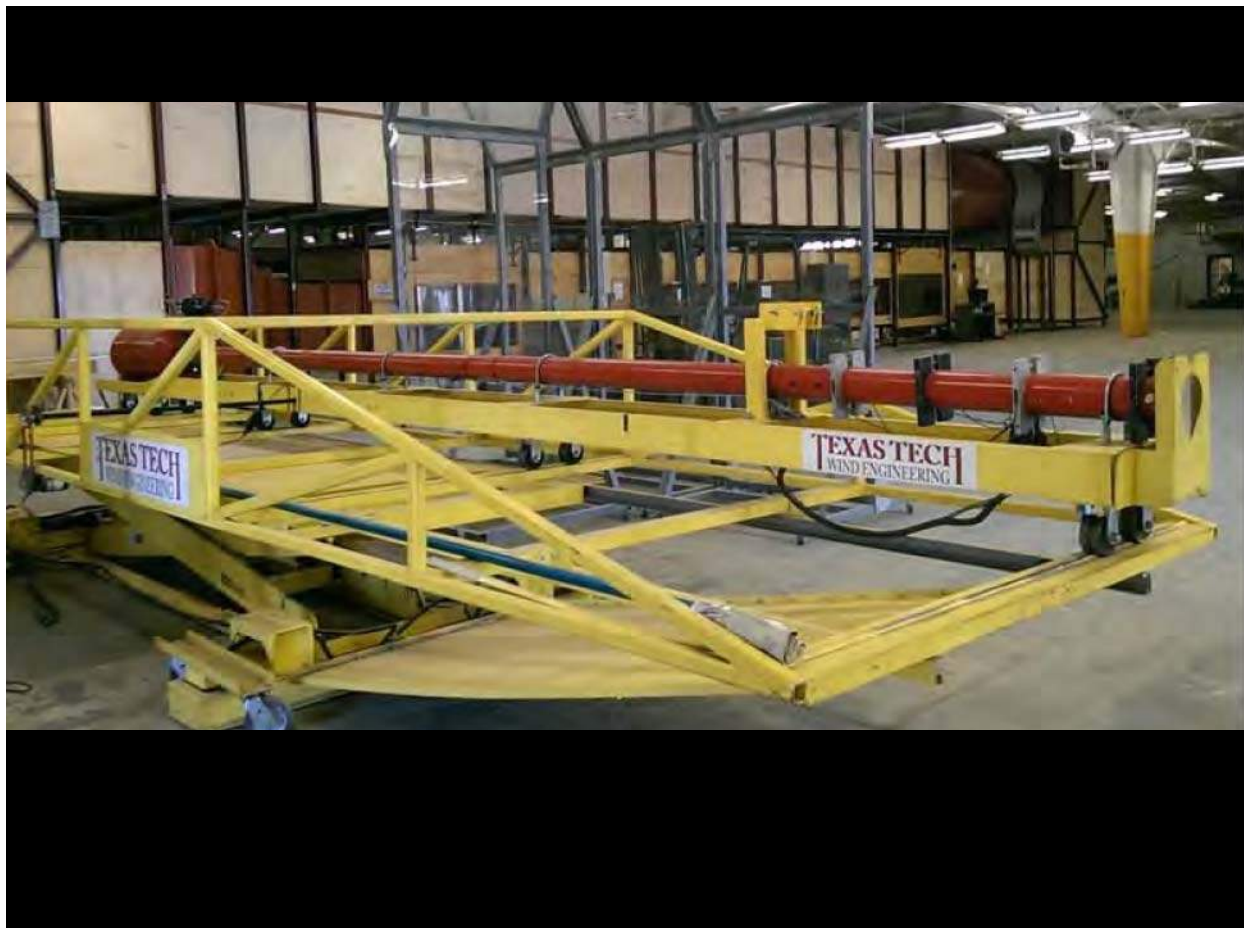


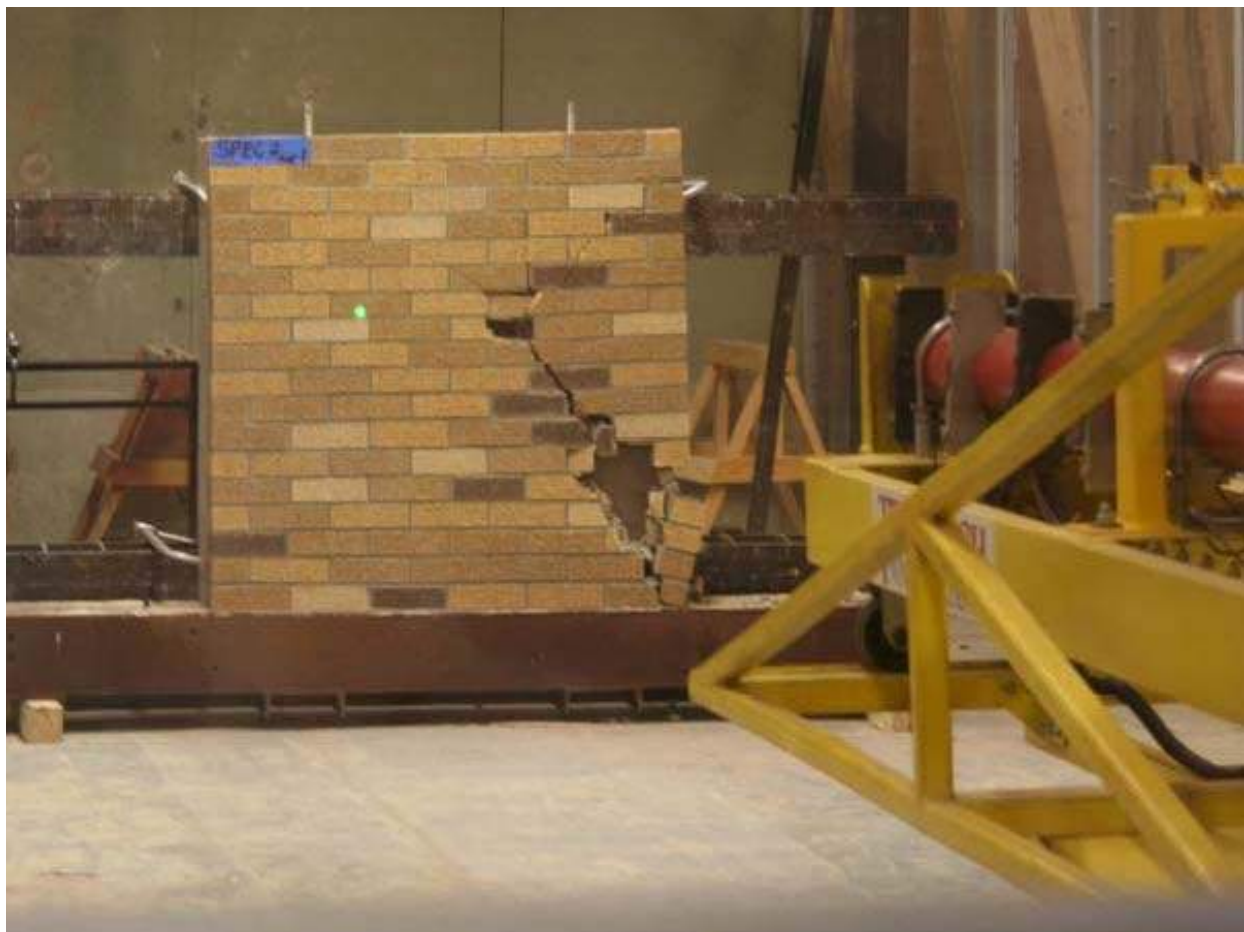
