# 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.

www.floridamasonry.com

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MASONRY ASSOCIATION OF FLORIDA, INC.
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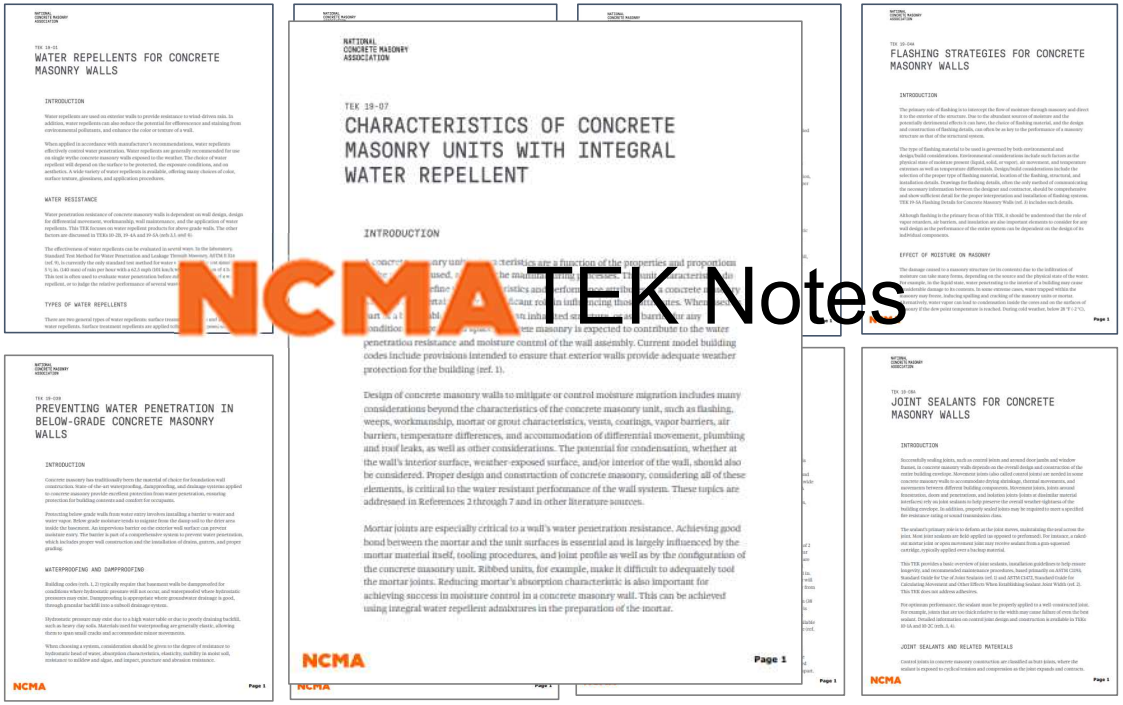
# Session Handouts



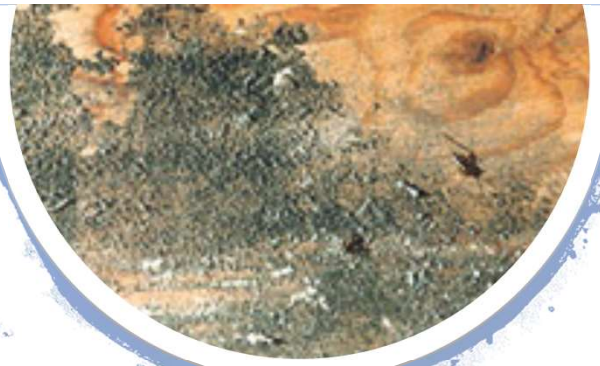

NCMA TEK Notes

# 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!

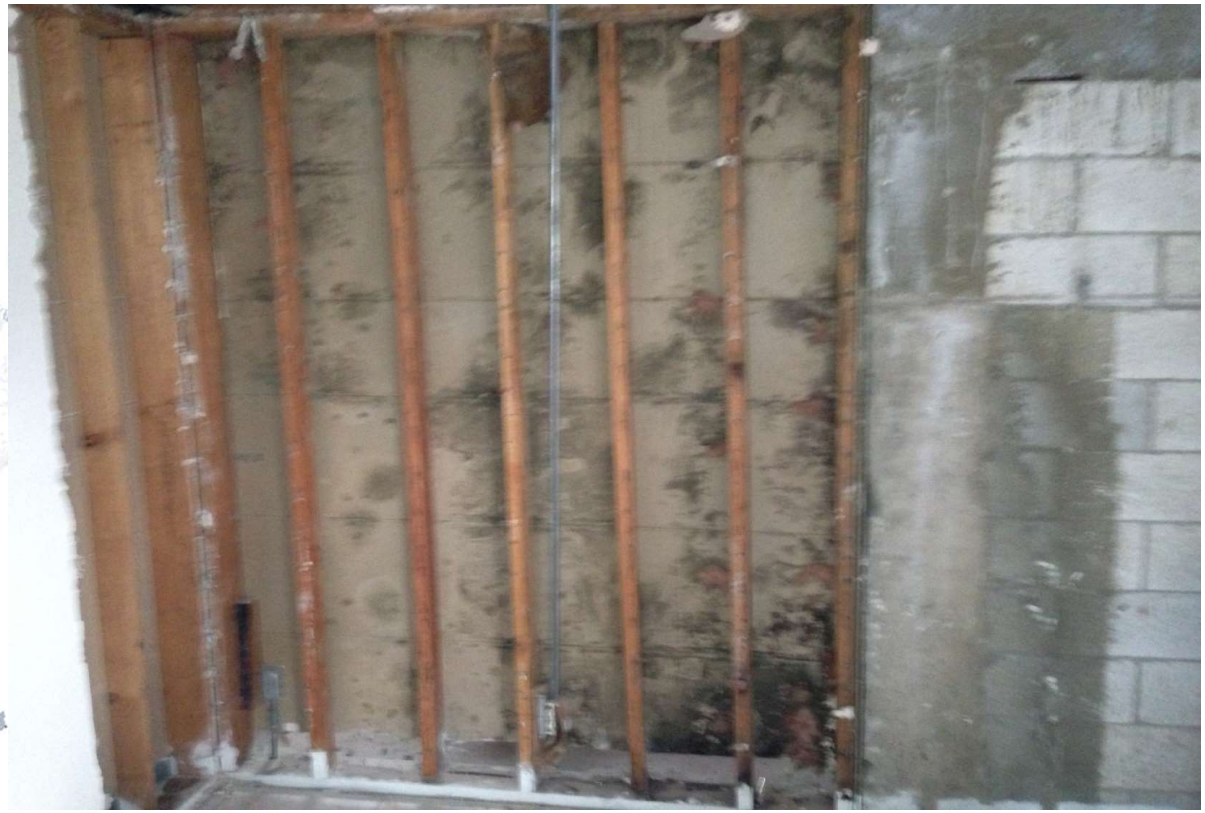



Breathing Problems Anyone?

