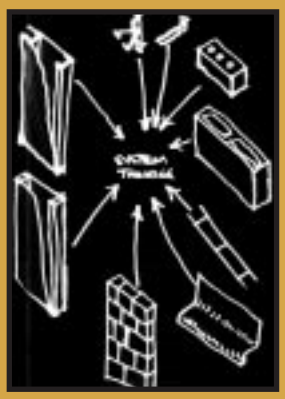
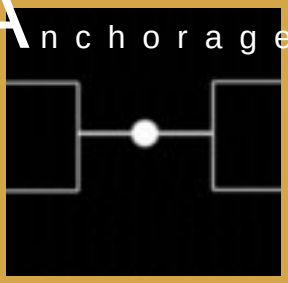
MASONRY ADVISORY COUNCIL

THINK SYSTEMS

A SYSTEMS APPROACH TO THE DESIGN AND EXECUTION OF MASONRY CAVITY AND VENEER WALL SYSTEMS

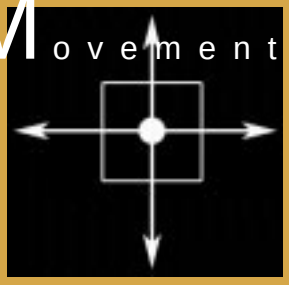


To successfully design and build masonry cavity walls and veneers, one must take a systems approach. A masonry wall is an organized assemblage of interdependent parts which work together to form a building envelope. The wall may be made of a combination of clay brick, concrete masonry units, stone, calcium silicate units, etc. The backup may be concrete masonry, wood frame construction, steel stud construction, concrete, etc. A good designer should know the intricacies of each material and what detailing implications those characteristics may require. This document is intended to aide the designer to make these decisions for some of the more common masonry wall systems used today.



Anchorage

All masonry veneers must be laterally anchored to the structural backup. Corrugated ties, adjustable anchors, and horizontal joint reinforcement are all examples of anchoring devices. Building codes require the architect to indicate specified type, size and spacing of all ties and anchors on the project drawings. Since the architect is responsible for the design of the anchorage strategy, she would be wise to understand the intricacies of veneer anchorage.



Movement control

All materials will undergo dimensional changes over time. The degree of expansion or contraction varies with the material in question. Brick, for example, is fired in a kiln and is as small as it will ever be. Once installed, a brick will undergo a slight degree of irreversible moisture expansion. Conversely, concrete masonry is cured by hydration, and will shrink over time. To control this shrinkage in concrete masonry, hot dipped galvanized joint reinforcing is set in bed joints at 16” o.c. vertically. Control joints are created to control cracking in concrete block while expansion joints are placed in brick walls to allow expansion.

Moisture Control

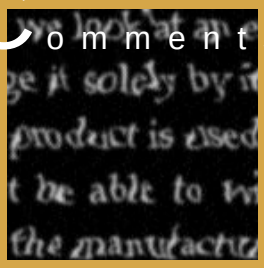
All 4” unreinforced masonry veneers are expected to allow some wind driven rain to penetrate, most likely through hairline cracks between brick and mortar. For this reason, an airspace is designed between veneer and backup to allow moisture to drain down the cavity and exit at flashing and weep holes. All of these systems require proper flashing details to perform correctly. See “Flashing...Tying the Loose Ends” published by the Masonry Advisory Council for more information on flashing details.

THINK SYSTEMS

System #1

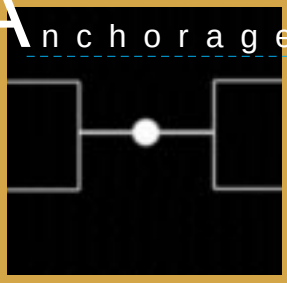
3 5/8" Brick Veneer + 1 1/2" Insulation + 1 1/8" Airspace + 7 5/8" CMU Backup
Total wall thickness = 14"

Comments

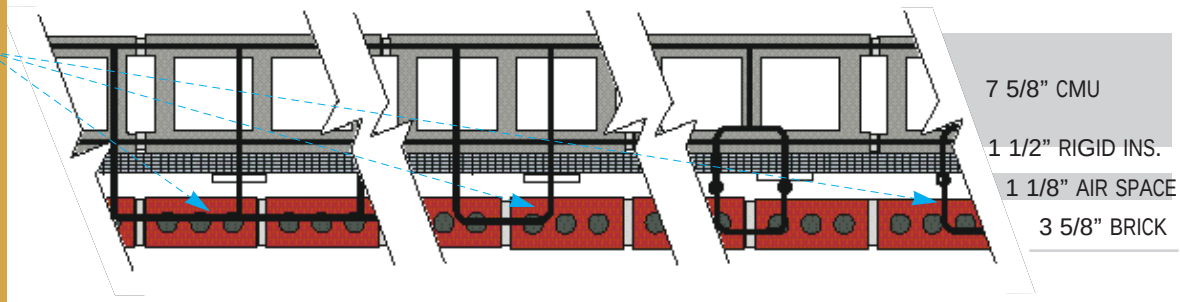


This system is a cavity wall consisting of an exterior brick veneer and a CMU backup. The two wythes are anchored with horizontal joint reinforcement, providing one tie per 2.67 ft^2 of wall area. The joint reinforcement can be ladder tri-rod type, tab type, or adjustable. Since 4 inches of unreinforced brick masonry will allow some water to penetrate, we design the system to manage the entrant water. A clean airspace provides a space for water to drain down where it can be directed to the exterior at flashing locations.

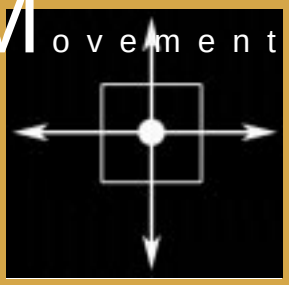
Anchorage



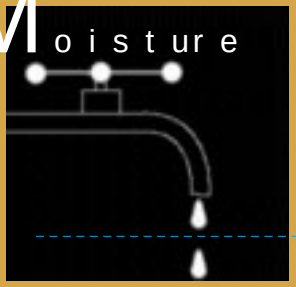
Tri-rod Tab type Adjustable



Movement



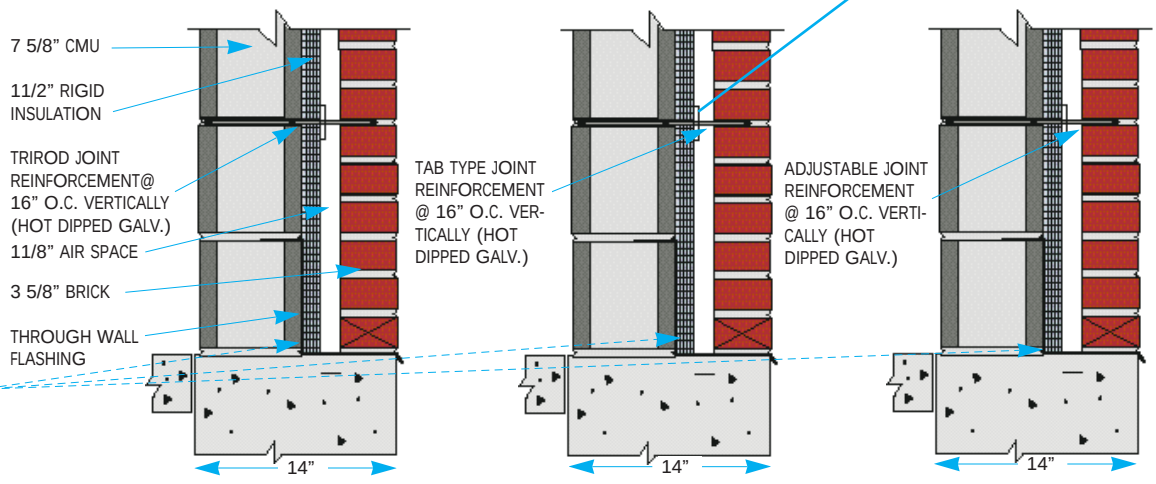
Moisture



INSULATION GRIP MAINTAINS CAVITY CONTINUITY

R- VALUE NOTES

TYPE OF RIGID INSULATION	R-VALUE OF WALL
WITH 1 1/2" POLYSIOCYANURATE (TUFF-R)	17.53
WITH 1 1/2" EXTRUDED POLYSTYRENE (DOW/FOAMULAR)	11.20
WITH 1 1/2" EXPANDED POLYSTYRENE (BEAD BOARD)	9.70

