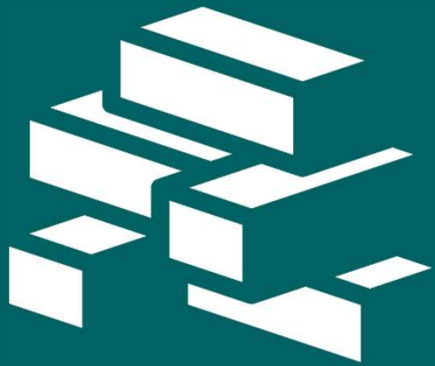


MASONRY

Association

of Florida



Designing Concrete Masonry Walls to Resist Moisture Penetration

**Masonry Professional
Education Series**

Don Beers, PE , GC

Don Beers, PE, GC is currently the staff engineer for the Masonry Association of Florida (since 2009) and President of Adrian Engineering, Inc. Previous to 2009 Don acted as Engineering Services Manager with Rinker Materials for 29 years. He is a graduate of the University of South Florida in Civil and Structural Engineering and is a licensed engineer and general contractor in Florida. Has served as Chairman of the National Concrete Masonry Association's Codes Committee, the Florida Concrete & Products Association's Block Committee and a board member for The Masonry Society (TMS).

don@floridamasonry.com



ABOUT US

The Masonry Association of Florida (MAF) is a not-for-profit trade association dedicated to expanding the market share of masonry construction in Florida. Masonry construction dominates the construction industry because of its adaptability to the Florida climate. One of the most durable building products available, masonry resists storms, termites and mold, while reducing energy costs, maintenance and noise. The MAF is a coalition of Florida masonry industry professionals who believe it's time to bring our industry together.

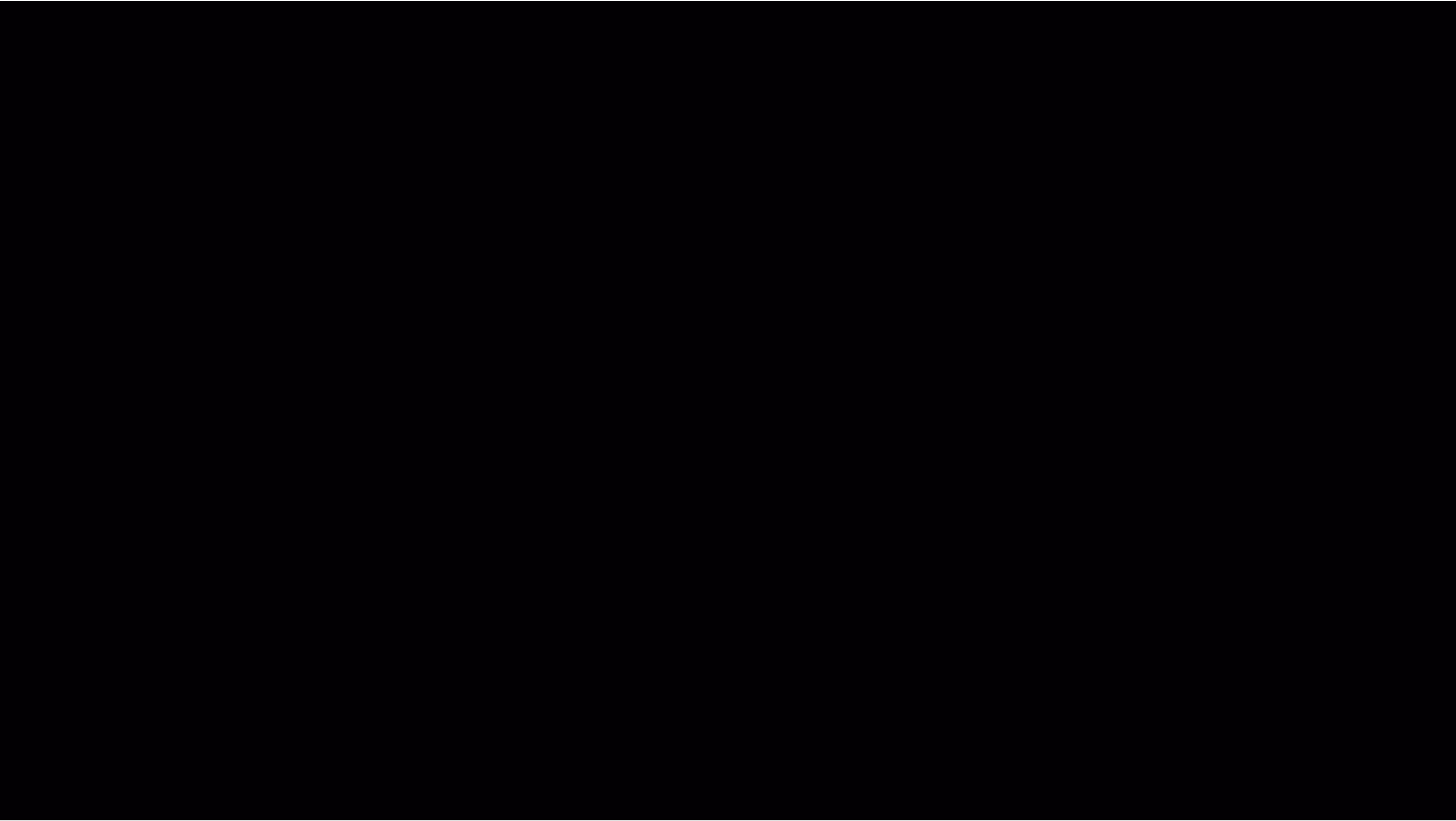
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FLORIDA
MASONRY APPRENTICE
& EDUCATIONAL
FOUNDATION



Session Handouts

NCMA
TEK 19-07
WATER REPELLENTS FOR CONCRETE MASONRY WALLS

INTRODUCTION

Water repellents are used on exterior walls to provide resistance to water intrusion, to reduce water absorption, to reduce water penetration, to reduce water absorption, to reduce water penetration, and to reduce water absorption.

When applied in accordance with manufacturer's recommendations, water repellents effectively reduce water penetration. Water repellents are generally recommended for use on masonry surfaces that are exposed to weather. The choice of water repellent will depend on the location of the masonry, the exposure conditions, and the availability of a wide variety of water repellents that are available, offering many different masonry systems, finishes, and application procedures.

WATER RESISTANCE

Water penetration resistance of concrete masonry walls is dependent on wall design, shape and structural details, workmanship, and conditions, and the application of water repellents. This TEK focuses on water repellent products for above-grade walls. The other factors are discussed in TEK 19-08, "Water Repellent Products for Below-Grade Walls."

The effectiveness of water repellents can be evaluated in several ways. In the laboratory, Standard Test Method for Water Penetration and Leakage Through Masonry, ASTM E 154, is commonly the only method used to evaluate water repellents. In the field, it is difficult to evaluate water repellents. However, there are several methods that can be used to evaluate water repellents in the field. These methods include: visual inspection, water absorption tests, and water penetration tests.

TYPES OF WATER REPELLENTS

There are two general types of water repellents: surface-applied water repellents and penetrating water repellents. Surface-applied water repellents are applied to the exterior surface of the masonry. Penetrating water repellents are applied to the exterior surface of the masonry and penetrate into the masonry.

NCMA
TEK 19-07
CHARACTERISTICS OF CONCRETE MASONRY UNITS WITH INTEGRAL WATER REPELLENT

INTRODUCTION

Concrete masonry units (CMUs) are a function of the properties and proportions of the constituent materials. The characteristics of CMUs are determined by the type of aggregate used, the type of cement used, the type of water used, the type of curing used, and the type of finishing used. The characteristics of CMUs are also influenced by the type of water repellent used. This TEK discusses the characteristics of CMUs with integral water repellents. It covers the types of water repellents, the types of CMUs, and the types of applications. It also discusses the benefits and limitations of CMUs with integral water repellents.

NCMA
TEK 19-08
FLASHING STRATEGIES FOR CONCRETE MASONRY WALLS

INTRODUCTION

The primary goal of flashing is to prevent the flow of water through elements and joints in the exterior of the structure. This is an absolute necessity of modern building. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion.

The type of flashing material to be used is governed by both environmental and design conditions. Environmental conditions include wind direction and speed, precipitation, and temperature. Design conditions include the type of flashing material, the location of the flashing material, and the condition of the flashing material. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion.

Although flashing is the primary form of the TEK, it should be understood that the role of flashing is not limited to the exterior wall assembly. Flashing is also used in the interior wall assembly. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion.

EFFECT OF MOISTURE ON MASONRY

Moisture is a critical component of the exterior wall assembly. It is the primary defense against water intrusion. Flashing is a critical component of the exterior wall assembly. It is the primary defense against water intrusion.

NCMA
TEK 19-08
PREVENTING WATER PENETRATION IN BELOW-GRADE CONCRETE MASONRY WALLS

INTRODUCTION

Concrete masonry walls below-grade are exposed to water and moisture. Water and moisture can cause significant damage to the masonry. This TEK discusses the methods for preventing water penetration in below-grade concrete masonry walls. It covers the types of water repellents, the types of flashing, and the types of applications. It also discusses the benefits and limitations of these methods.

Water repellents are used on exterior walls to provide resistance to water intrusion, to reduce water absorption, to reduce water penetration, and to reduce water absorption. Water repellents are used on exterior walls to provide resistance to water intrusion, to reduce water absorption, to reduce water penetration, and to reduce water absorption.

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NCMA
TEK 19-08
JOINT SEALANTS FOR CONCRETE MASONRY WALLS

INTRODUCTION

Joint sealants are used to prevent water penetration through the joints in concrete masonry walls. This TEK discusses the types of joint sealants, the types of applications, and the types of benefits and limitations. It covers the types of joint sealants, the types of applications, and the types of benefits and limitations.