# Don’t Feed the Mold!

Mold on Wood But NOT on Masonry

# Don’t Feed the Mold!



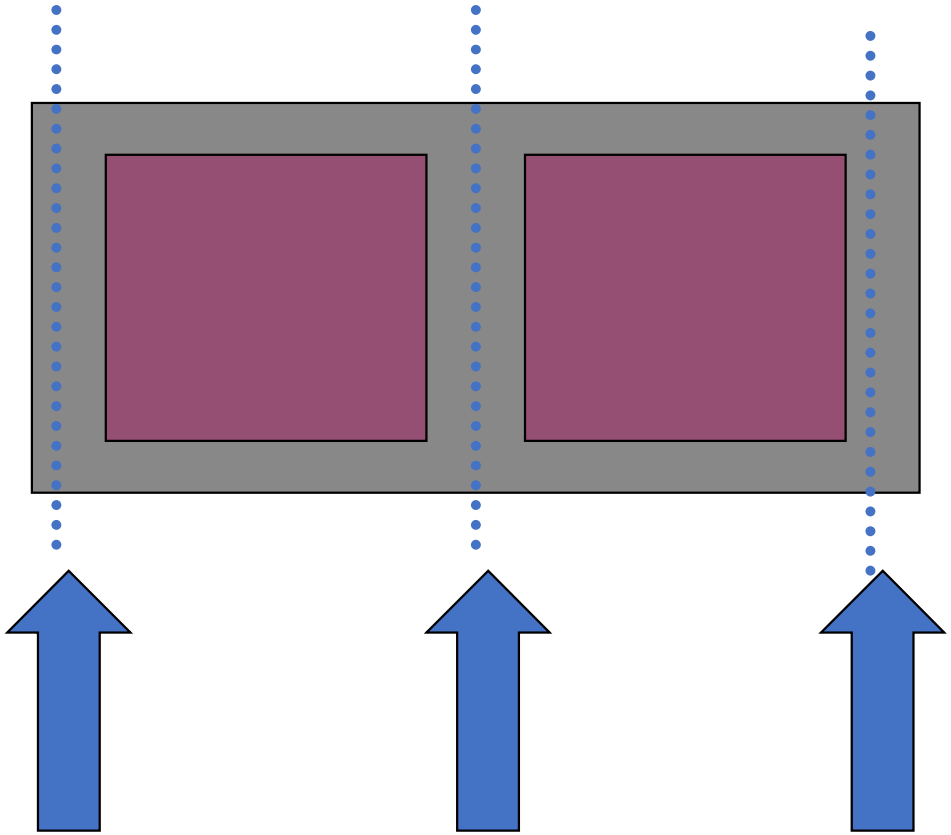
# Moisture and Mold Summary

- Masonry is not a food source for mold!

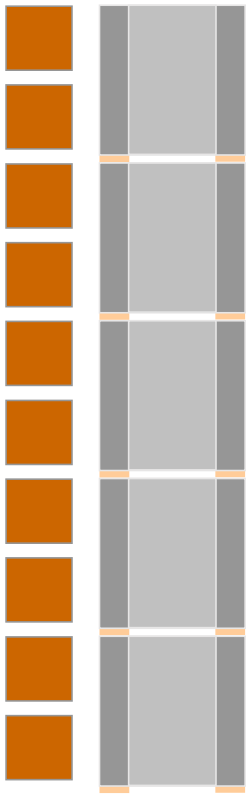
- Masonry is not damaged by moisture!

# Forces of Moisture Migration

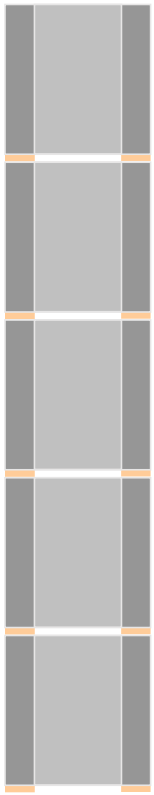
- Capillary Action
- Gravity
- Pressure
  - Wind driven rain
  - Differential pressure



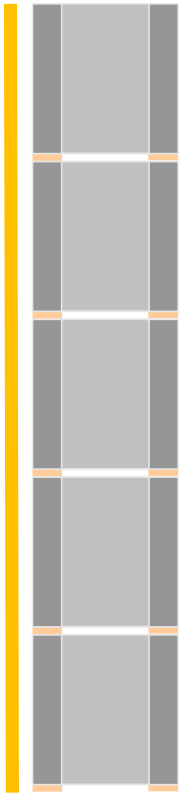
# Design Considerations:
# Basic Concrete Masonry Wall Types