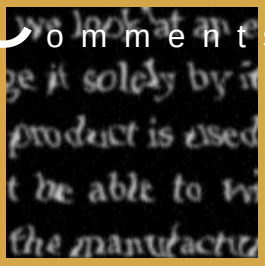


THINK SYSTEMS

System #2

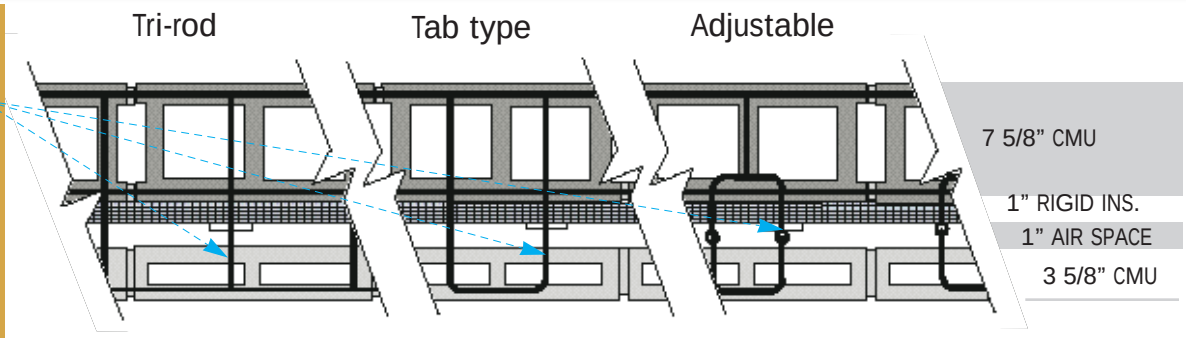
3 5/8” CMU Veneer + 2” Airspace + 7 5/8” CMU

Comments

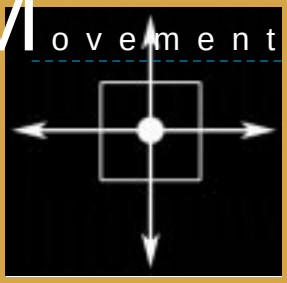


This system is a cavity wall consisting of an exterior concrete masonry veneer and a structural CMU backup. The two wythes are anchored with horizontal joint reinforcement. The joint reinforcement can be ladder tri-rod type, tab type, or adjustable. To resist shrinkage of the concrete masonry veneer, the selection of joint reinforcement should take into account the requirements for shrinkage control in the veneer. These exterior units should be integrally water repellent treated or coated after construction.

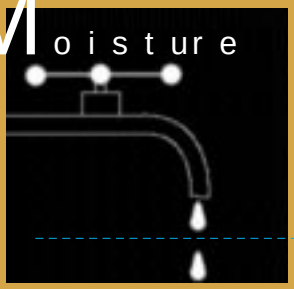
Anchorage

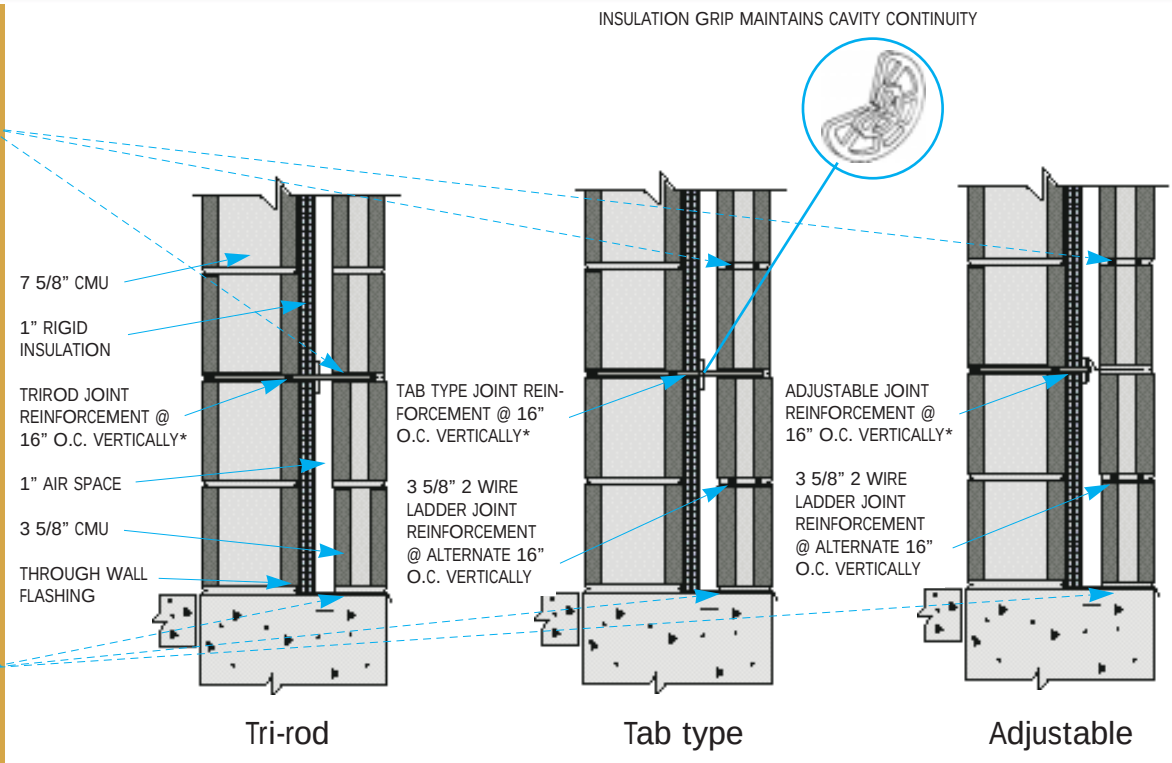


Movement



Moisture





* All joint reinforcement should be hot-dipped galvanized

MASONRY ADVISORY COUNCIL

THINK SYSTEMS

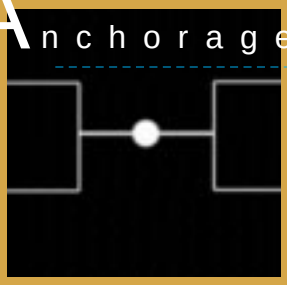
System #3

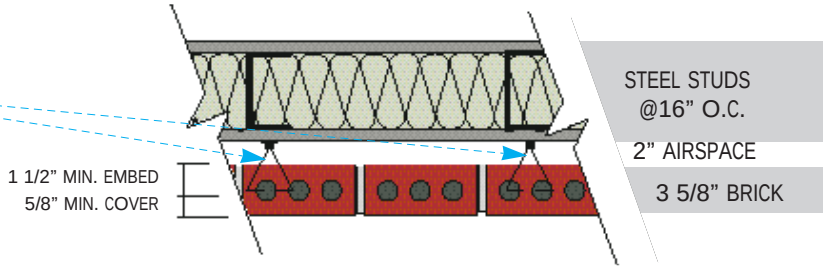
3 5/8” Brick Veneer + 2” Airspace + 6” Steel Studs