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FLORIDA CONCRETE & PRODUCTS ASSOCIATION, INC.

WATER PENETRATION TESTING OF STUCCO ON CONCRETE MASONRY CONSTRUCTION



MASONRY INFORMATION TECHNOLOGISTS, INC.

M.I.T.

"Our experience helps you to weigh masonry issues."

Conducted by: Masonry Information Technologists
Jim Guide, President

Project No. 05-466B
Date: May 2007

NCMA TEK Notes

Associated Effects of Moisture

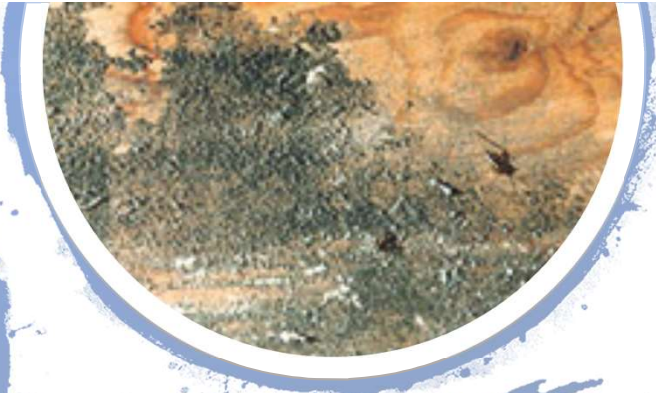
- Efflorescence
- Corrosion of Metals & Reinforcing
- Staining/Mold/Mildew
- Leaks
- Rotting & Disintegration of Insulation/Wood/etc.



Protect Your Family From Mold!

Don't Feed the Mold!





Breathing Problems Anyone?
Don't Feed the Mold!

Mold on Wood But NOT on
Masonry

**Don't Feed
the Mold!**



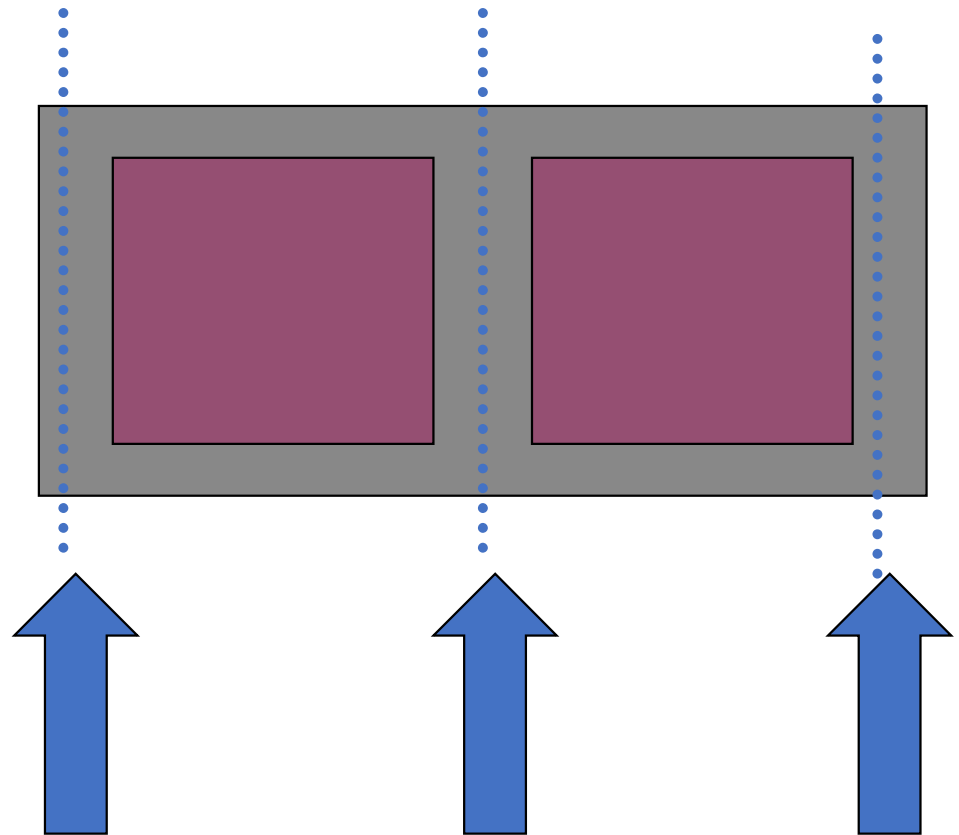
Moisture and Mold Summary

- Masonry is not a food source for mold!
- Masonry is not damaged by moisture!

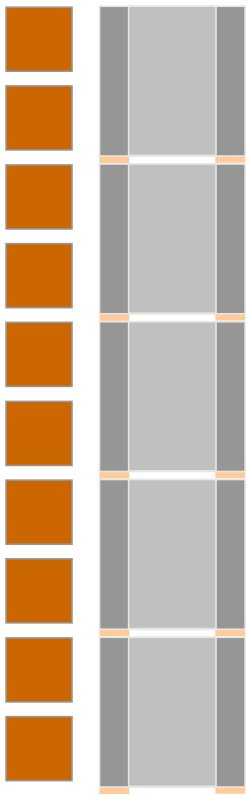


Forces of Moisture Migration

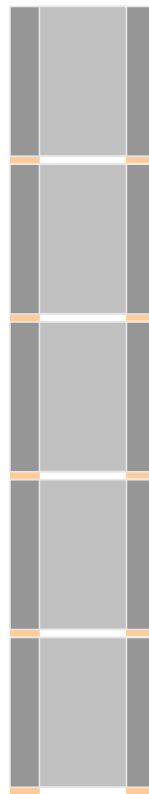
- Capillary Action
- Gravity
- Pressure
 - Wind driven rain
 - Differential pressure



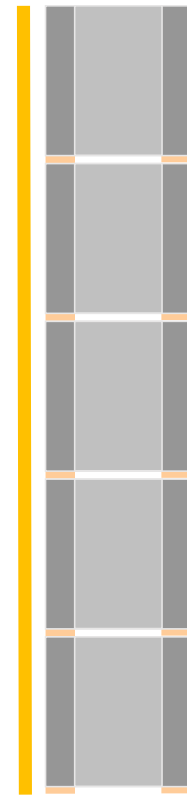
Design Considerations: Basic Concrete Masonry Wall Types