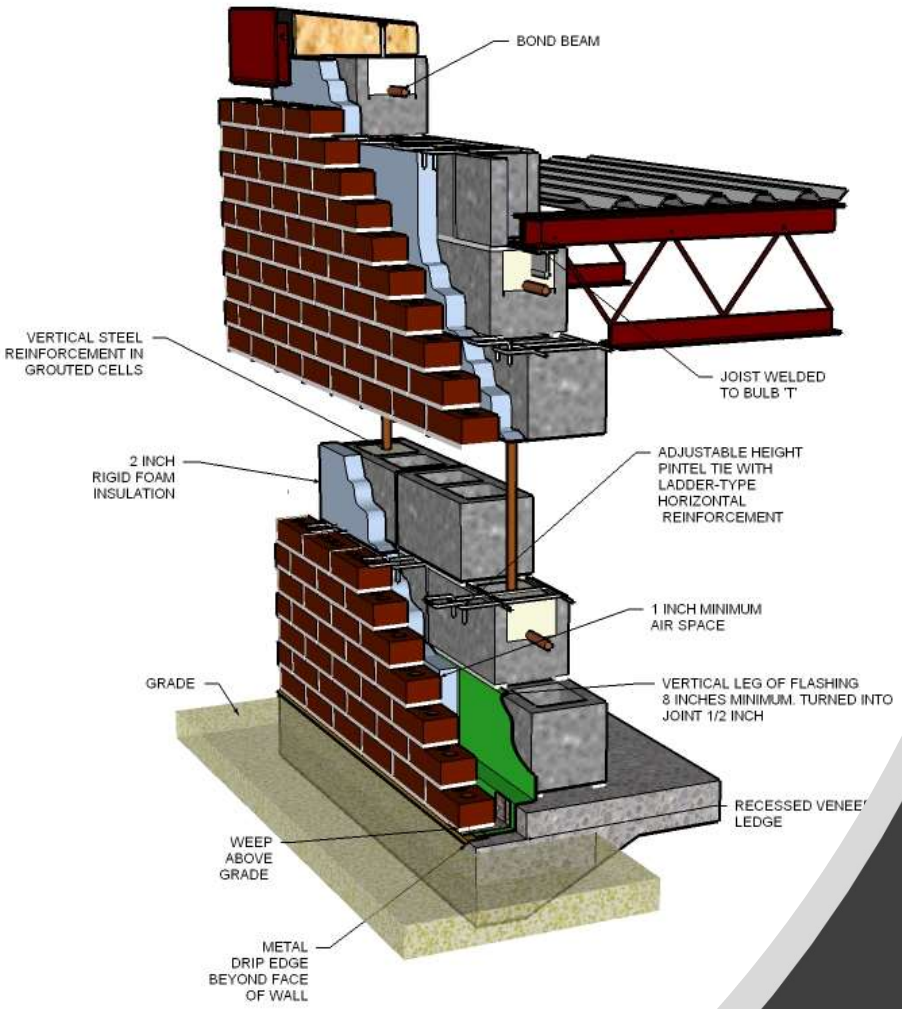
Double Wythe Cavity



Single Wythe



Stucco

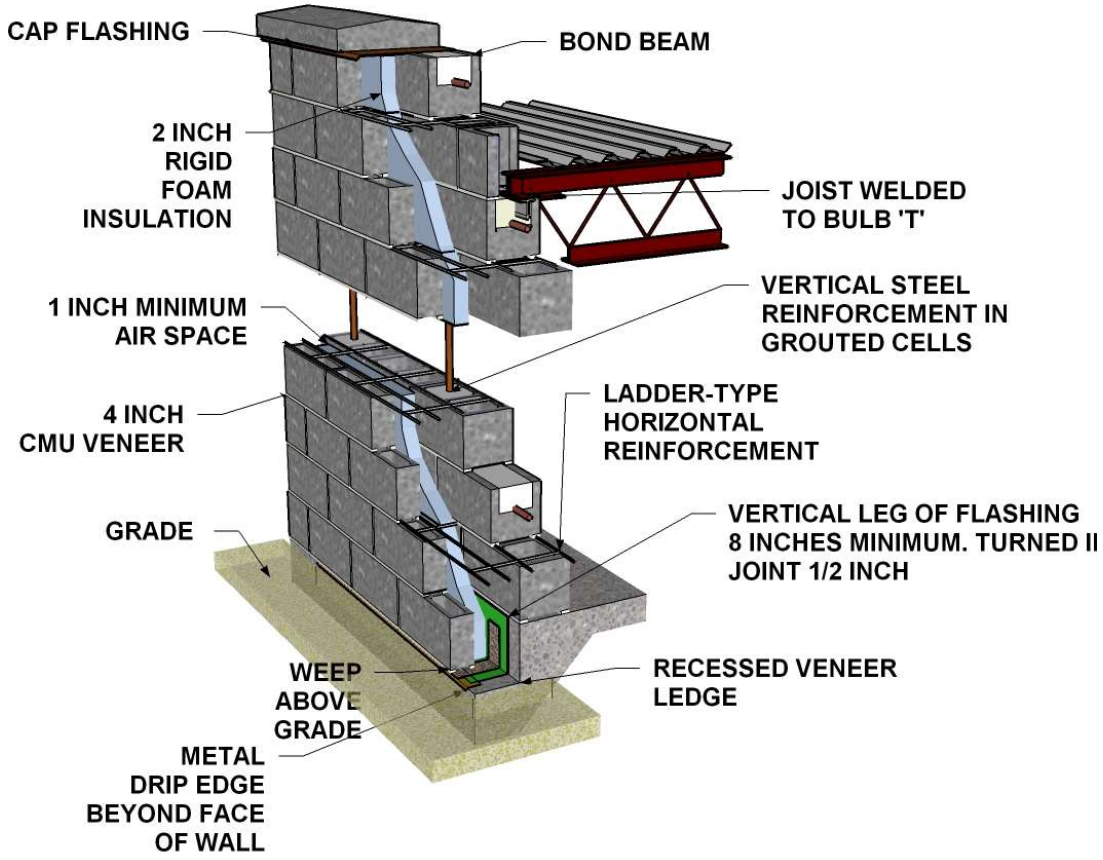



# Double Wythe Cavity Wall System

## Worlds Best Wall System

# Double Wythe Cavity Wall System

Worlds Best Wall System




WHY?

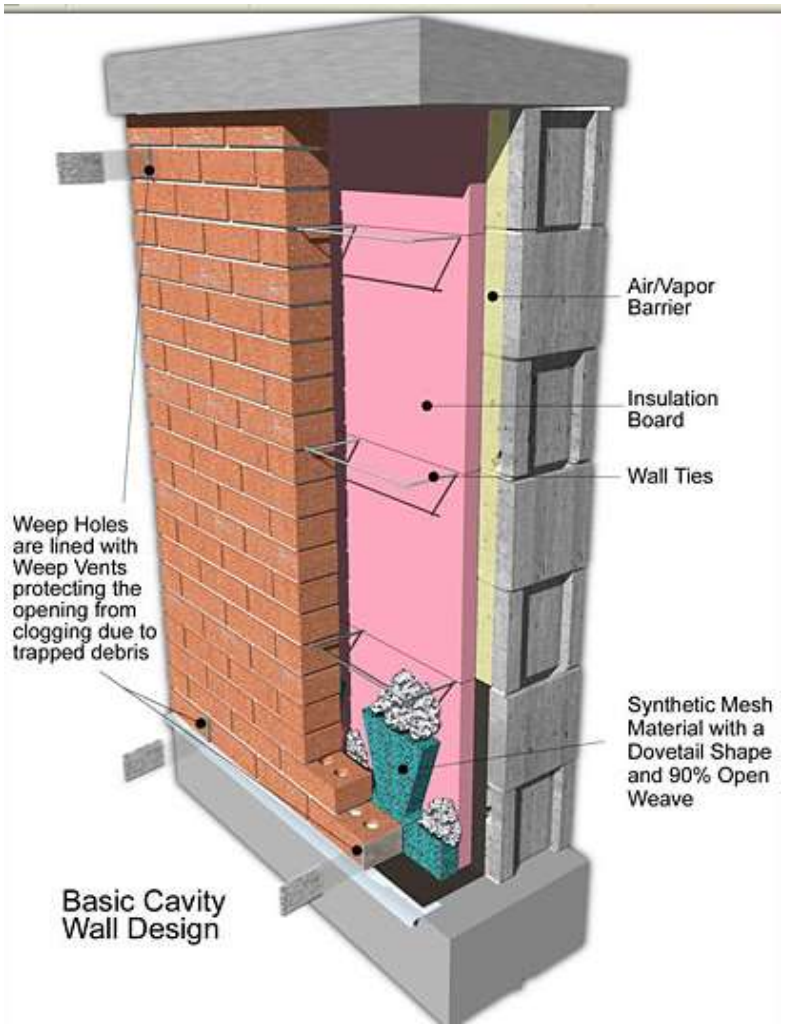
# Double Wythe Cavity Wall System

- 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

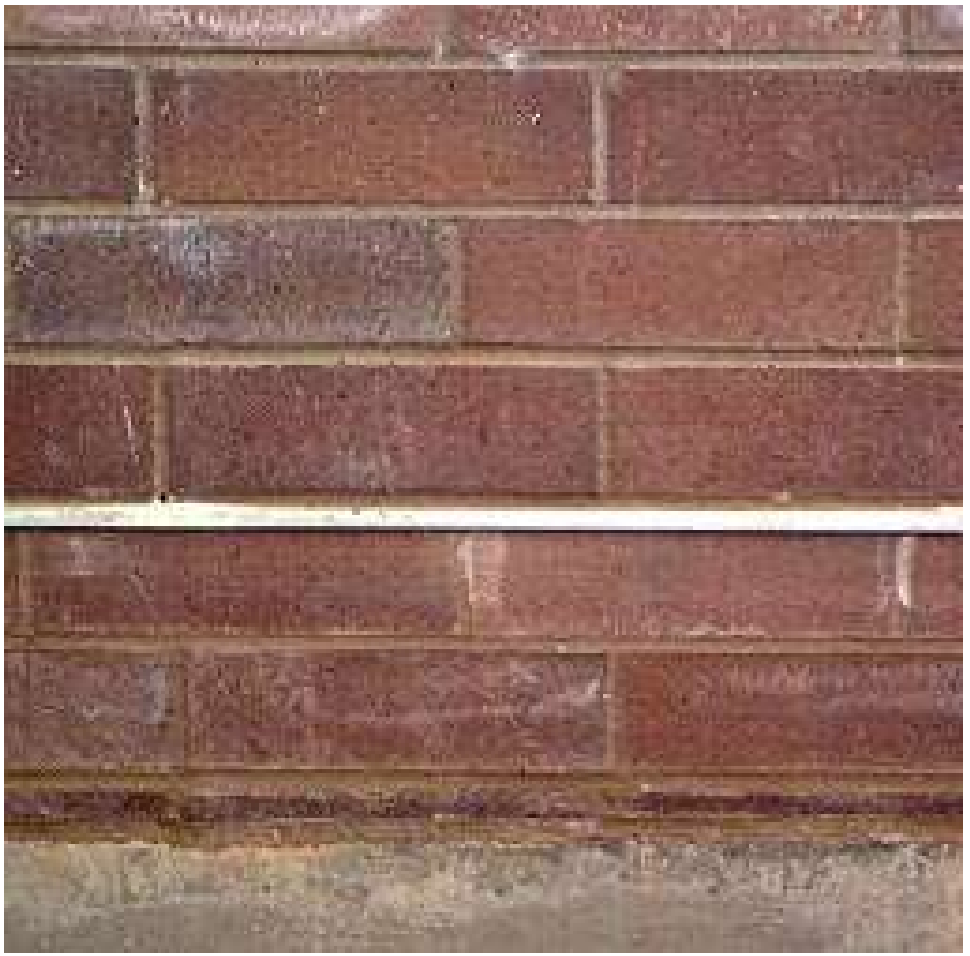
Needed anywhere the downward vertical path of water to the weeps is interrupted:

- 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

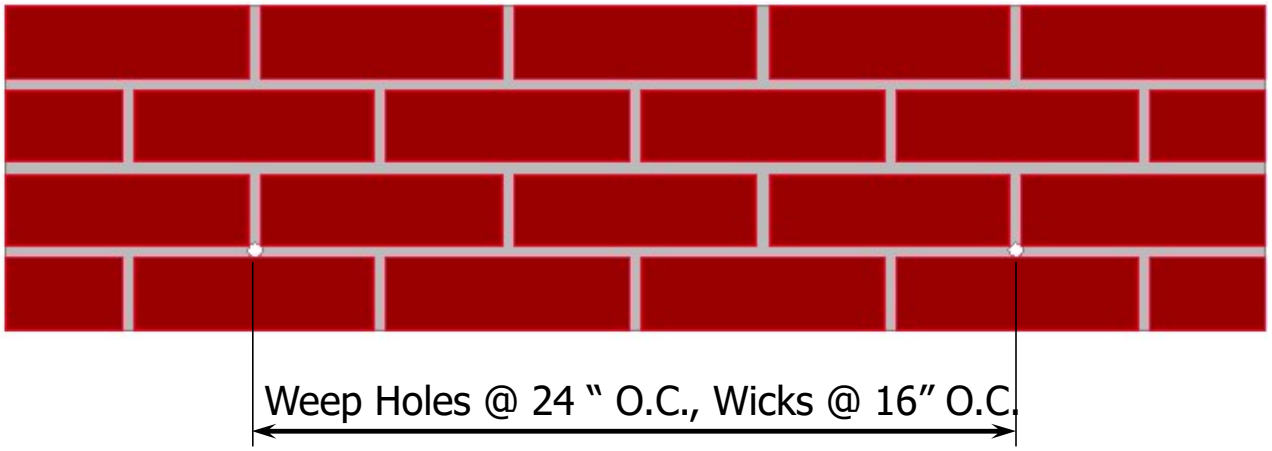
# Flashing Materials
## Plastic and Rubber Compounds

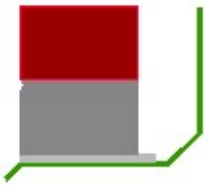
| Material | Advantages | Disadvantages |
|---|---|---|
| PVC | Easy to form and join, non-staining, low cost | Easily damaged, full support required, metal drip edge required, questionable durability |

# Weep Holes

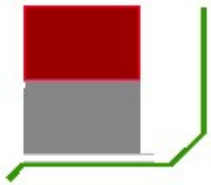
- Cotton sash cord for drainage path (remove after wall is laid up)
- Partially open head joints (preferred)

# Weep Holes



Rope Wick



Weep Tube

Open Head Joint
(Preferred)

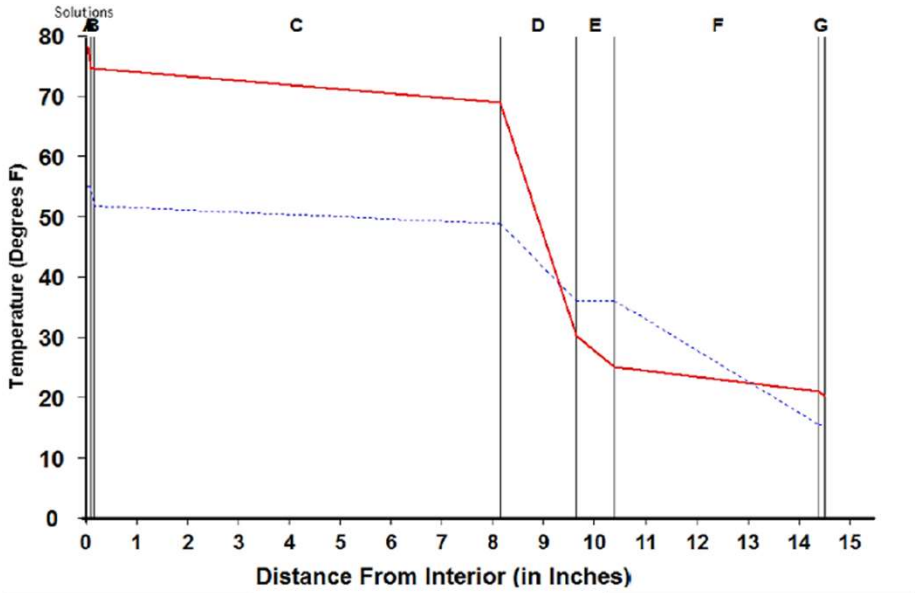


# Weeps & Drainage

# Window Sills- ¾” Slope Minimum

# Masonry Cavity Wall – Orlando Winter

## Exterior XPS Insulation Attached Directly to Block




| | Component Name | Thickness | R-Value | Rep |
|---|---|---|---|---|
| A | Interior Air Film | 0.100 | 0.68 | 0.001 |
| B | Latex Paint 2 Coat | 0.050 | 0.01 | 0.500 |
| C | Block Cinder & Gravel | 8.000 | 1.10 | 0.400 |
| D | CAVITYMATE Plus Ins | 1.500 | 7.50 | 1.350 |
| E | Wall Air Space NonRefl | 0.750 | 1.01 | 0.006 |
| F | Brick Face 4 in | 4.000 | 0.80 | 1.300 |
| G | Outside Air Film Winter | 0.100 | 0.17 | 0.001 |
| H | | | | |
| I | | | | |
| J | | | | |
| K | | | | |
| L | | | | |
| | TOTAL | 14.500 | 11.27 | 3.558 |

| Interface | Temperature Actual | Temperature Dewpnt | Accum (cz/day-sqft) |
|---|---|---|---|
| -A | 78.00 | 54.95 | 0.000 |
| AB | 74.50 | 54.95 | 0.000 |
| BC | 74.45 | 51.65 | 0.000 |
| CD | 68.79 | 48.72 | 0.000 |
| DE | 30.19 | 36.01 | * 0.003 |
| EF | 24.99 | 35.94 | * 0.005 |
| FG | 20.87 | 15.42 | 0.000 |
| GH | 20.00 | 15.40 | 0.000 |
| HI | | | |
| IJ | | | |
| JK | | | |
| KL | | | |
| L- | | | |