Comments

Due to the potentially corrosive nature of the steel stud backup, moisture control is an important issue. The airspace must be at least two inches and industry standard flashing procedures should be followed to establish a water management system. The brick veneer is anchored to the steel stud backup using adjustable veneer anchors(not corrugated anchors). These anchors should be screwed though the sheathing to the studs behind at one anchor per 2.67 ft^2 of wall. For this system, the Brick Industry Association recommends Type S mortar for higher tensile bond strength. Steel studs should be designed for a maximum deflection of L/600 to L/720.

Anchorage





Theoretical Wall R Value ≈ 22.16

Actual Wall R Value ≈ 14.56*

* BASED ON ASHRAE’S TABLE C-2 SHOWN BELOW

Movement

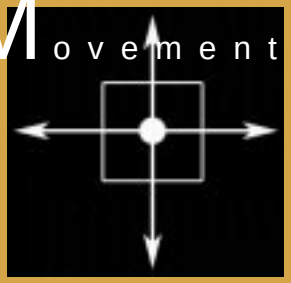
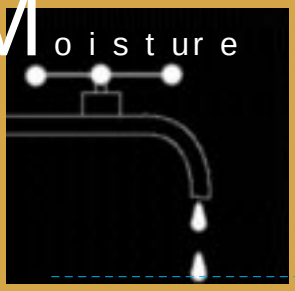
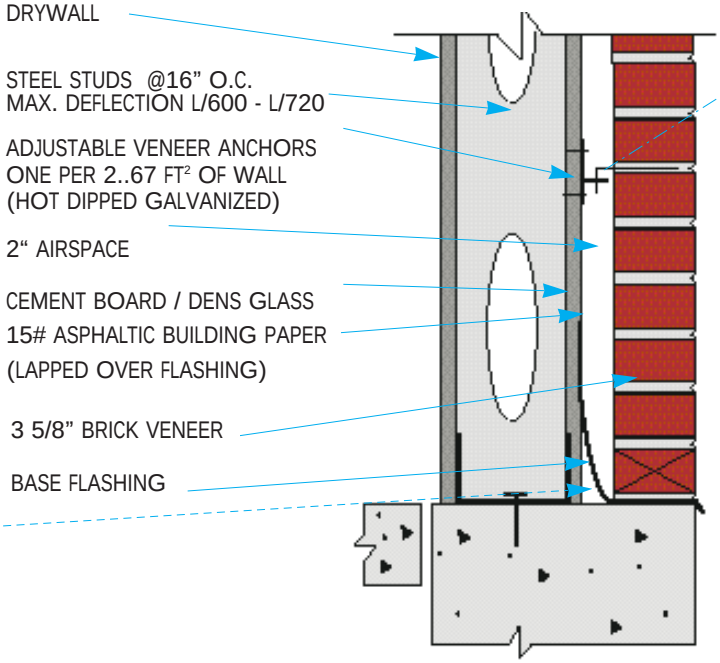


TABLE C-2 WALL SECTIONS WITH METAL STOPS PARALLEL PATH CORRECTION FACTORS

SIZE OF MEMBERS	STUD GAUGE	FRAMING SPACING	BATT R-VALUE	CORRECTION FACTOR
2 X 4	18-16	16” O.C.	R-11	0.50
2 X 4	18-16	24” O.C.	R-11	0.60
2 X 6	18-16	16” O.C.	R-19	0.40
2 X 6	18-16	24” O.C.	R-19	0.45

Moisture





ANCHORAGE NOTES

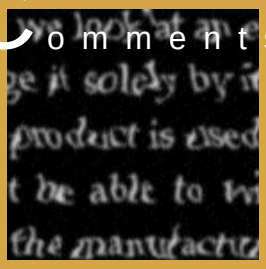
- PROVIDE AT LEAST ONE ANCHOR FOR EACH 2.67FT² OF WALL
- SPACE ANCHORS AT A MAXIMUM OF 32 IN. HORIZONTALLY AND 18 IN. VERTICALLY.
- PROVIDE ADDITIONAL ANCHORS AROUND ALL OPENINGS LARGER THAN 16” IN EITHER DIMENSION. PLACE ANCHORS AROUND PERIMETER OF OPENING AT A MAXIMUM OF 3 FT. O.C. PLACE ANCHORS WITHIN 12” OF OPENINGS.
- ANCHORS ATTACHED WITH 2 38 MM (MIN) 1 1/2” LONG CORROSION RESISTANT SCREWS

THINK SYSTEMS

System #4

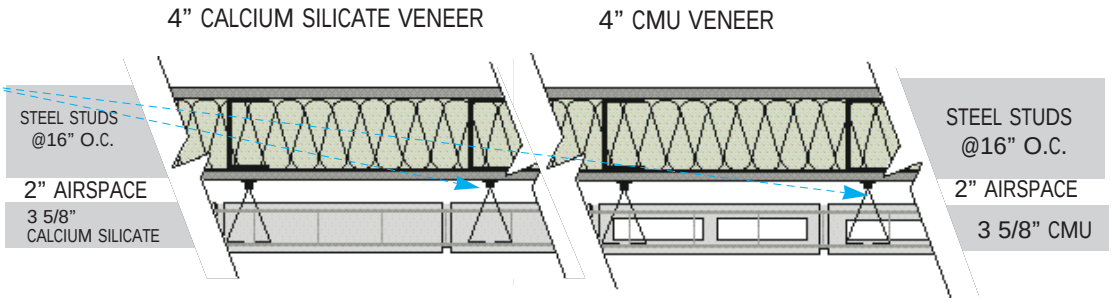
3 5/8” CMU/Calcium Silicate Veneer + 2” Airspace + 6” Steel Studs

Comments

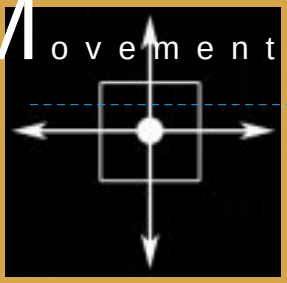


Due to the potentially corrosive nature of the steel stud backup, moisture control is an important inssue. The airspace must be at least two inches and industry standard flashing procedures should be followed to establish a water management system. The CMU veneer is anchored to the steel stud backup using adjustable veneer anchors(not corrugated anchors). These anchors should be screwed though the sheathing into the studs behind at one anchor per 2.67 ft² of wall. Due to natural shinkage of the CMU, joint reinforcement should be placed in the bed joints @ 16” o.c. vertically. Steel studs should be designed for a maximum deflection of L/600 to L/720.