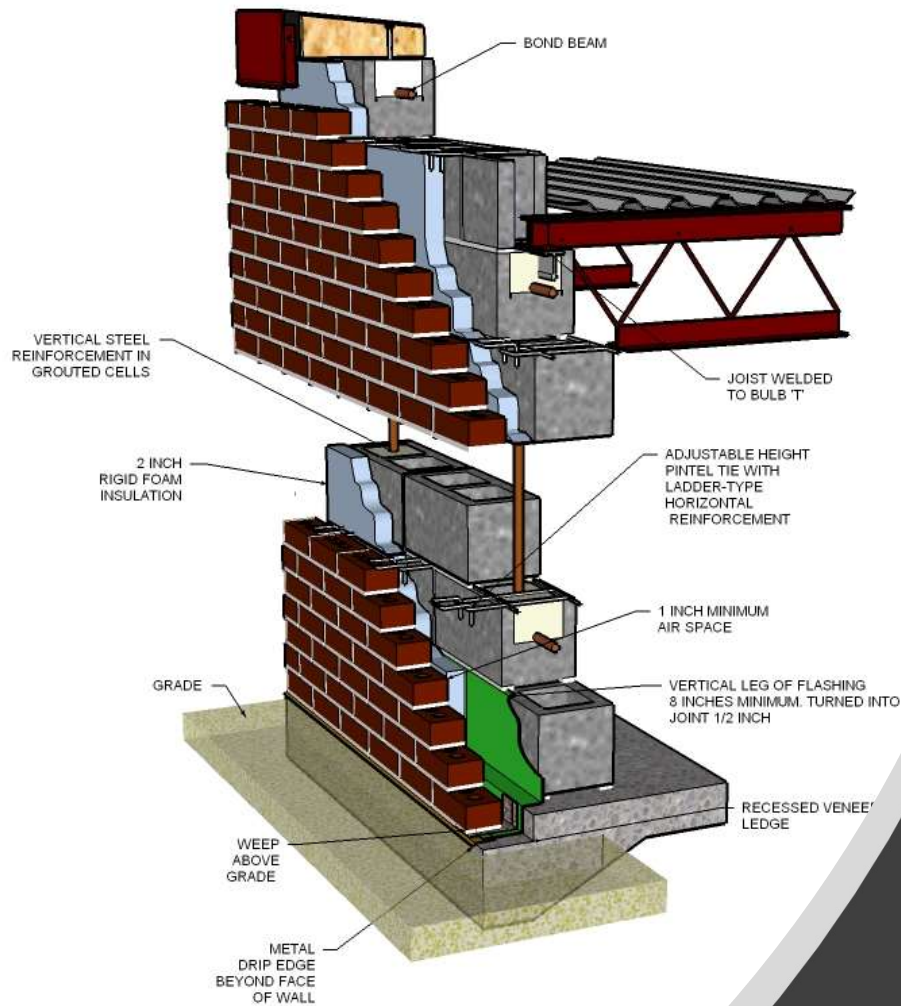
Double Wythe Cavity



Single Wythe

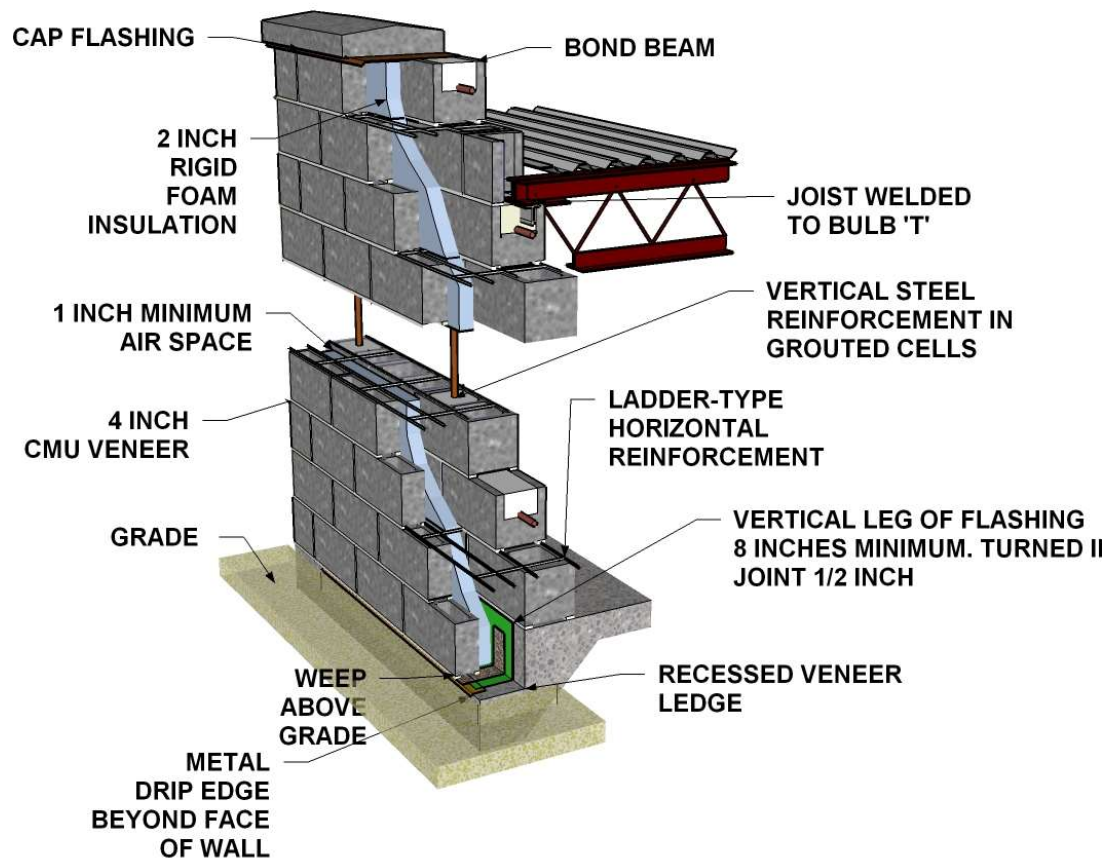


Stucco



Double Wythe Cavity Wall System

Worlds Best Wall System




Double Wythe Cavity Wall System


Worlds Best Wall System

WHY?

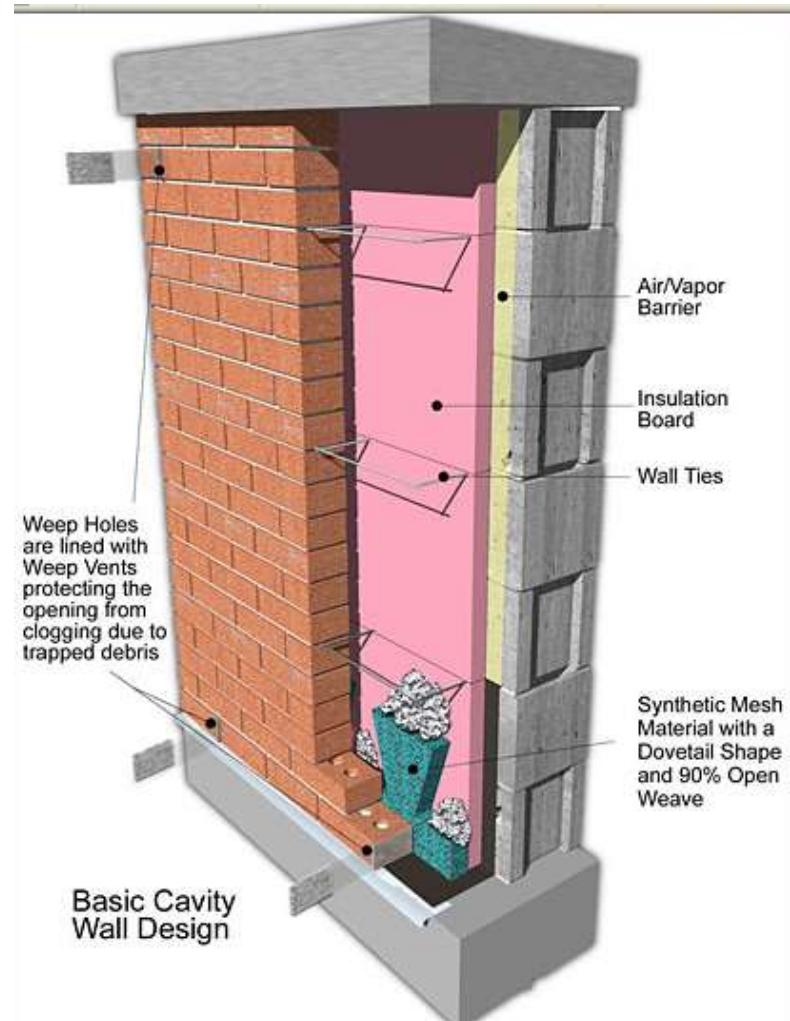
Double Wythe Cavity Wall System

- **Insulation Envelope (No Thermal Bridging)**
 - **External and Internal Mass**
 - **Moisture Control (Dew Point Control) (Desiccant Action of Interior Wythe)**
 - **Drainage (4 Separate Barriers)**
 - **Wall Cracking (or Jointing) in Either Wythe Does Not Lead to Wall Leakage**
 - **Maintenance (Life Cycle Cost)**
 - **Beauty**
 - **Flexibility (Both Design and Construction)**
- 

Double Wythe Cavity Wall System

- **Inside Block Surface Can Remain Exposed**
 - **Strength**
 - **Fire Proof (Reduces Insurance Cost)**
 - **Rot Proof**
 - **Termite Proof**
 - **Corrosion Proof**
 - **Sound Attenuation is Fantastic**
 - **LEED Points (Environmental)**
 - **Did I say Life Cycle Cost?**
- 

Cavity Wall Detail



Flashing Locations

Needed anywhere the downward vertical path of water to the weeps is interrupted:

- Base and foundation
- Lintels
- Bond beams
- Parapets
- Intermediate roofs



Good Flashing Detail - Cavity Wall



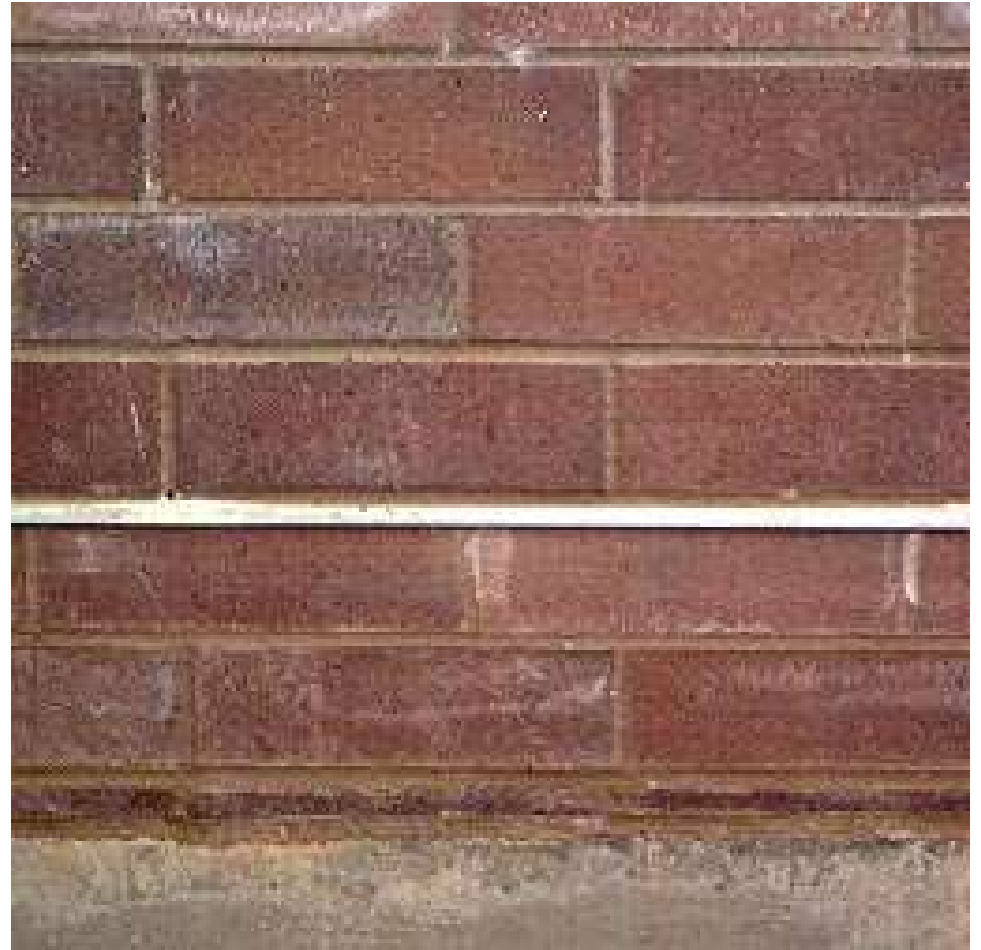


Poor Detail





Drip Edge





End Dams



Flashing Materials - Metals

Material	Advantages	Disadvantages
Stainless Steel	Durable, non staining	Hard to form
Cold-Rolled Copper	Flexible, durable, easy to work with	Damaged by excessive flexing and can stain
Galvanized Steel	Easy to paint and durable	Corrodes early in acidic and salty air