# 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**

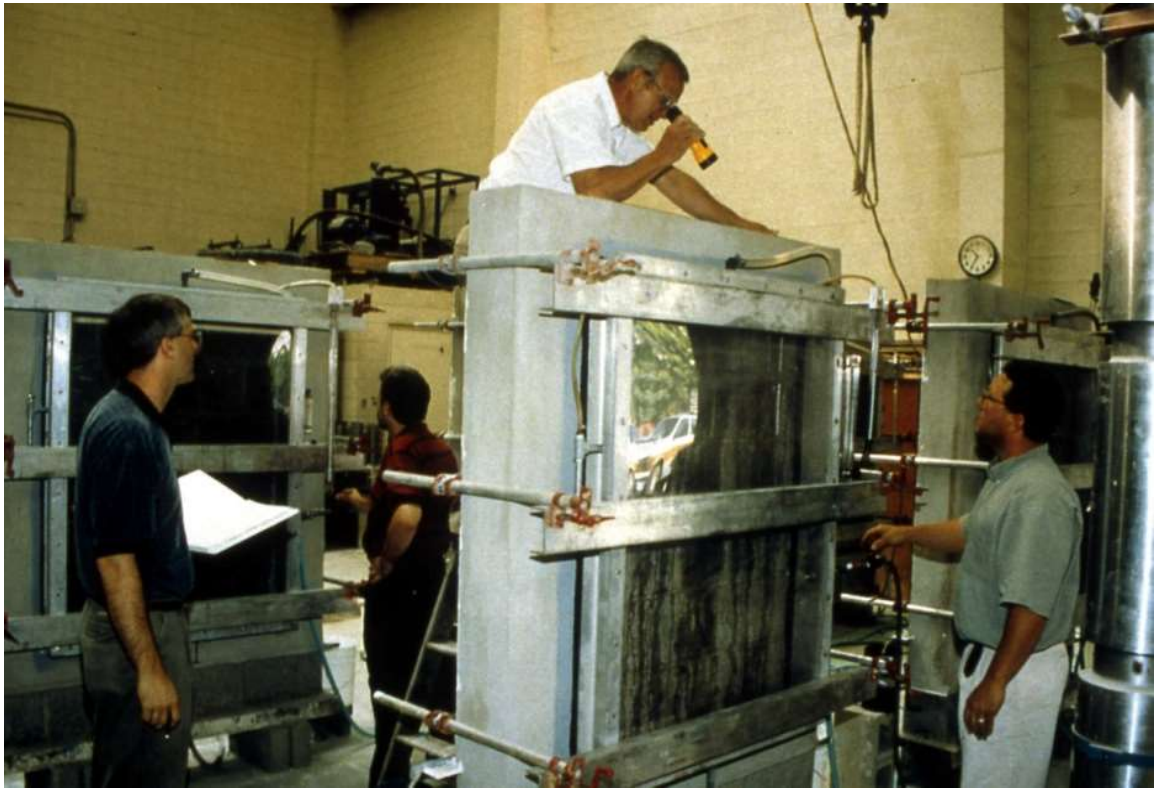
# Integral Water Repellents

- 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

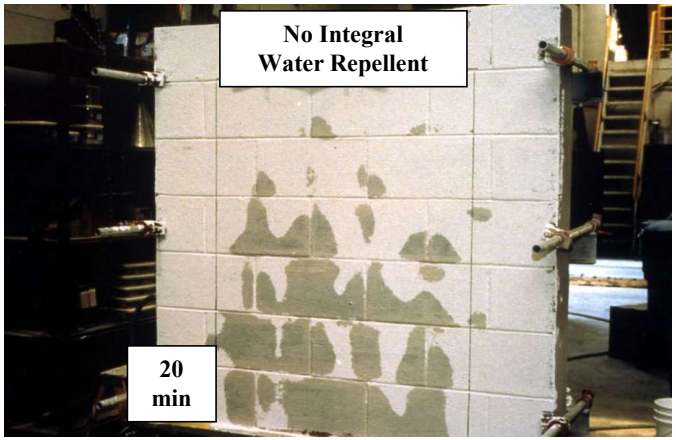
- 3 ft x 4 ft  Test Area
- Spray-bar at 0.23 gal linear ft/min
- Air pressure of 10 psf
- Simulates 62.5 mph wind-driven rain(at 5.5 in/hr)
- Test run for 4 to 72 hours

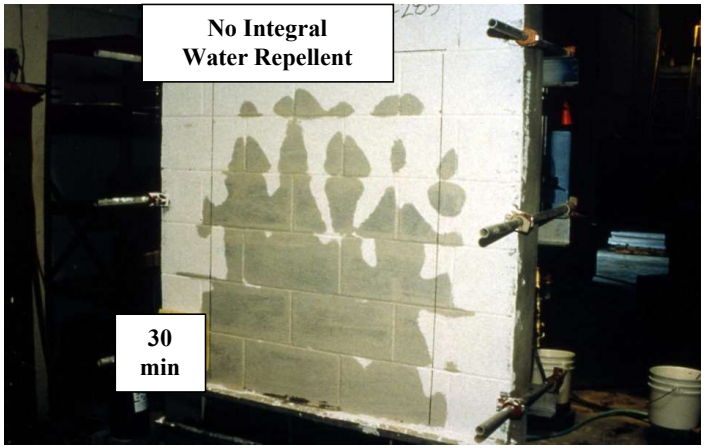
# ASTM E 514 Wall Evaluation

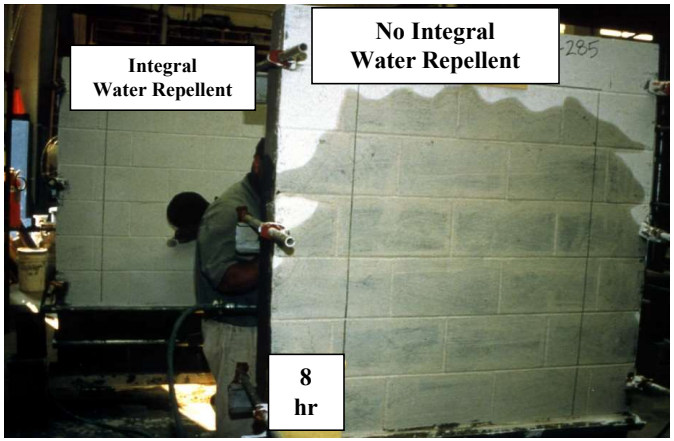


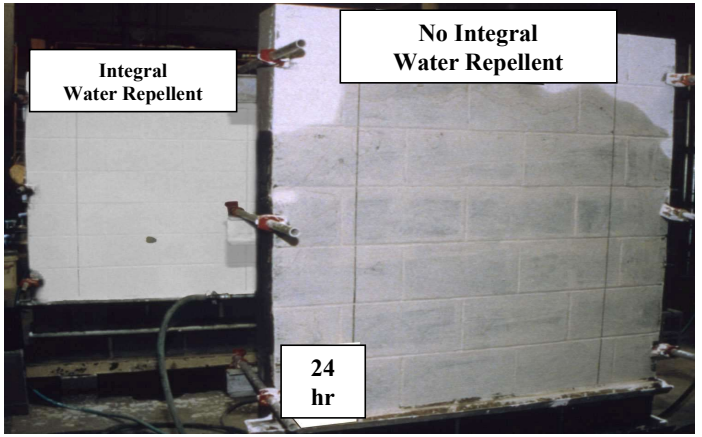
- % Dampness on back (interior) face of wall
- Leakage through front face shell (water collected in cores and drained through weeps & flashing)