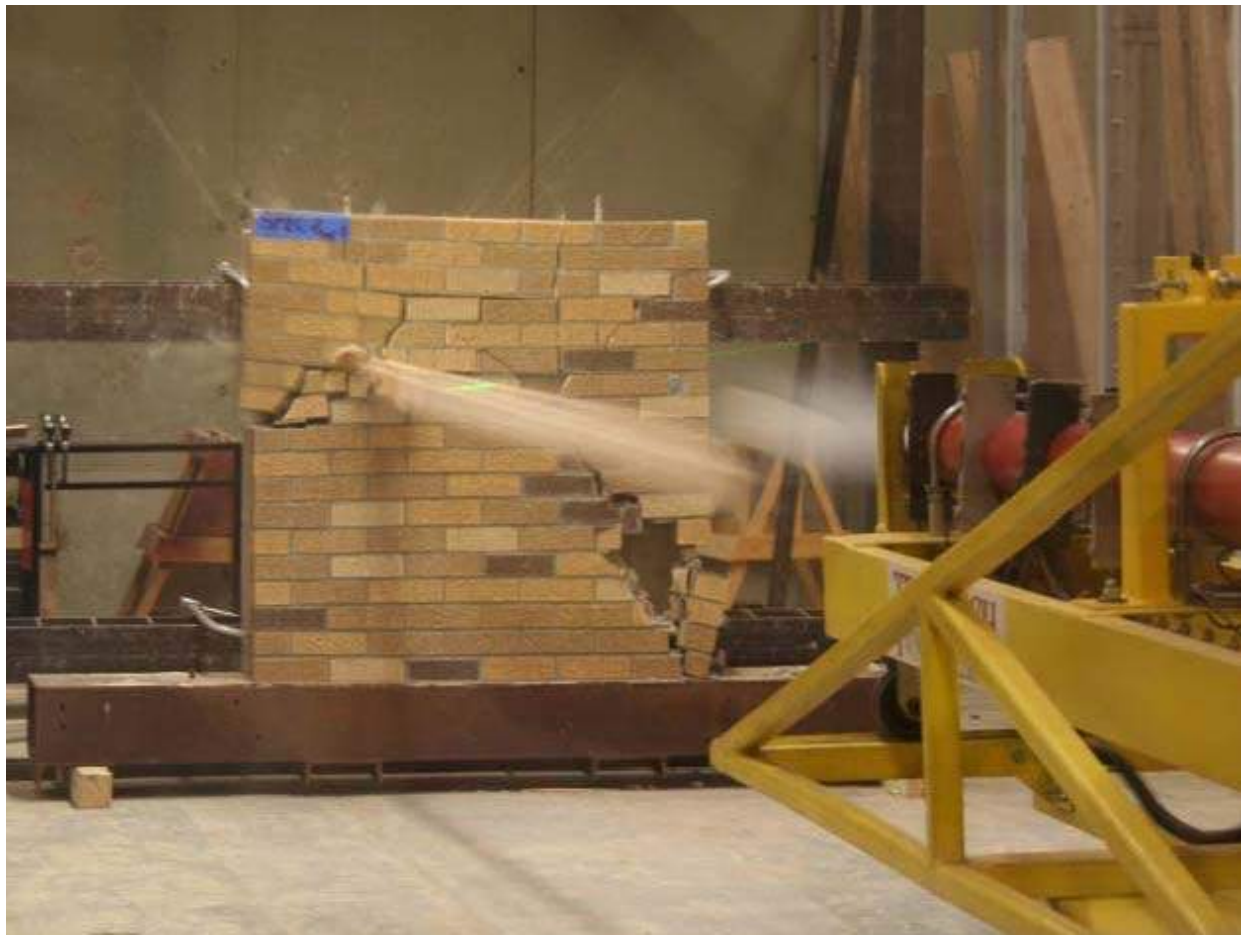
Tornado Missile Testing – Masonry Cavity Walls (Specimen 1)

Clay brick, utility size; 2" cavity;
8" CMU back-up partially grouted & reinforced at 32" c/c.