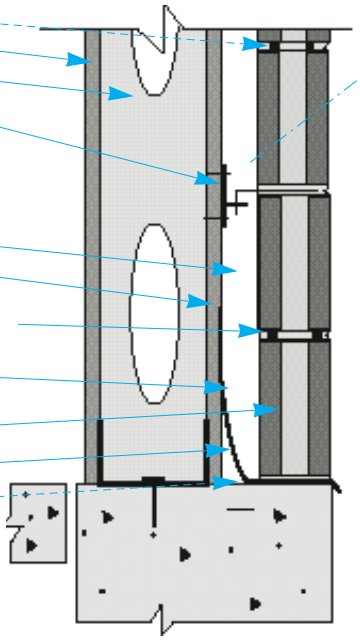
Anchorage

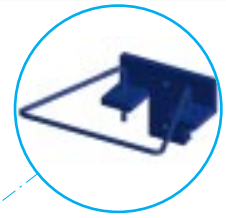


Movement



Moisture





* All joint reinforcement should be hot-dipped galvanized

ANCHORAGE NOTES

- PROVIDE AT LEAST ONE ANCHOR FOR EACH 2.67FT² OF WALL
- SPACE ANCHORS AT A MAXIMUM OF 32 IN. HORIZONTALLY AND 18 IN. VERTICALLY.
- PROVIDE ADDITIONAL ANCHORS AROUND ALL OPENINGS LARGER THAN 16” IN EITHER DIMENSION. PLACE ANCHORS AROUND PERIMETER OF OPENING AT A MAXIMUM OF 3 FT. O.C. PLACE ANCHORS WITHIN 12” OF OPENINGS.
- ANCHORS ATTACHED WITH 2 38 MM (MIN) 1 1/2” LONG CORROSION RESISTANT SCREWS

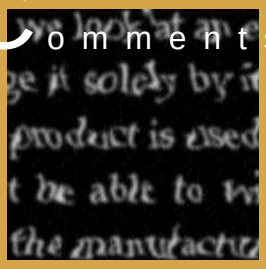
MASONRY ADVISORY COUNCIL

THINK SYSTEMS

System #5

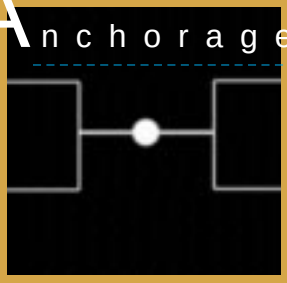
3 5/8” Brick Veneer w/ cmu band + 2” Airspace + 6” Steel Studs

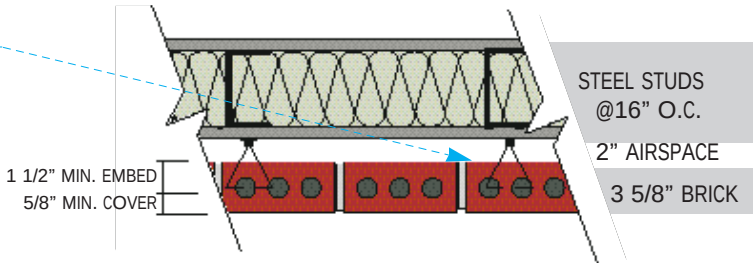
Comments



Due to the potentially corrosive nature of the steel stud backup, moisture control is an important inssue. The airspace must be at least two inches and industry standard flashing procedures should be followed to establish a water management system. The veneer is anchored to the steel stud backup using adjustable veneer anchors(not corrugated anchors). These anchors should be screwed though the sheathing to the studs behind. Due to natural shinkage of the CMU, joint reinforcement should be placed in the bed joints of the CMU ribbon @ 16” o.c. vertically. Type S mortar should be used for greater bond. Steel studs should be designed for a maximum deflection of L/600 to L/720.

Anchorage



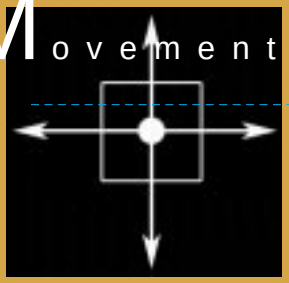


Type S mortar should be used for greater tensile bond strength.

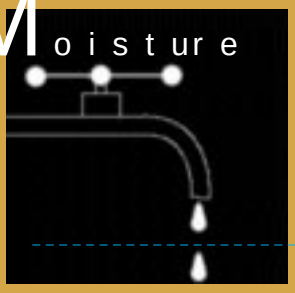
ANCHORAGE NOTES

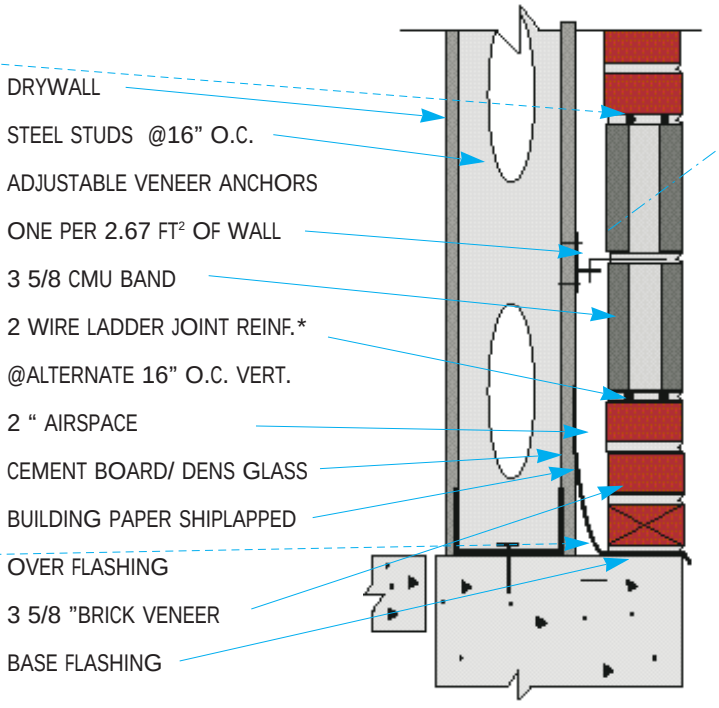
- PROVIDE AT LEAST ONE ANCHOR FOR EACH 2.67FT² OF WALL
- SPACE ANCHORS AT A MAXIMUM OF 32 IN. HORIZ. AND 18 IN.VERT.
- PROVIDE ADDITIONAL ANCHORS AROUND ALL OPENINGS LARGER THAN 16” IN EITHER DIMENSION. PLACE ANCHORS AROUND PERIMETER OF OPENING AT A MAXIMUM OF 3 FT. O.C. PLACE ANCHORS WITHIN 12” OF OPENINGS.
- ANCHORS ATTACHED WITH 2 HOT-DIPPED GALVANIZED OR NON CORROSIVE SCREWS

Movement



Moisture





MOVEMENT NOTES

VERTICAL CONTROL JOINTS IN CONCRETE MASONRY SHOULD BE AS FOLLOWS:

1.) SPACED AT 20’ O.C.