Flashing Materials

Plastic and Rubber Compounds

Material	Advantages	Disadvantages
EPDM	Flexible, easy to form, non-staining	Aesthetics, full support recommended
Rubberized asphalt	Fully adhered, self healing, flexible, easy to form and join	Full support required, degrades in UV light, metal drip edge required

**Pause for
Questions**



Flashing Materials

Plastic and Rubber Compounds

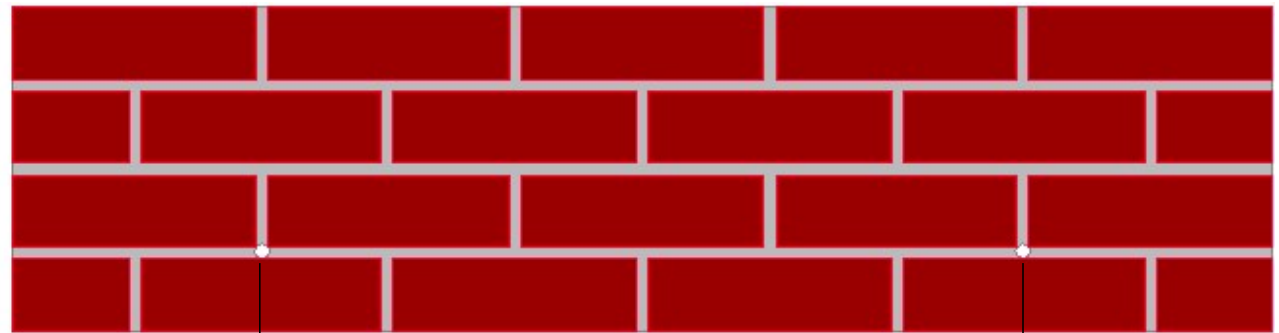
Material	Advantages	Disadvantages
PVC	Easy to form and join, non-staining, low cost	Easily damaged, full support required, metal drip edge required, questionable durability

Weep Holes

- Cotton sash cord for drainage path (remove after wall is laid up)
- Partially open head joints (preferred)

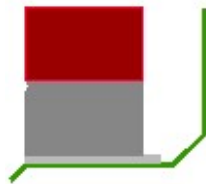


Weep Holes



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

(MSJC – 33 inches O.C.)



Rope Wick



Weep Tube

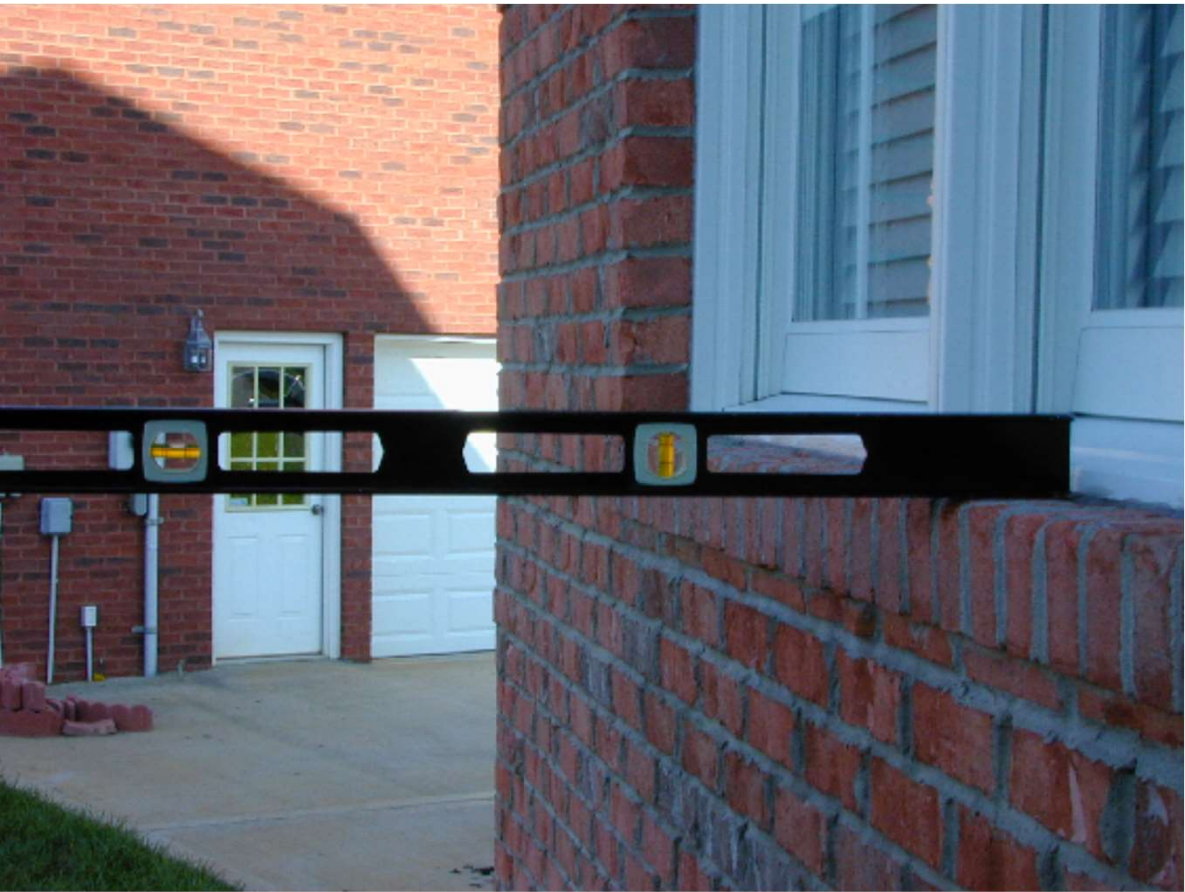


Open Head Joint
(Preferred)



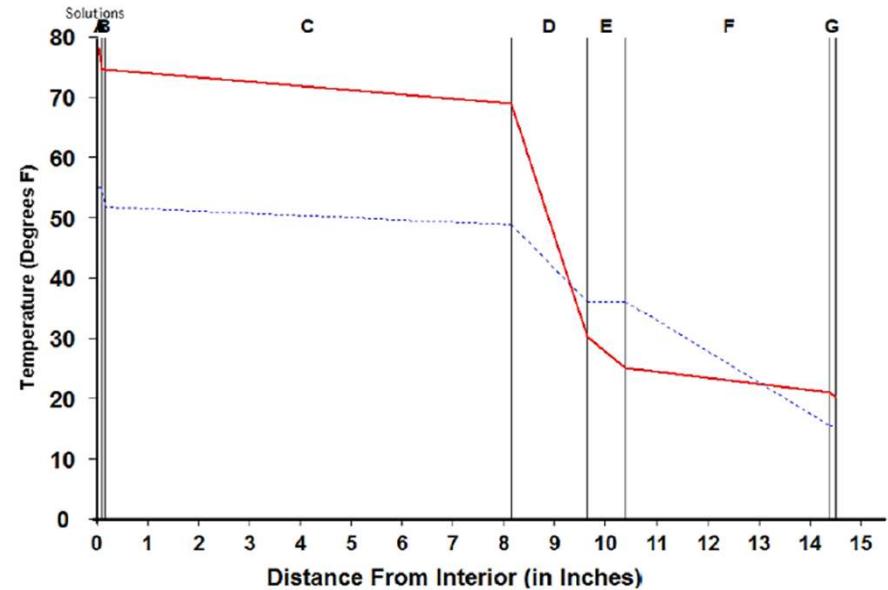
Weeps & Drainage

Window Sills- $\frac{3}{4}$ " Slope Minimum



Masonry Cavity Wall - Orlando Winter

Exterior XPS Insulation
Attached Directly to
Block



Legend	
—	Actual Temperature
- - -	Dewpoint Temperature

Dewpoint Theory predicts condensation in a system at any point where the actual and dewpoint temperature lines cross.

	Conditions:	
	Interior	Exterior
Temperature	78.0	20.0
Humidity	45.0	80.0

Component Name	Thickness	R-Value	Rep	Interface	Temperature		Accum (oz/day-sqft)
					Actual	Dewpnt	
A Interior Air Film	0.100	0.68	0.001	-A	78.00	54.95	0.000
B Latex Paint 2 Coat	0.050	0.01	0.500	AB	74.50	54.95	0.000
C Block Cinder & Gravel	8.000	1.10	0.400	BC	74.45	51.65	0.000
D CAVITYMATE Plus ins	1.500	7.50	1.350	CD	68.79	48.72	0.000
E Wall Air Space NonRefI	0.750	1.01	0.006	DE	30.19	36.01	* 0.003
F Brick Face 4 in	4.000	0.80	1.300	EF	24.99	35.94	* 0.005
G Outside Air Film Winter	0.100	0.17	0.001	FG	20.87	15.42	0.000
				GH	20.00	15.40	0.000
H				HI			
I				IJ			
J				JK			
K				KL			
L				L-			
TOTAL	14.500	11.27	3.558				



Single Wythe Walls

Ground, split, scored, tumbled, fluted, slump, glazed – the options are endless...