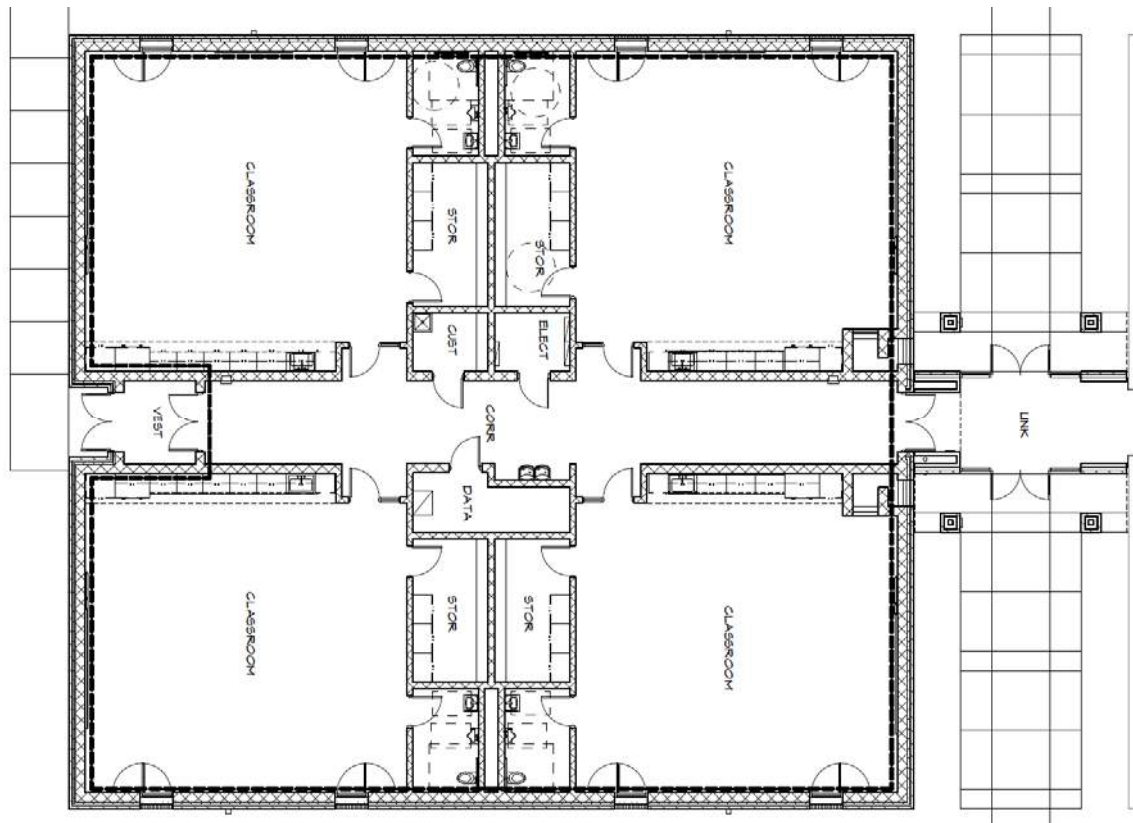
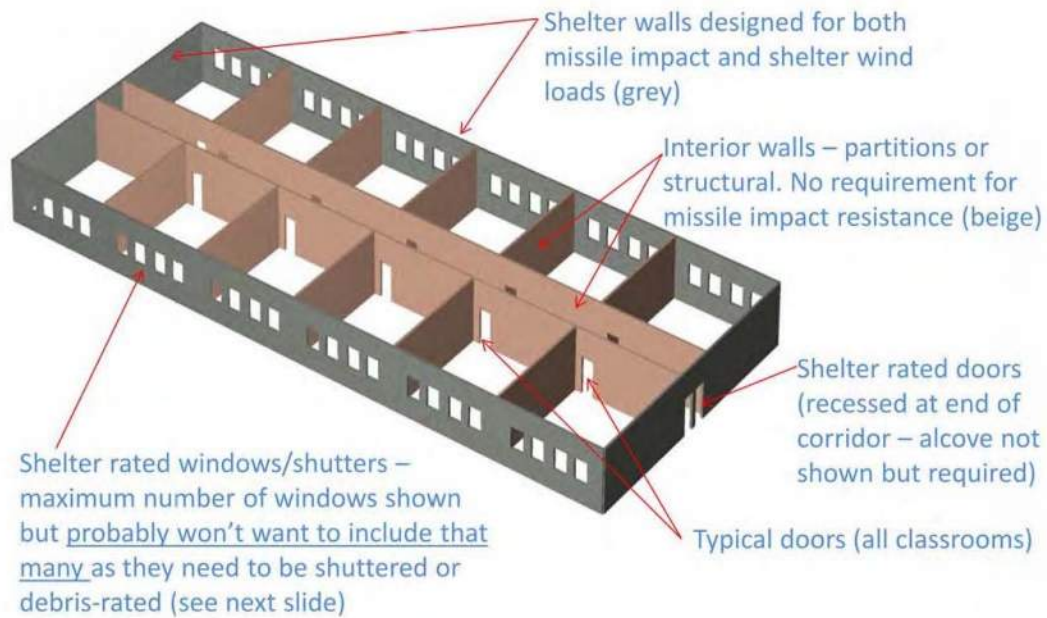
SPECIMEN 1 UTILITY BRICK VENEER W/ PARTIALLY GROUTED & REINFORCED CMU BACKUP
REV. 5/19/14, 5/5/2014 AS BUILT N.T.S.