2.) PLACED AT EVERY INSIDE CORNER

3.) PLACED 4 INCHES FROM ONE SIDE OF EVERY OUTSIDE CORNER

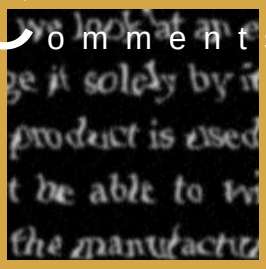
* All joint reinforcement should be hot-dipped galvanized

THINK SYSTEMS

System #6

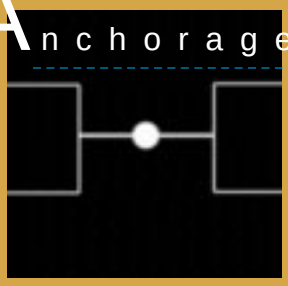
3 5/8” Brick Veneer + 1” Airspace + Wood Studs

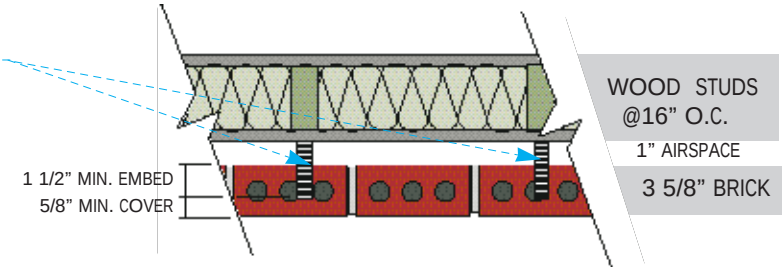
Comments



This system is most likely to be a residential application. Since 4 inches of unreinforced brick masonry will allow some water to penetrate, we design the system to manage the entrant water. A clean airspace provides a space for water to drain down where it can be directed to the exterior at flashing locations. The veneer is anchored to the wood backup using corrugated veneer ties nailed into wood studs @ one tie per 2.67ft^2. More anchors are required around openings larger than 16 inches in any dimension - see anchor notes below.

Anchorage

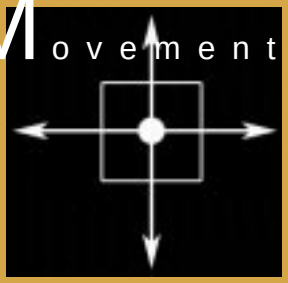




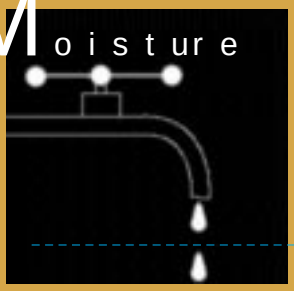
ANCHORAGE NOTES

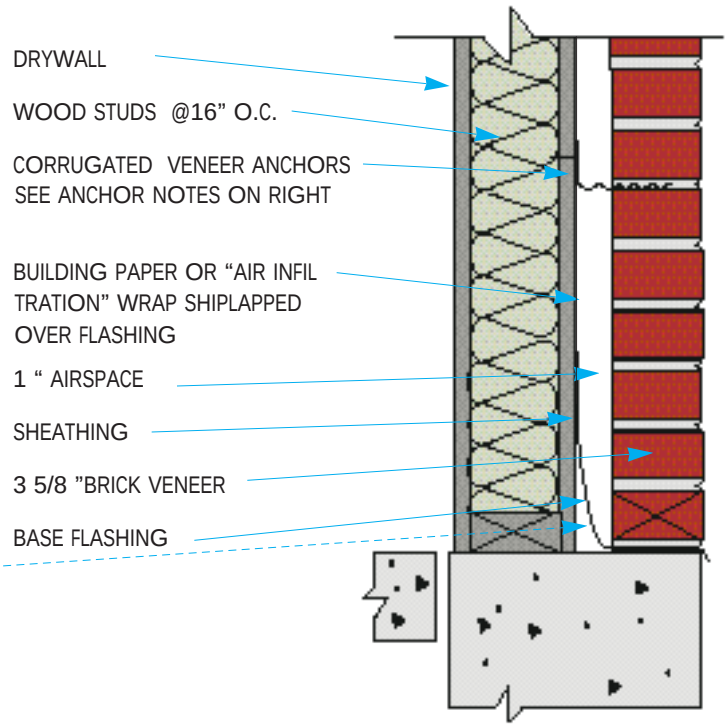
- PROVIDE AT LEAST ONE ANCHOR FOR EACH 2.67FT^2 OF WALL
- SPACE ANCHORS AT A MAXIMUM OF 32 IN. HORIZ. AND 18 IN.VERT.
- PROVIDE ADDITIONAL ANCHORS AROUND ALL OPENINGS LARGER THAN 16” IN EITHER DIMENSION. PLACE ANCHORS AROUND PERIMETER OF OPENING AT A MAXIMUM OF 3 FT. O.C. PLACE ANCHORS WITHIN 12” OF OPENINGS.
- ATTACH ANCHOR TO STUD WITH CORROSION- RESISTANT 8D COMMON NAIL. LOCATE NAIL WITHIN 1/2” OF BEND.

Movement



Moisture





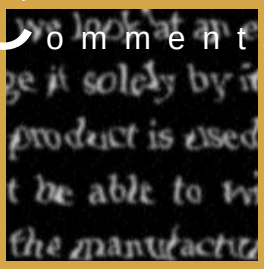
MASONRY ADVISORY COUNCIL

THINK SYSTEMS

System #7

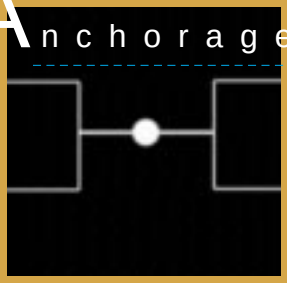
3 5/8" Brick Veneer with CMU Band + 1" Airspace + Wood Studs

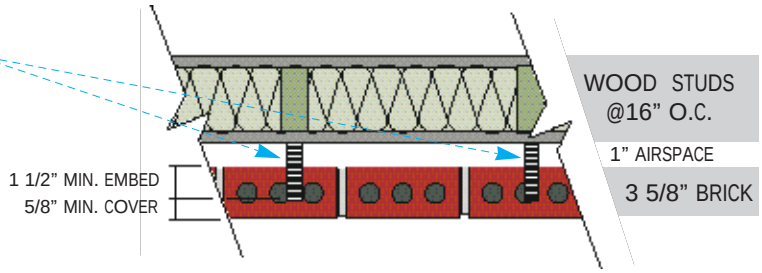
Comments



This system is most likely to be a residential application. Since 4 inches of unreinforced brick masonry will allow some water to penetrate, we design the system to manage the entrant water. A clean airspace provides a space for water to drain down where it can be directed to the exterior at flashing locations. The veneer is anchored to the wood backup using corrugated veneer ties nailed into wood studs @ one tie per 2.67ft^2.