Best Performance Is Achieved By Redundancy

Level of Defense

Internal Protection

1

Integral Water Repellants

Integral Water Repellents

- An admixture which does not alter the finished appearance of the block.
- Lasts the lifetime of the unit.
- Cuts down on possibility of efflorescence.
- Incorporate a compatible admixture into the mortar.

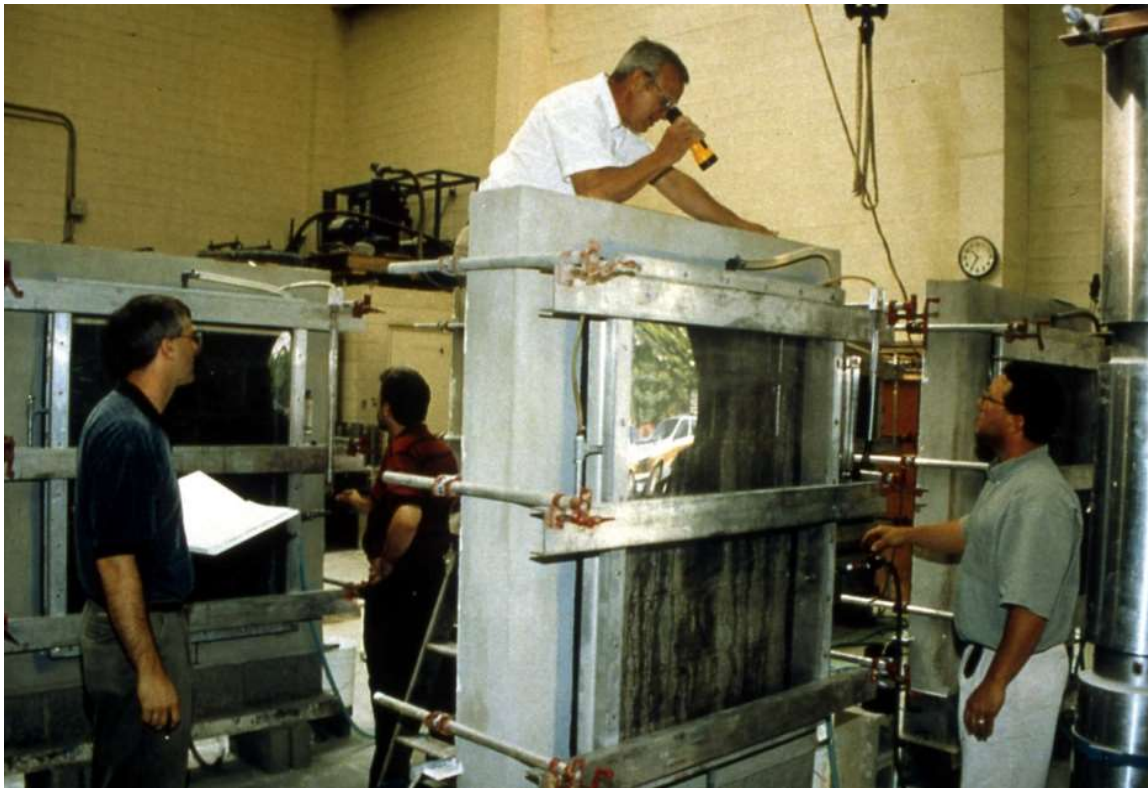


ASTM E 514 Test Method



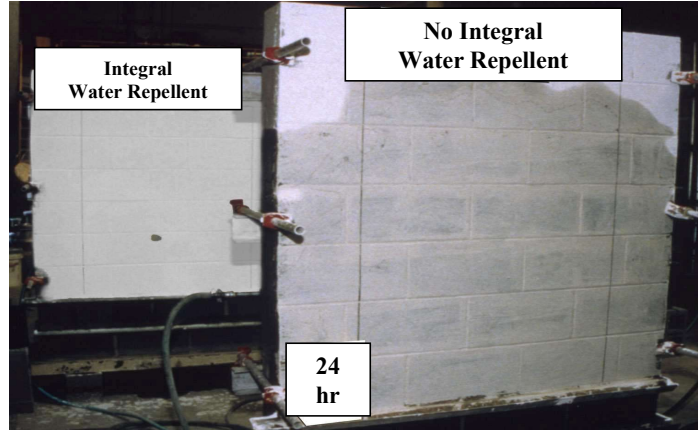
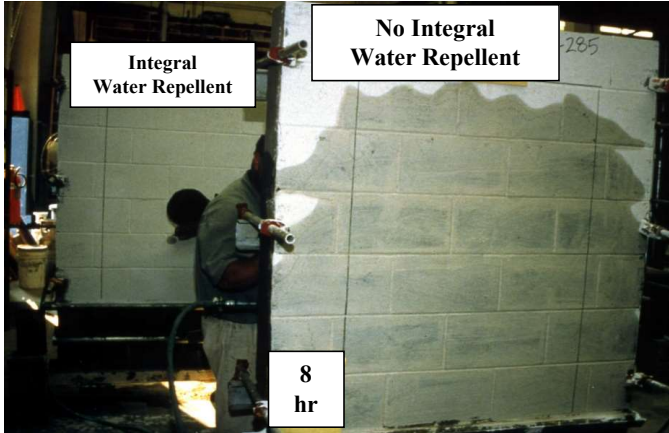
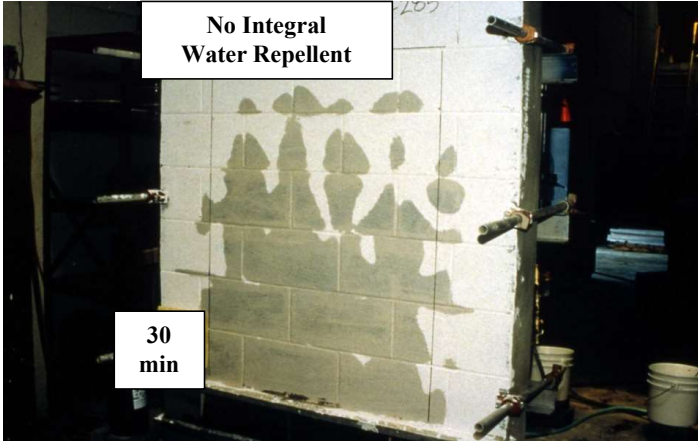
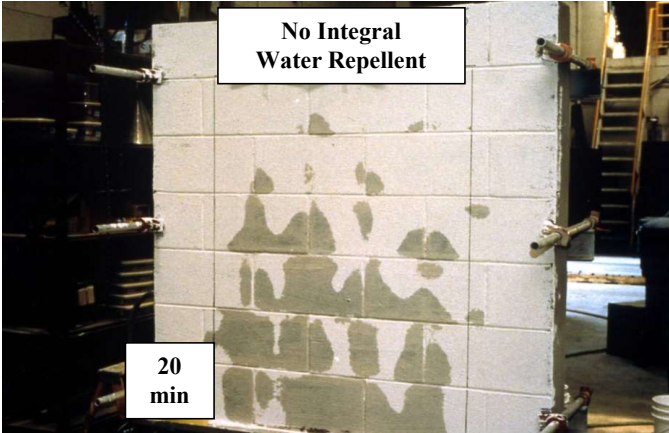
- 3 ft x 4 ft Test Area
- Spray-bar at 0.23 gal linear ft/min
- Air pressure of 10 psf
- Simulates 62.5 mph wind-driven rain(at 5.5 in/hr)
- Test run for 4 to 72 hours

ASTM E 514 Wall Evaluation



- % Dampness on back (interior) face of wall
- Leakage through front face shell (water collected in cores and drained through weeps & flashing)