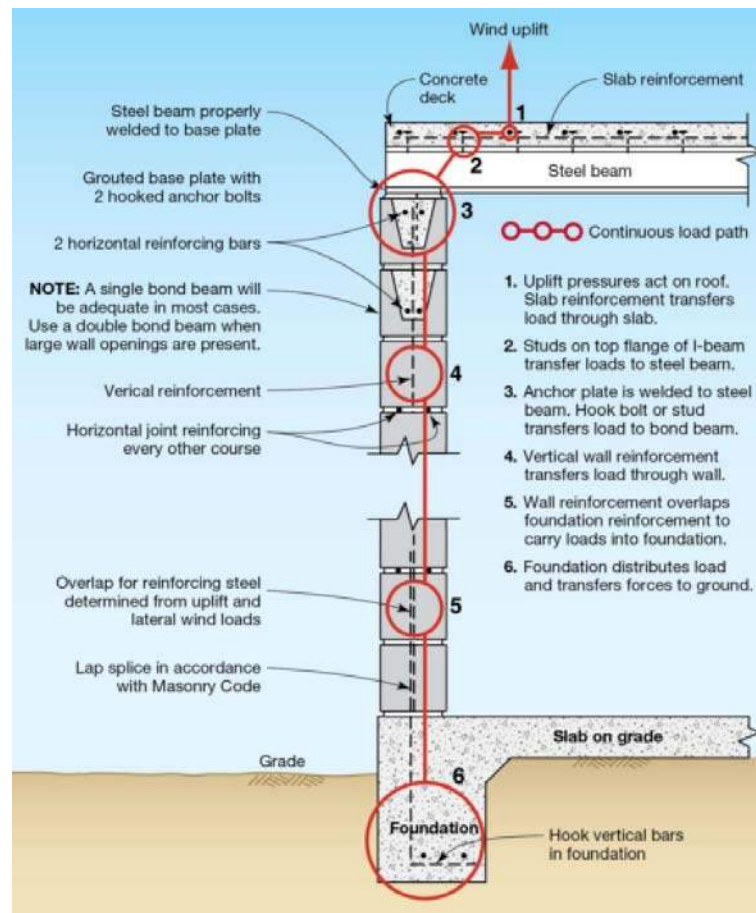




ICC 500 shelter concept

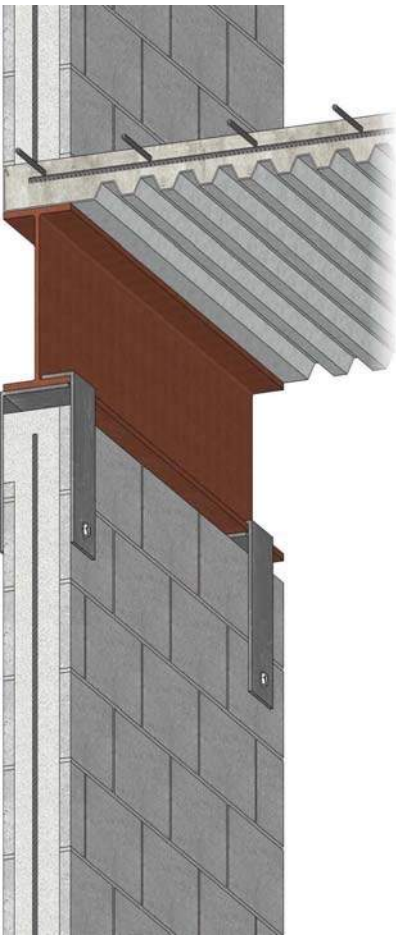
Classroom wing as Shelter





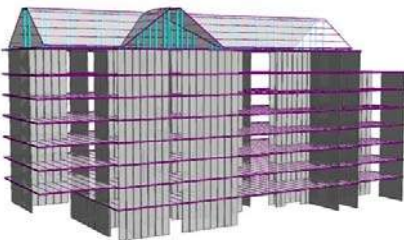
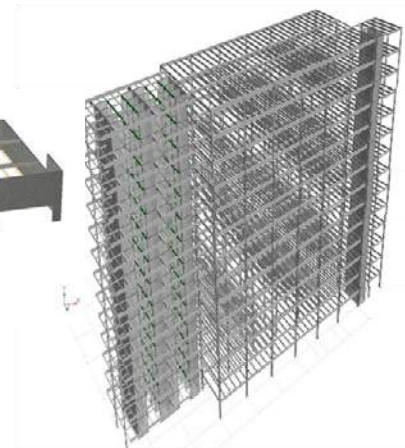
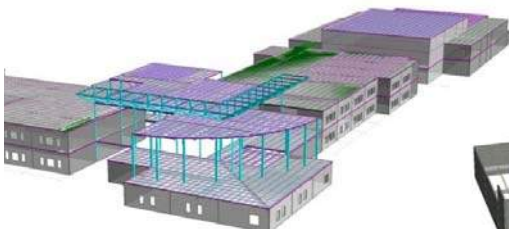
window shutter





recap

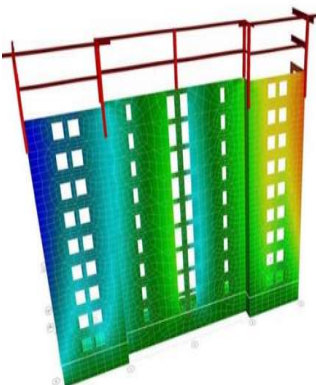
1. new systems (SAM) and new design options for masonry
 2. control joints locations are critical, and affect lintel design
 3. masonry can be 6" to 16"
 4. new products are available
 5. prefabrication can improve construction speed, efficiency
 6. consider masonry partitions
 7. storm shelters or hardened structure
- masonry can be much thinner and taller than many engineers believe
 - i. use advanced analysis methods, use f'_m 2000, 2500, or 3000 or 4,000 psi (when needed)



sponsored by:



designed by:





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