# ASTM E 514 Test Method

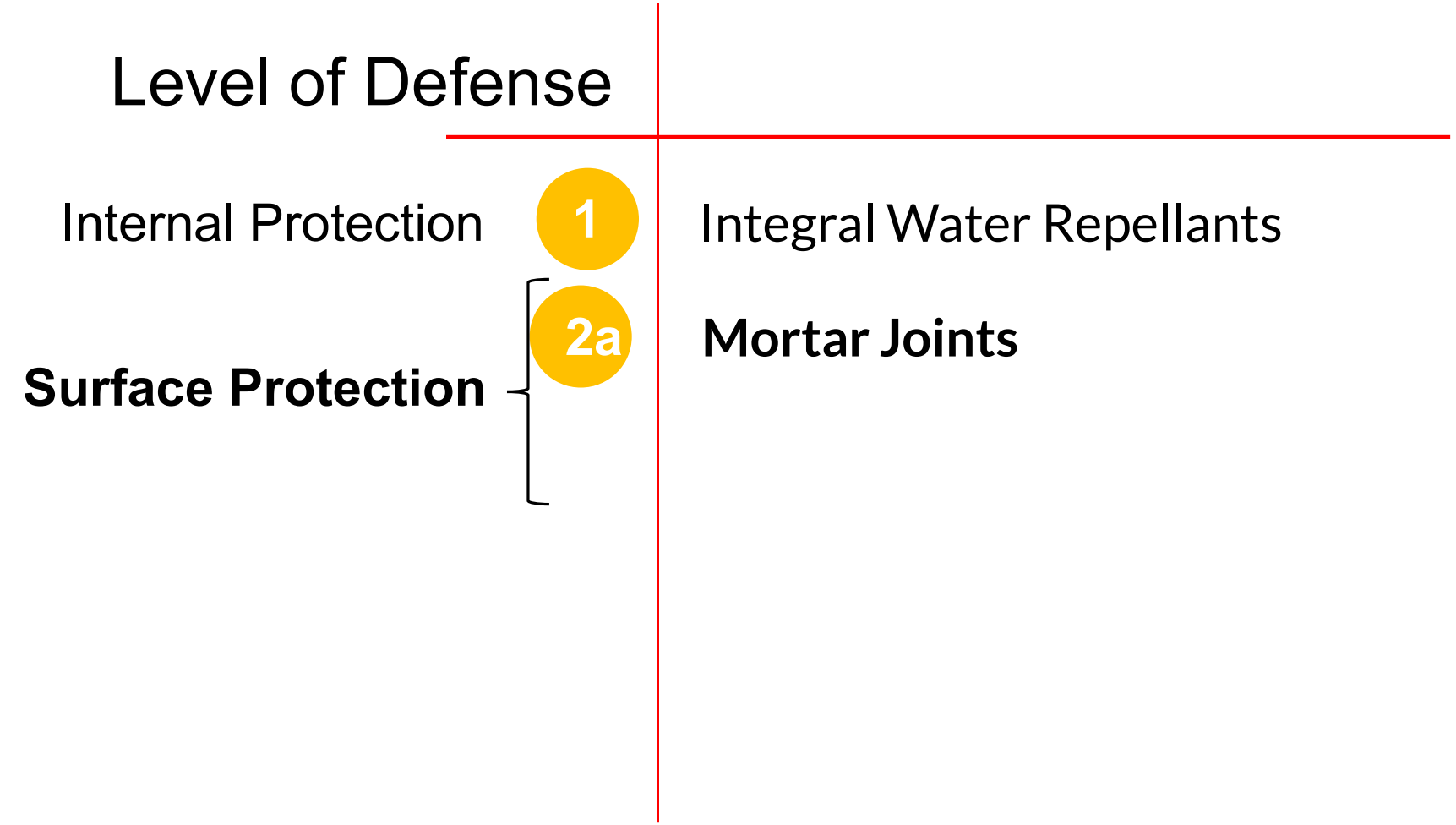


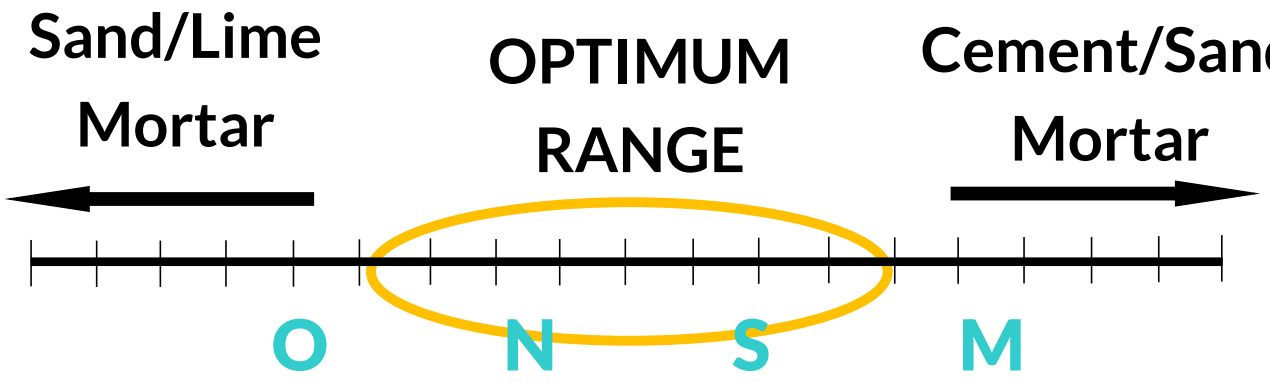



# Best Performance Is Achieved By Redundancy

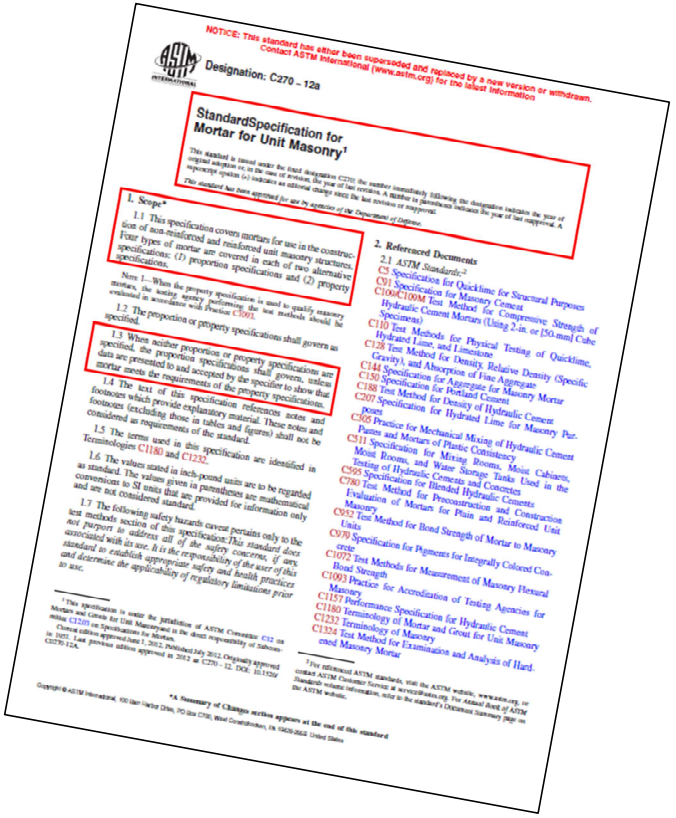


# Which Mortar is the Best?




- Workability
- Water Retention
- Late Strength
- Autogenous Healing

- Strength
- Early Setting
- Bond
- Durability