ASTM E 514 Test Method



Best Performance Is Achieved By Redundancy

Level of Defense

Internal Protection

1

Integral Water Repellants

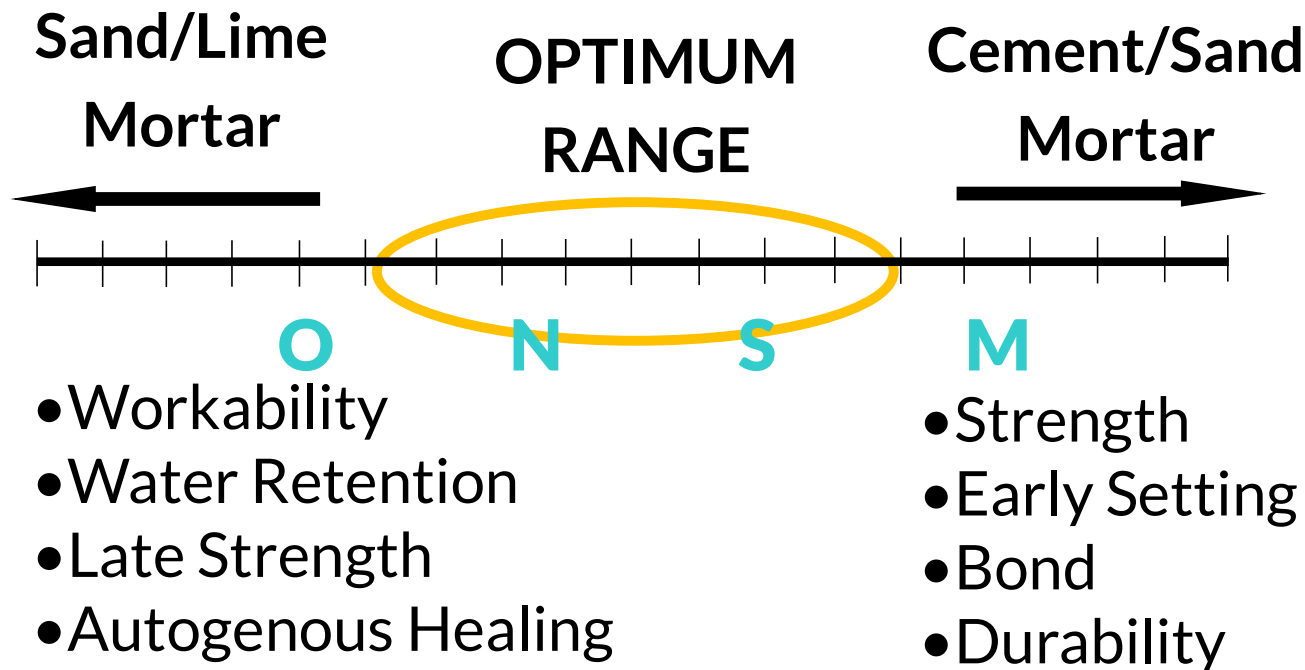
2a

Mortar Joints

Surface Protection

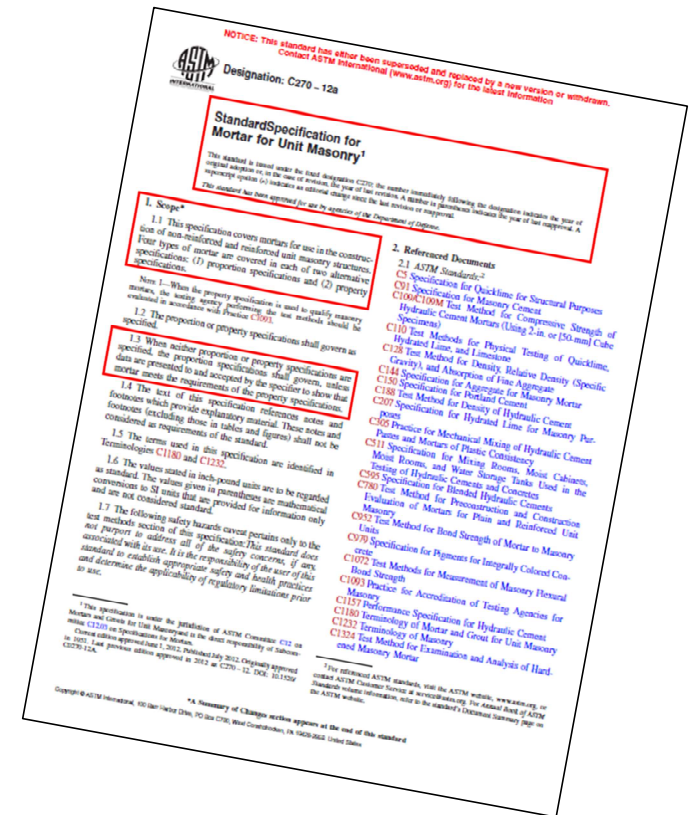


Which Mortar is the Best?



ASTM C 270 Mortar Selection Guide:

- Exterior walls - Type N (except high wind) (alternatively S or M)
- Below grade - Type S (alternatively M or N)



Joint Profiles

The role of tooling and the effect of joint profiles



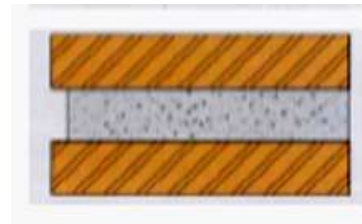
Concave



Weatherstruck



Flush



Raked

Best Performance Is Achieved By Redundancy

Level of Defense

Internal Protection

1

Integral Water Repellants

2A

Mortar Joints

2B

Sealants & Coatings

Surface Protection

Surface Protection: Clear Surface Treatments

- **Acrylics** - form elastic film over surface. Quick drying. \$
- **Silicone Resins** - good penetration. Drying time 4-5 hours. \$
- **Silanes** - good penetration. More volatile. Can be applied to damp surfaces. \$\$
- **Siloxanes** - similar benefits of silanes. Effective on wider variety of surfaces. \$\$

Best Performance Is Achieved By Redundancy

Level of Defense

Internal Protection	1	Integral Water Repellants
Surface Protection	2A	Mortar Joints
	2B	Sealants & Coatings
Wall Drainage	3	Flashing, Weeps & Vents

Flashing Locations

Needed anywhere the downward vertical path of water to the weeps is interrupted:

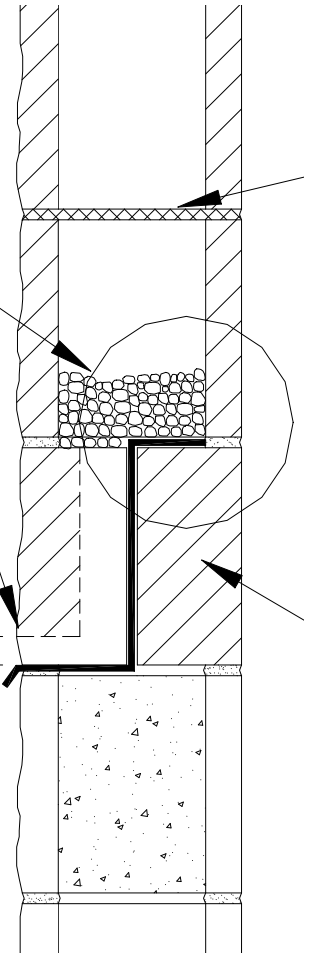
- Base and foundation
- Lintels
- Bond beams
- Parapets
- Intermediate roofs

Flashing Detail at Unreinforced Cell

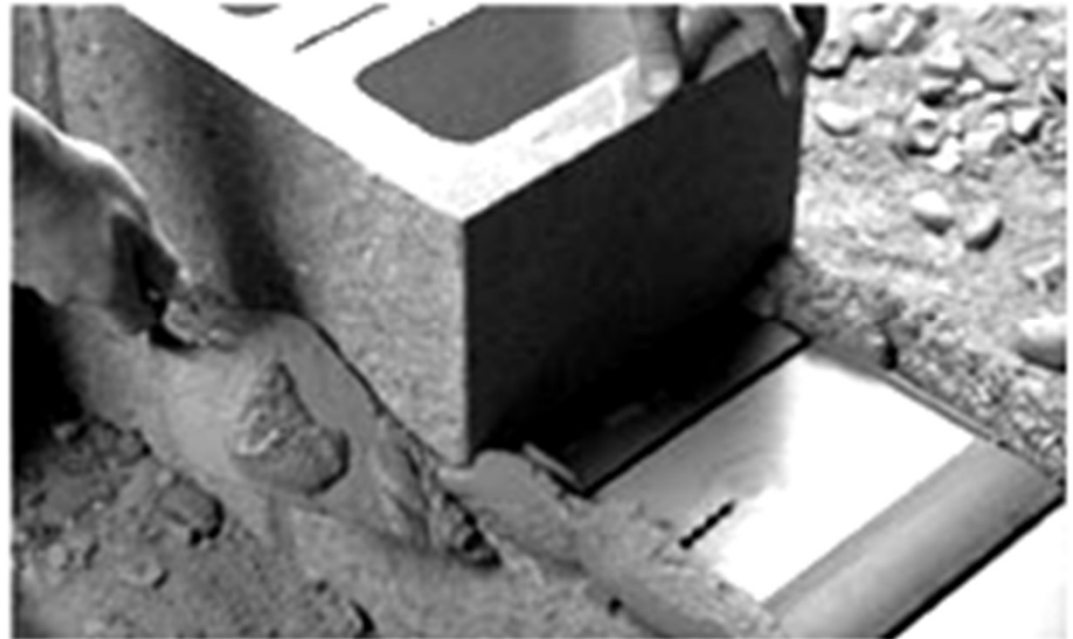
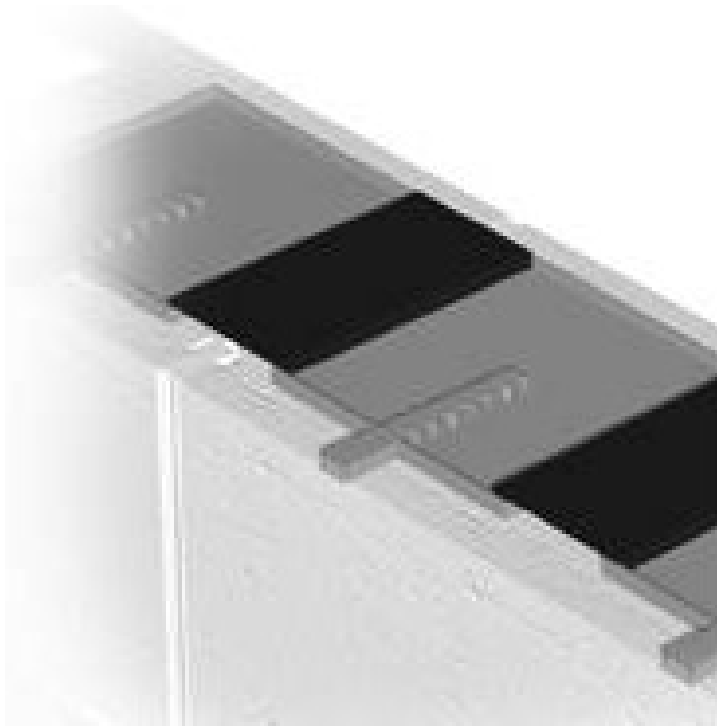
Cavity filter*
(typ. b & c)

Weep holes @
2 ft. 8 in. (813 mm)
o.c. partially open
"L-shaped" head
joints

1 in. (25 mm)



Through-Wall Single-Wythe Block Flashing



Best Performance Is Achieved By Redundancy

Level of Defense

Internal Protection	1	Integral Water Repellants
Surface Protection	2A	Mortar Joints
	2B	Sealants & Coatings
Wall Drainage	3	Flashing, Weeps & Vents
Crack Control	4	Control Joints

Location of Control Joints

- Abrupt changes in wall height
- Changes in wall thickness
- Above joints in foundations and floors
- Below joints in roofs and floors
- ½ the allowable joint spacing from wall corners
- One or both sides of doors and windows.