Anchorage

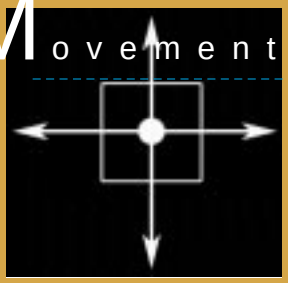




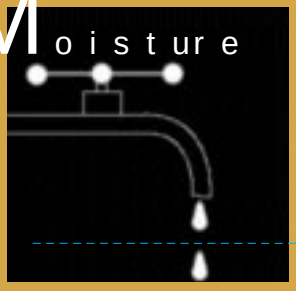
ANCHORAGE NOTES

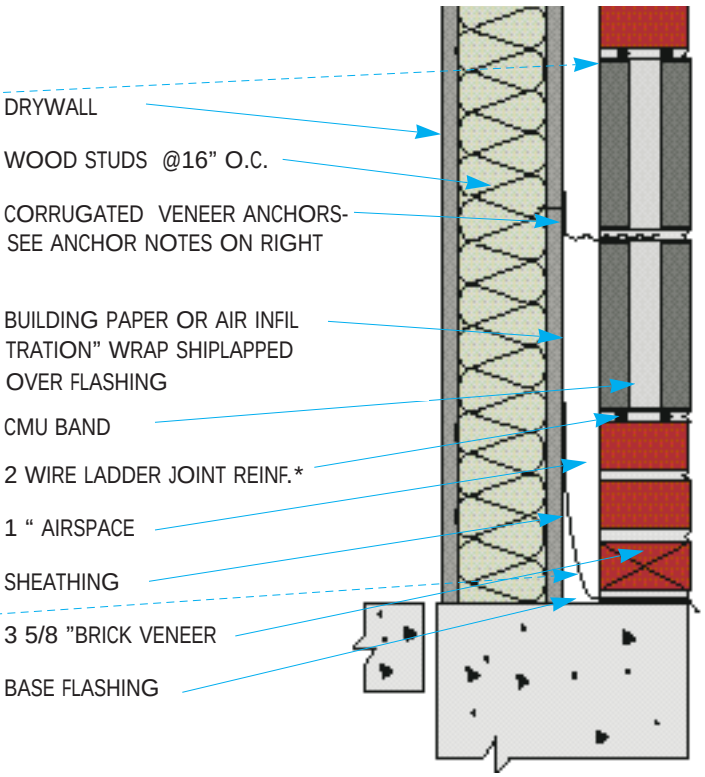
- PROVIDE AT LEAST ONE ANCHOR FOR EACH 2.67FT^2 OF WALL
- SPACE ANCHORS AT A MAXIMUM OF 32 IN. HORIZ. AND 18 IN.VERT.
- PROVIDE ADDITIONAL ANCHORS AROUND ALL OPENINGS LARGER THAN 16" IN EITHER DIMENSION. PLACE ANCHORS AROUND PERIMETER OF OPENING AT A MAXIMUM OF 3 FT. O.C. PLACE ANCHORS WITHIN 12" OF OPENINGS.
- ATTACH ANCHOR TO STUD WITH CORROSION- RESISTANT 8D COMMON NAIL. LOCATE NAIL WITHIN 1/2" OF BEND.

Movement



Moisture





MOVEMENT NOTES

VERTICAL CONTROL JOINTS IN CONCRETE MASONRY SHOULD BE AS FOLLOWS:

1.) SPACED AT 20 O.C.

2.) PLACED AT EVERY INSIDE CORNER

3.) PLACED 4 INCHES FROM ONE SIDE OF EVERY OUTSIDE CORNER

.

* All joint reinforcement should be hot-dipped galvanized

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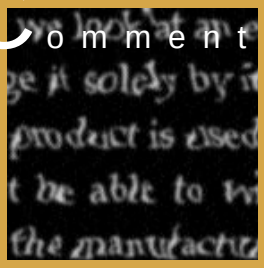
THINK SYSTEMS

System #8

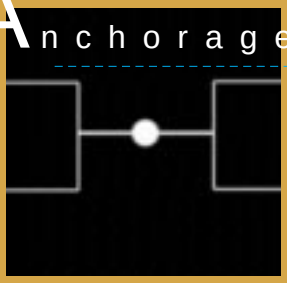
3 5/8" Glazed Brick + 2" Airspace + 7 5/8" CMU Backup

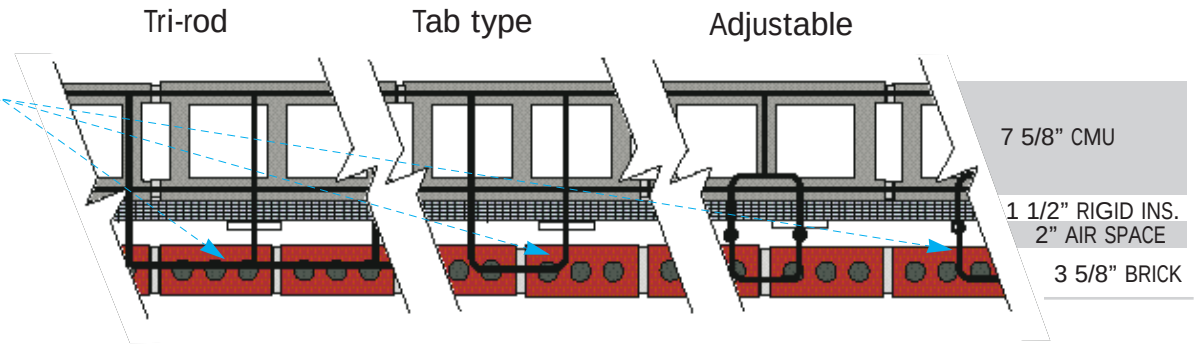
Comments



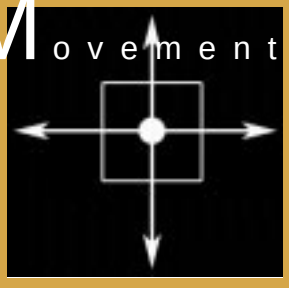
This system is a cavity wall consisting of an exterior glazed brick veneer and a CMU backup. The two wythes are anchored with horizontal joint reinforcement, providing one tie per 2.67 ft^2 of wall area The joint reinforcement can be ladder tri-rod type, tab type, or adjustable. This system uses glazed clay units which have a low perm rating. The glazing does not allow water to enter or escape in the same manner as a non-glazed brick. For this reason the air space in the cavity should be no smaller than 2" and the cavity should be vented at the top and bottom of the wall with open head joints @ 24"O.C.