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

Designation: C270 – 12a

**Standard Specification for Mortar for Unit Masonry**[1]

1. Scope*

2. Referenced Documents

## 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

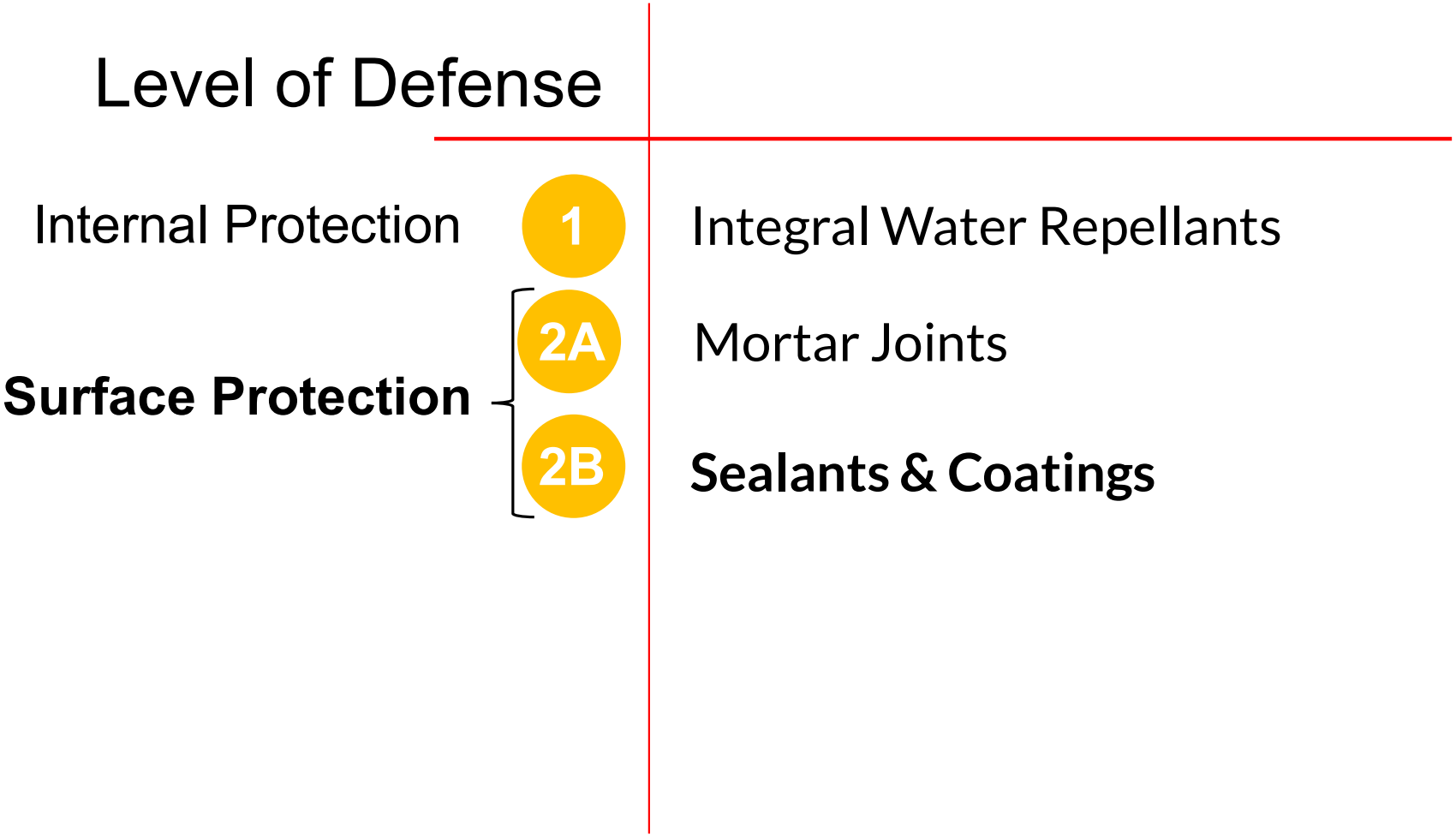
*Concave*

*Weatherstruck*

*Flush*

*Raked*

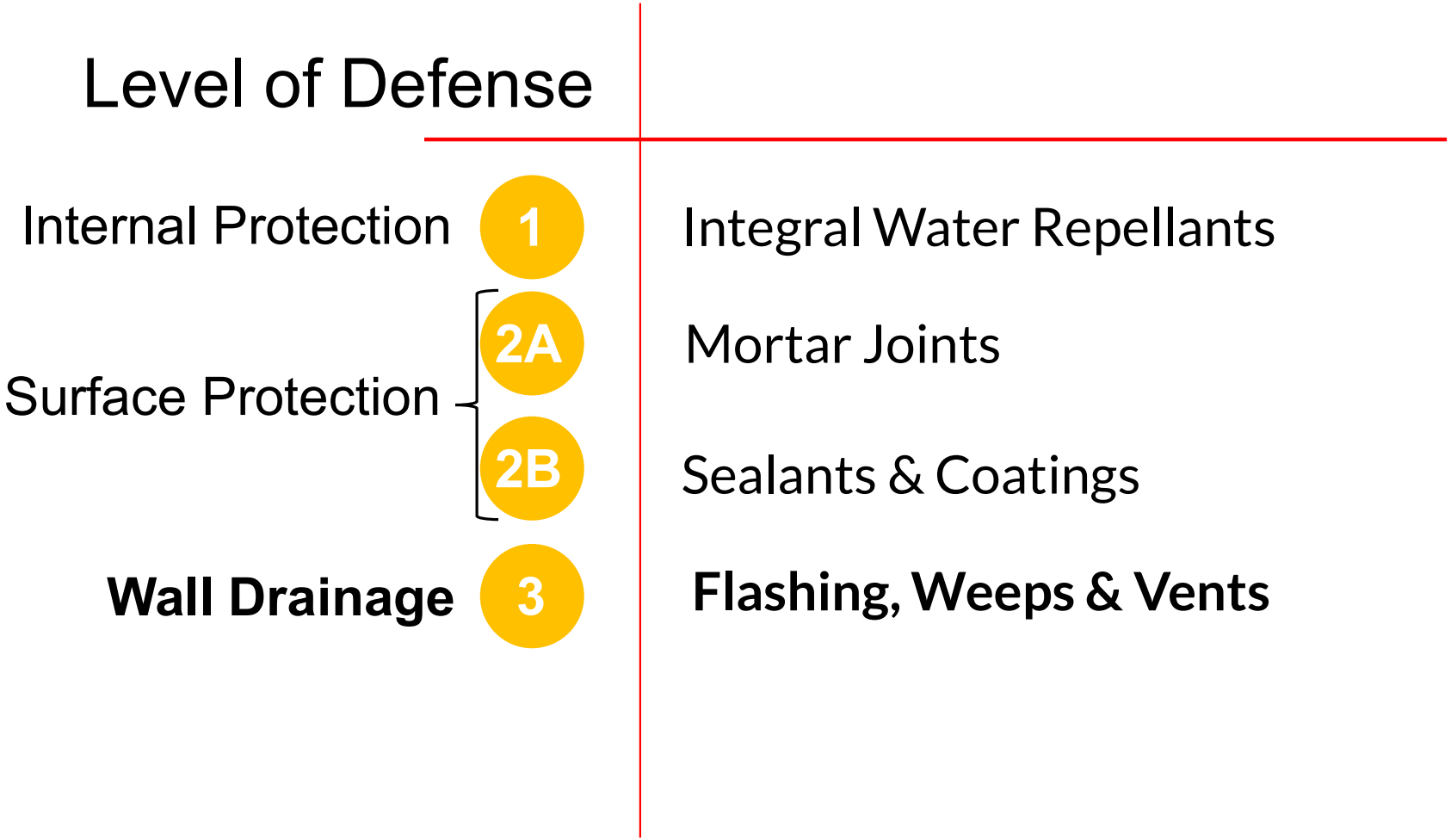
# Best Performance Is Achieved By Redundancy