Location of Control Joints

Control Joints should be located at the following points of weakness or high stress concentrations:

1. At all abrupt changes in wall height
2. At all changes in wall thickness, such as those at pipe or duct chases and those adjacent to columns or pilasters.
3. Above joints in foundations and floors
4. Below joints in roofs and floors that bear on the wall
5. At a distance of not over one-half the allowable joint spacing from bonded intersections or corners.
6. At one or both sides of all door and window openings unless other crack control measures are used such as joint reinforcement of bond beams.

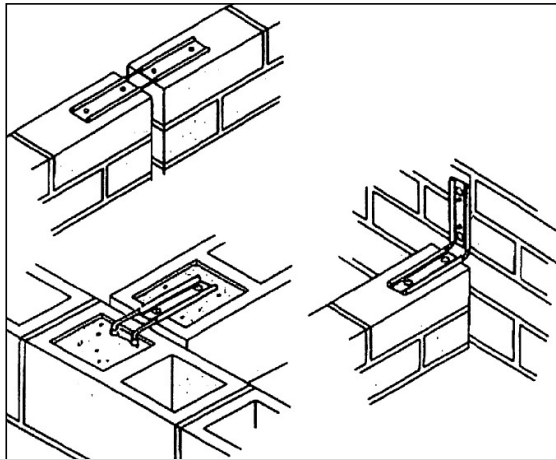
CONTROL JOINT SPACING FOR MOISTURE CONTROLLED,
*TYPE I
CONCRETE MASONRY UNITS

Historical

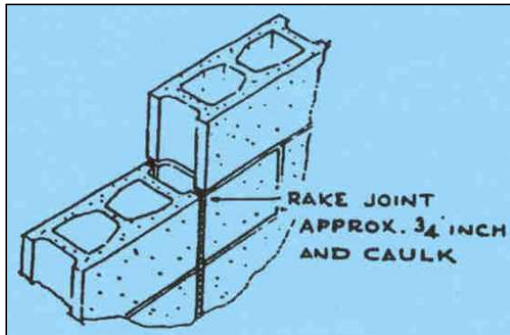
Recommended Spacing Of Control Joints	Vertical Spacing of Joint Reinforcement			
	None	24"	16"	8"
Expressed as ratio of Panel length to height L/H	2	2 ½	3	4
With Panel Length (L) Not to Exceed:	40'	45'	50'	60'

*See Bury the Myth for Type II

Control Joints

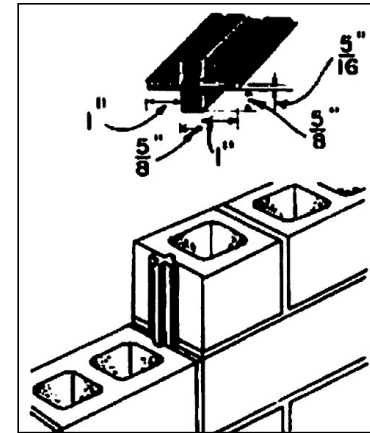


Mechanical Slip Connectors

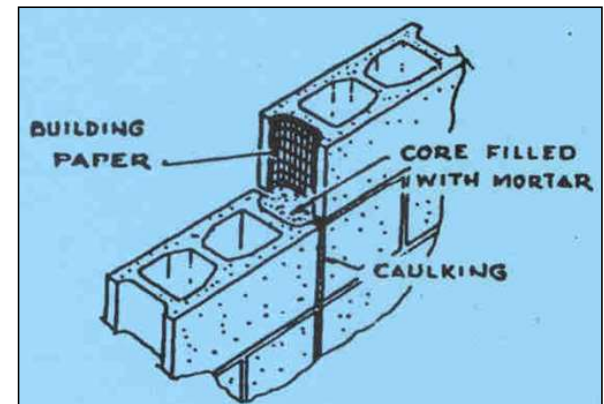


Standard Raked Joint (No Keyway)

The
4 most
Common
Control
joints



Sash Block with Preformed Gasket



Michigan Keyed Joint

CJ TEK 10-2C Table 1

**1 #5 bar for
12' height of wall**

Table 1—Recommended Control Joint Spacing for Above Grade Exposed Concrete Masonry Walls^A

Distance between joints not to exceed the lesser of:	
Length to height ratio	or ft (m)
1½ : 1	25 (7.62)

^A Notes:

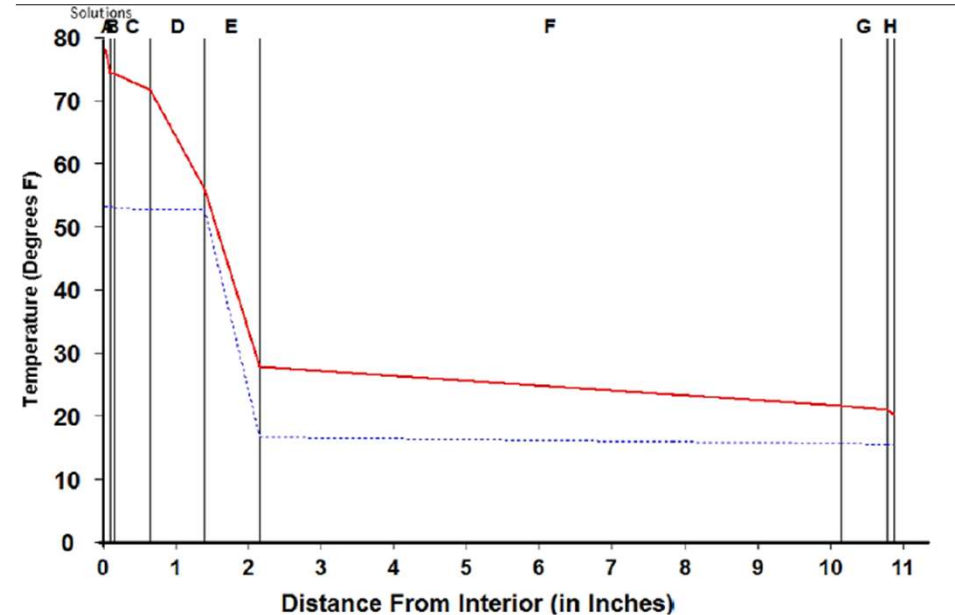
1. Table values are based on the use of horizontal reinforcement having an equivalent area of not less than 0.025 in.²/ft (52.9 mm²/m) of height to keep unplanned cracks closed (see Table 2).
2. Criteria applies to all concrete masonry units.

**Pause for
Questions**



Stucco on Block - Orlando Winter

Interior XPS Insulation
Attached Directly to
Block



Legend	
—	Actual Temperature
- - -	Dewpoint Temperature

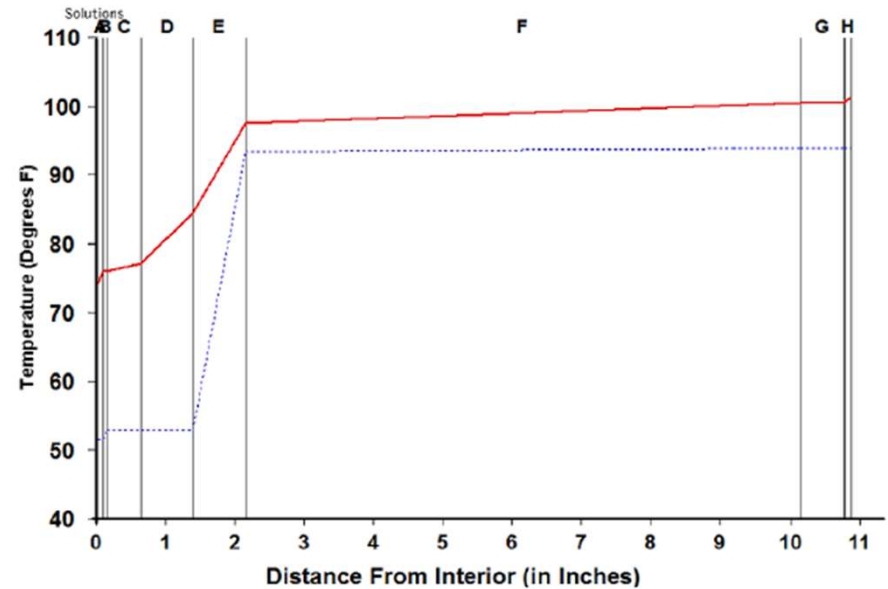
Dewpoint Theory predicts condensation in a system at any point where the actual and dewpoint temperature lines cross.