Anchorage

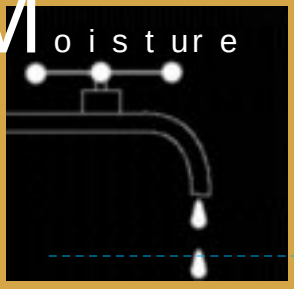


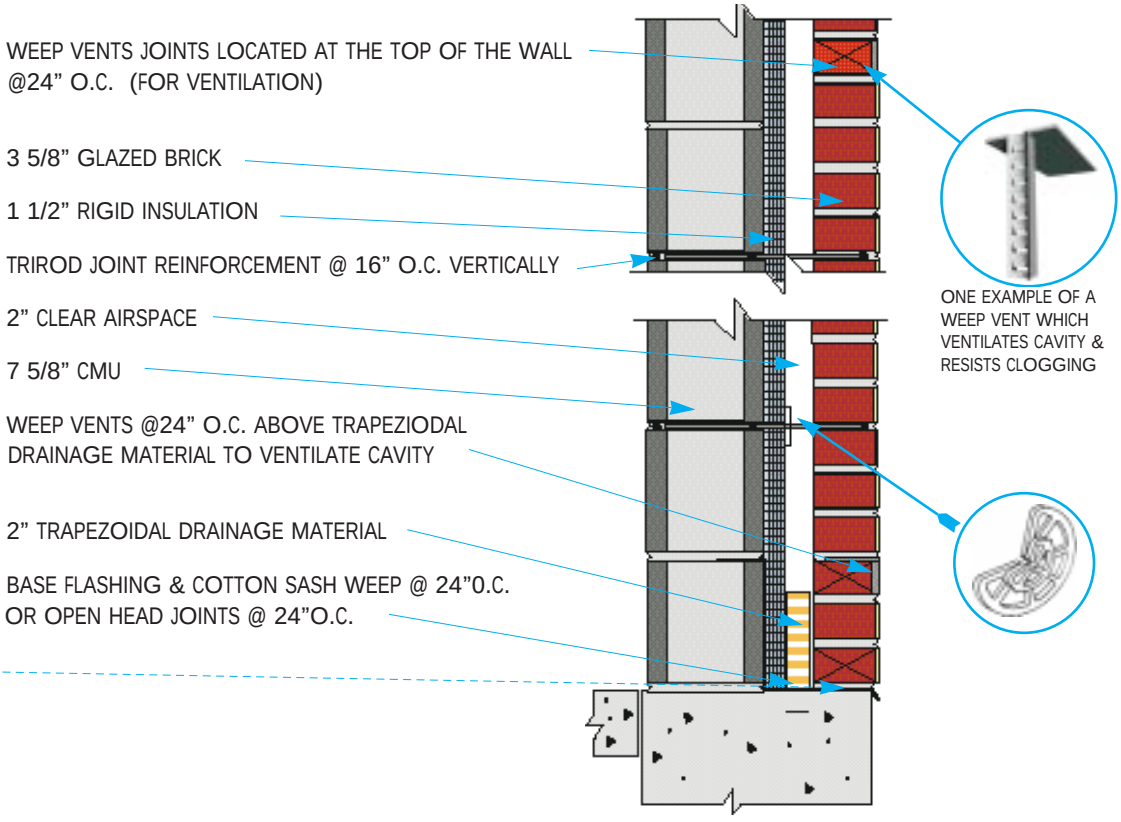


Movement



Moisture



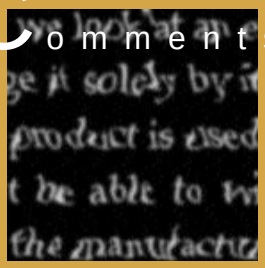


THINK SYSTEMS

System #9

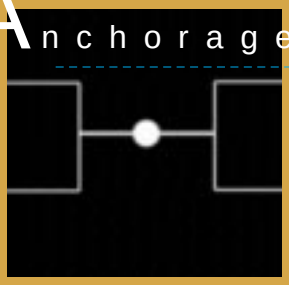
NARROWER, MORE ECONOMICAL BRICK / BLOCK CAVITY WALL

Comments

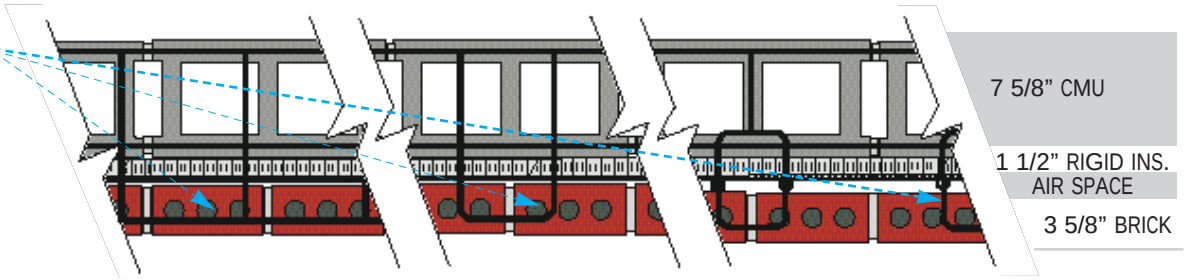


This system is a cavity wall consisting of an exterior brick and a CMU backup. The two wythes are anchored with horizontal joint reinforcement, providing one tie per 2.67 ft² of wall area The joint reinforcement can be ladder tri-rod type, tab type, or adjustable. Here we are using an insulated and attached drainage board to eliminate the need for a clear air space. This allows one to create a thinner more economical wall. Water drains down the drainage board and exits though weep holes at flashing locations.

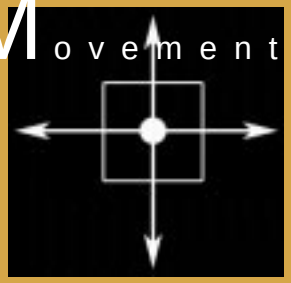
Anchorage



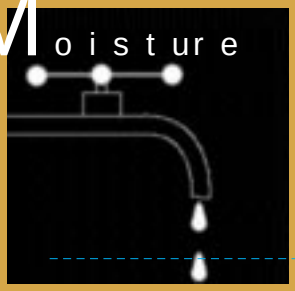
Tri-rod Tab type Adjustable



Movement



Moisture



7 5/8" CMU

HOT DIPPED, GALVANIZED TRIROD JOINT REINFORCEMENT

@16" O.C. VERTICALLY

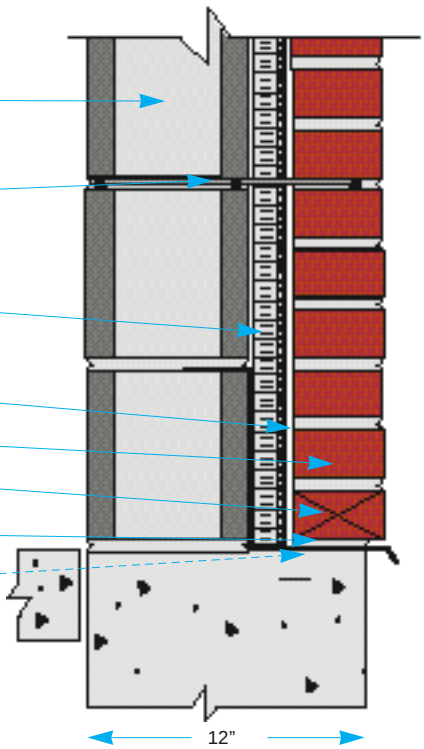
1 1/2" RIGID INSULATION WITH 3/8" ADHERED DRAINAGE MAT

0 - 3/8" SPACE

3 5/8" BRICK

OPEN HEAD JOINT WEEP HOLES @24"O.C.

BASE FLASHING



R - Value of Wall ≈ 14.74

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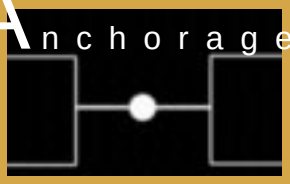
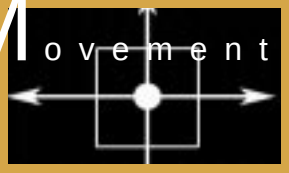
THINK SYSTEMS

System #10

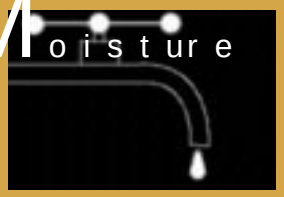
Anchorage



Movement

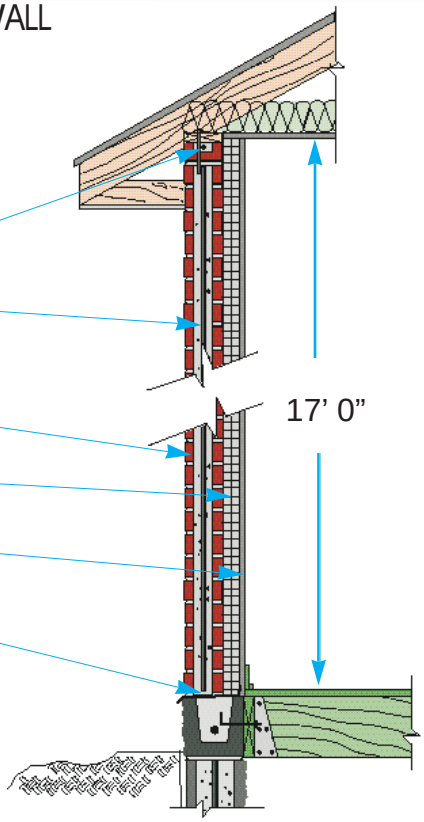


Moisture



5” HOLLOW REINFORCED BRICK WALL

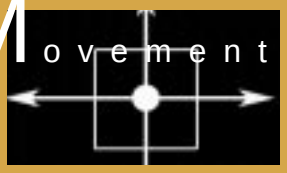
(residential / retail / commercial / religious)