Conditions:		
	Interior	Exterior
Temperature	78.0	20.0
Humidity	42.0	80

Component Name	Thickness	R-Value	Rep	Interface	Temperature Actual	Temperature Dewpnt	Accum (oz/day-eqft)
A Interior Air Film	0.100	0.68	0.001	-A	78.00	53.06	0.000
B Latex Paint 2 Coat	0.050	0.01	0.500	AB	74.17	53.06	0.000
C Drywall .5in	0.500	0.45	0.014	BC	74.12	52.71	0.000
D Wall Air Space Reflect	0.750	2.80	0.006	CD	71.59	52.70	0.000
E TUFF-R Insulation	0.750	5.00	30.000	DE	55.84	52.69	0.000
F Block Cinder & Gravel	8.000	1.10	0.400	EF	27.71	16.48	0.000
G Stucco	0.625	0.10	0.030	FG	21.52	15.48	0.000
H Outside Air Film Winter	0.100	0.17	0.001	GH	20.96	15.40	0.000
				HI	20.00	15.40	0.000
				IJ			
				JK			
				KL			
				L-			
TOTAL		10.875	10.31				30.952

Stucco on Block -Orlando Summer

Interior XPS Insulation
Attached Directly to
Block



Legend	
—	Actual Temperature
⋯	Dewpoint Temperature

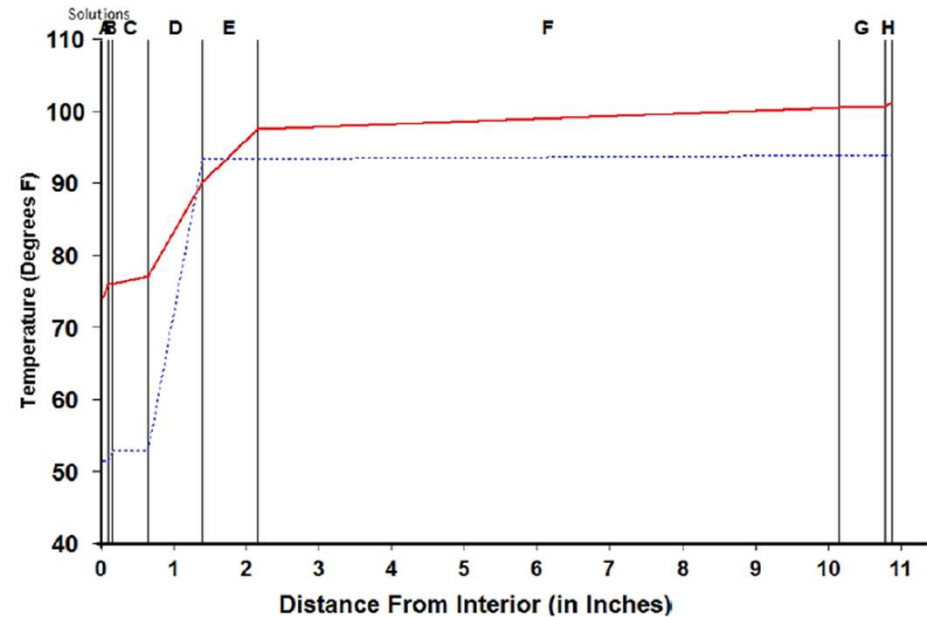
Dewpoint Theory predicts condensation in a system at any point where the actual and dewpoint temperature lines cross.

	Conditions:	
	Interior	Exterior
Temperature	74.0	101.0
Humidity	45.0	80

Component Name	Thickness	R-Value	Rep	Interface	Temperature		Accum (oz/ft ² -oqt)
					Actual	Dewpnt	
A Interior Air Film	0.100	0.68	0.001	-A	74.00	51.33	0.000
B Latex Paint 2 Coat	0.050	0.01	0.500	AB	75.78	51.33	0.000
C Drywall .5in	0.500	0.45	0.014	BC	75.81	52.69	0.000
D Wall Air Space Reflect	0.750	2.80	0.006	CD	76.99	52.72	0.000
E TUFF-R Insulation	0.750	5.00	30.000	DE	84.32	52.74	0.000
F Block Cinder & Gravel	8.000	1.10	0.400	EF	97.41	93.33	0.000
G Stucco	0.625	0.10	0.030	FG	100.29	93.64	0.000
H Outside Air Film Winter	0.100	0.17	0.001	GH	100.55	93.66	0.000
				HI	101.00	93.67	0.000
I				IJ			
J				JK			
K				KL			
L				L-			
TOTAL		10.875	10.31				30.952

Stucco on Block - Orlando Summer

Interior XPS Insulation Over Furring on Block



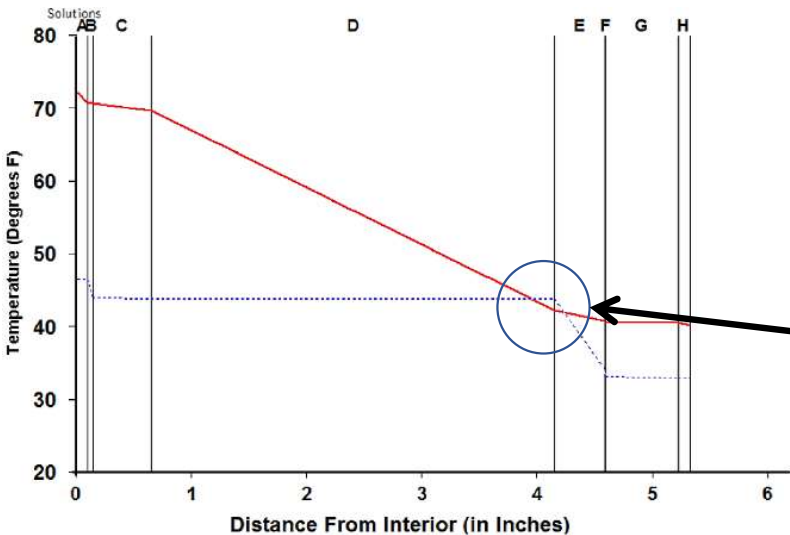
Legend	
—	Actual Temperature
- - -	Dewpoint Temperature

Dewpoint Theory predicts condensation in a system at any point where the actual and dewpoint temperature lines cross.

Conditions:		
	Interior	Exterior
Temperature	74.0	101
Humidity	45.0	80

Component Name	Thickness	R-Value	Rep	Interface	Temperature		Accum (oz/day-sqft)
					Actual	Dewpnt	
A Interior Air Film	0.100	0.68	0.001	-A	74.00	51.33	0.000
B Latex Paint 2 Coat	0.050	0.01	0.500	AB	75.78	51.33	0.000
C Drywall .5in	0.500	0.45	0.014	BC	75.81	52.69	0.000
D TUFF-R Insulation	0.750	5.00	30.000	CD	76.99	52.72	0.000
E Wall Air Space Reflect	0.750	2.80	0.006	DE	90.08	93.32	* 0.019
F Block Cinder & Gravel	8.000	1.10	0.400	EF	97.41	93.33	0.000
G Stucco	0.625	0.10	0.030	FG	100.29	93.64	0.000
H Outside Air Film Winter	0.100	0.17	0.001	GH	100.55	93.66	0.000
				HI	101.00	93.67	0.000
				IJ			
				JK			
				KL			
				L-			
TOTAL	10.875	10.31	30.952				

Stucco on Wood Frame - Orlando Winter



Condensation in the Batt Insulations Against the Outside Sheathing

Legend	
—	Actual Temperature
·····	Dewpoint Temperature

Dewpoint Theory predicts condensation in a system at any point where the actual and dewpoint temperature lines cross.

	Conditions:	
	Interior	Exterior
Temperature	72.0	40.0
Humidity	40.0	75.0

Component Name	Thickness	R-Value	Rep	Interface	Temperature Actual	Temperature Dewpnt	Accum (col/day-night)
A Interior Air Film	0.100	0.68	0.001	-A	72.00	46.39	0.000
B Latex Paint 2 Coat	0.050	0.01	0.500	AB	70.56	46.38	0.000
C Drywall .5in	0.500	0.45	0.014	BC	70.54	43.76	0.000
D R-13 Fiberglass Batt	3.500	13.00	0.010	CD	69.59	43.69	0.000
E OSB at 7/16 in	0.438	0.70	1.500	DE	42.07	43.63	▲ 0.002
F WEATHERMATE Housewrap	0.010	0.01	0.130	EF	40.59	34.00	0.000
G Stucco	0.625	0.10	0.030	FG	40.57	32.99	0.000
H Outside Air Film Winter	0.100	0.17	0.001	GH	40.36	32.76	0.000
				HI	40.00	32.75	0.000
				IJ			
				JK			
				KL			
				L-			
TOTAL	5.323	15.12	2.186				

R-13 Batt Insulation Between the Wood Studs

Florida Masonry and Stucco

Standing the
“Test of Time”





**Bond, Bond
& More
Bond**



Masonry & Stucco Do's & Don'ts

DO - Bond, Bond, Bond – and more bond. Open texture block (if available) to achieve mechanical and chemical bond.

DO - Line up your stucco joints with your block control joints. **NO OTHER JOINTS ARE REQUIRED IN STUCCO APPLIED DIRECTLY TO THE BLOCK.**



Masonry and Stucco

Do's and Don'ts

- **DO** – Make sure you have the proper control joints in the block work. Cracks leak. This is just as true for Single Wythe walls.
- **DO** – Use a “top of the line” Acrylic paint
- **DON'T** – use integral water proofing in the block. It will eliminate suction bond which is very important.
- **DON'T** – use lath unless absolutely necessary. Direct applied to the concrete or masonry substrate is the industry's recommendation.

What to do when stucco must be adhered to a smooth surface

- Prohibit “floating” or “sponging” of wall.
- Thoroughly clean substrate. Cleaner should be on the acid side to remove latent cement dust and particles.
- Dampen substrate (stucco contractors tend to over wet stucco mix if substrate is too dry).
- Make sure that a “suction bond” is available (does the surface absorb water?)

What to do when stucco must be adhered to a smooth surface

- **Use a non-re-emulsifiable (non-re-wettable) bonding agent meeting the requirements of ASTM C 932 (stucco must be applied while bonding agent is “tacky”).**
- **As an alternate to a surface applied bonding agent - replace 1/3 of mix water of scratch coat with ASTM 932 bonding agent (check product manufactures recommendations for this use).**

**Thank you!
Any other
Questions?**