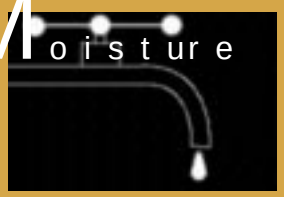
System #11

Anchorage

Movement

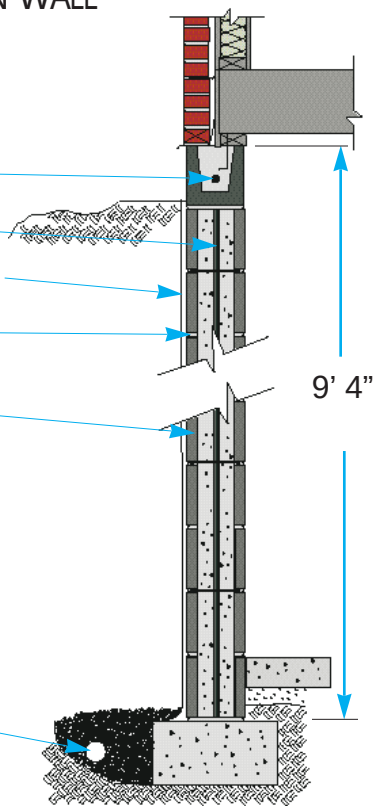


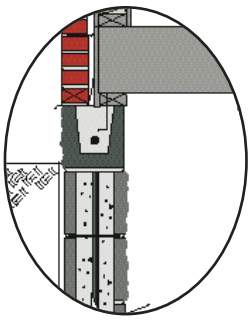
Moisture



8” REINFORCED CMU FOUNDATION WALL

(residential / commercial)





DECORATIVE ALTERNATE: SPLIT FACED UNITS FACING INWARD CREATE A FINISHED BASEMENT. TOP UNIT FACES OUTWARD.

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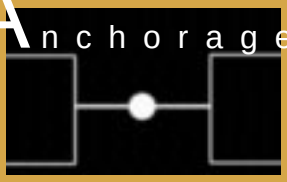
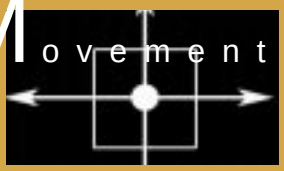
THINK SYSTEMS

System #12

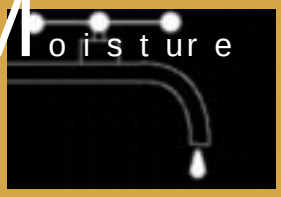
Anchorage



Movement

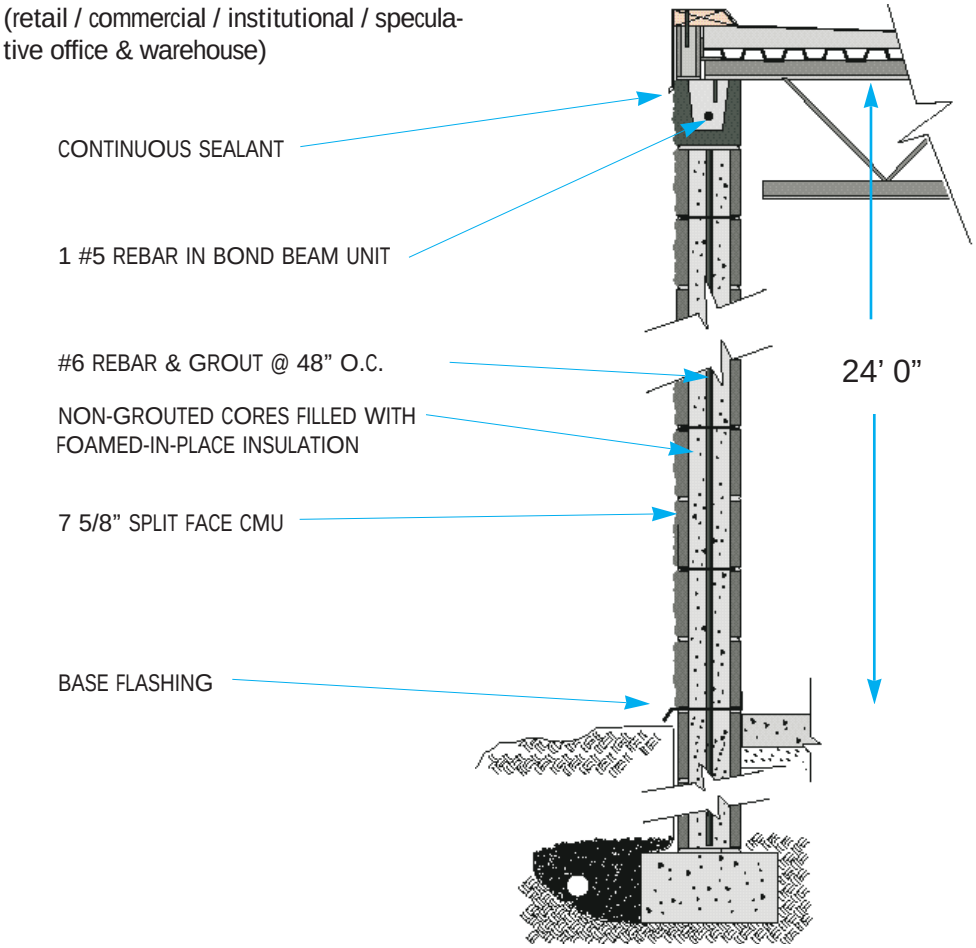


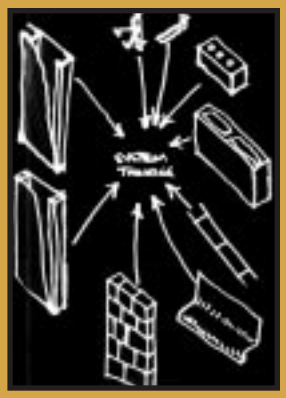
Moisture



8" REINFORCED SPLIT FACE CMU

(retail / commercial / institutional / speculative office & warehouse)





DISCLAIMER NOTICE

This guide contains technical information on masonry wall systems. It provides some of the basic information required to properly design and detail these systems. This booklet does not cover all designs or conditions. The information presented illustrates only principles that are involved.

The information contained in this guide is based on the available data and experience of the technical staff of the Masonry Advisory Council. This information should be recognized as suggestions which, if followed with good judgement, should produce positive results.

Final decisions on the use of information, details and materials as discussed in this guide are not within the purview of the Masonry Advisory Council, and must rest with the project designer, owner, or both.

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