# 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

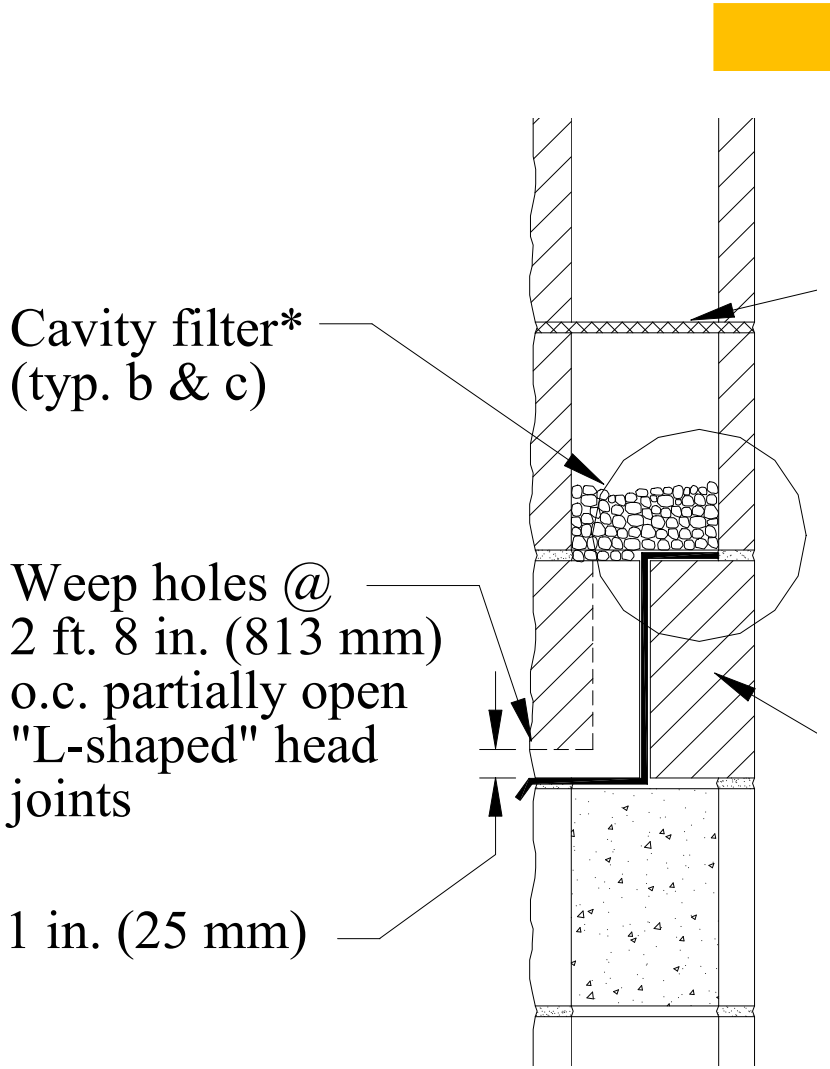


# Flashing Locations

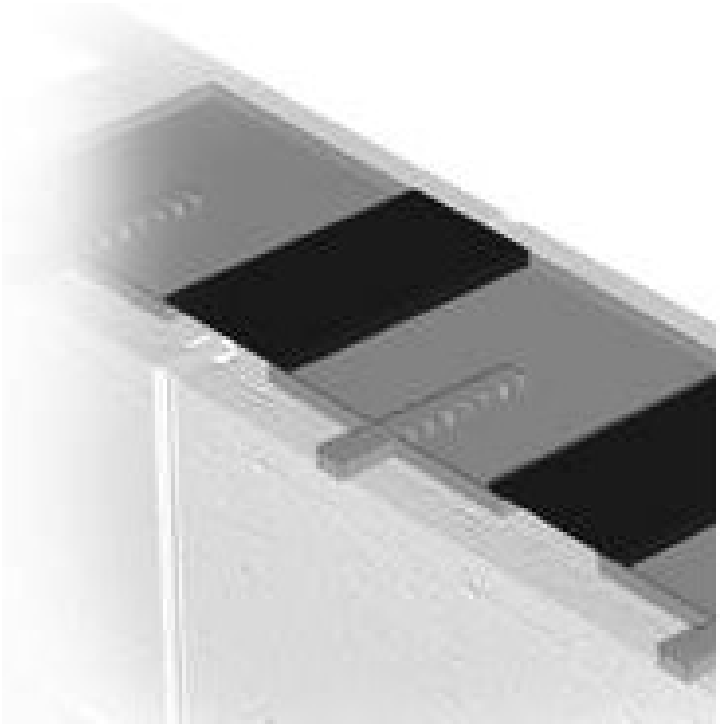
**Needed anywhere the downward vertical path of water to the weeps is interrupted:**

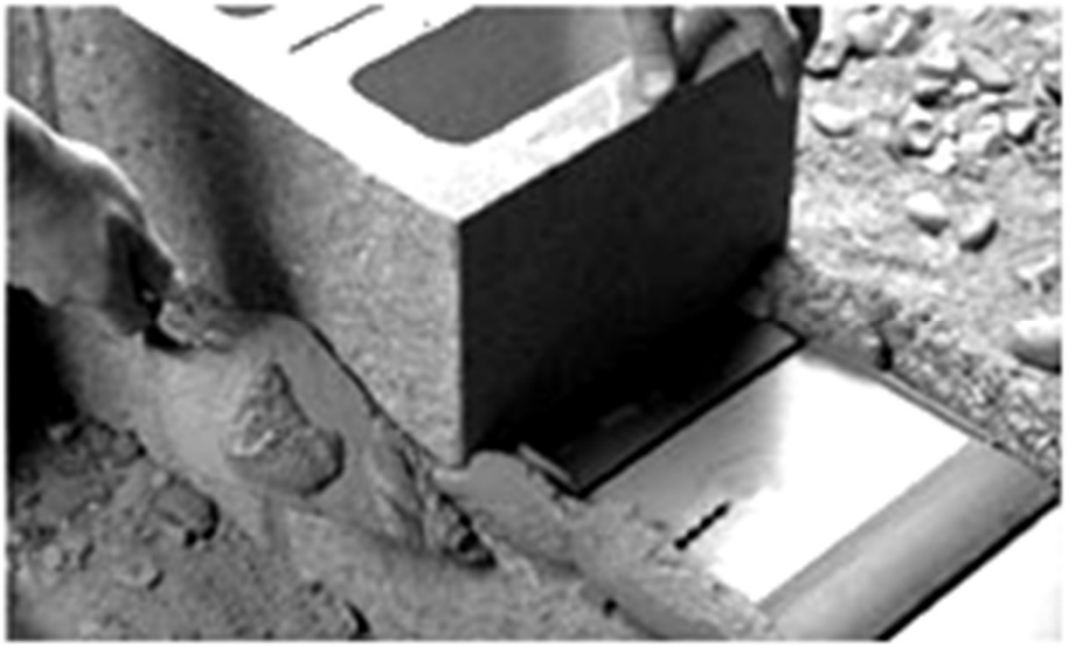
- **Base and foundation**
- **Lintels**
- **Bond beams**
- **Parapets**
- **Intermediate roofs**

# Flashing Detail at Unreinforced Cell

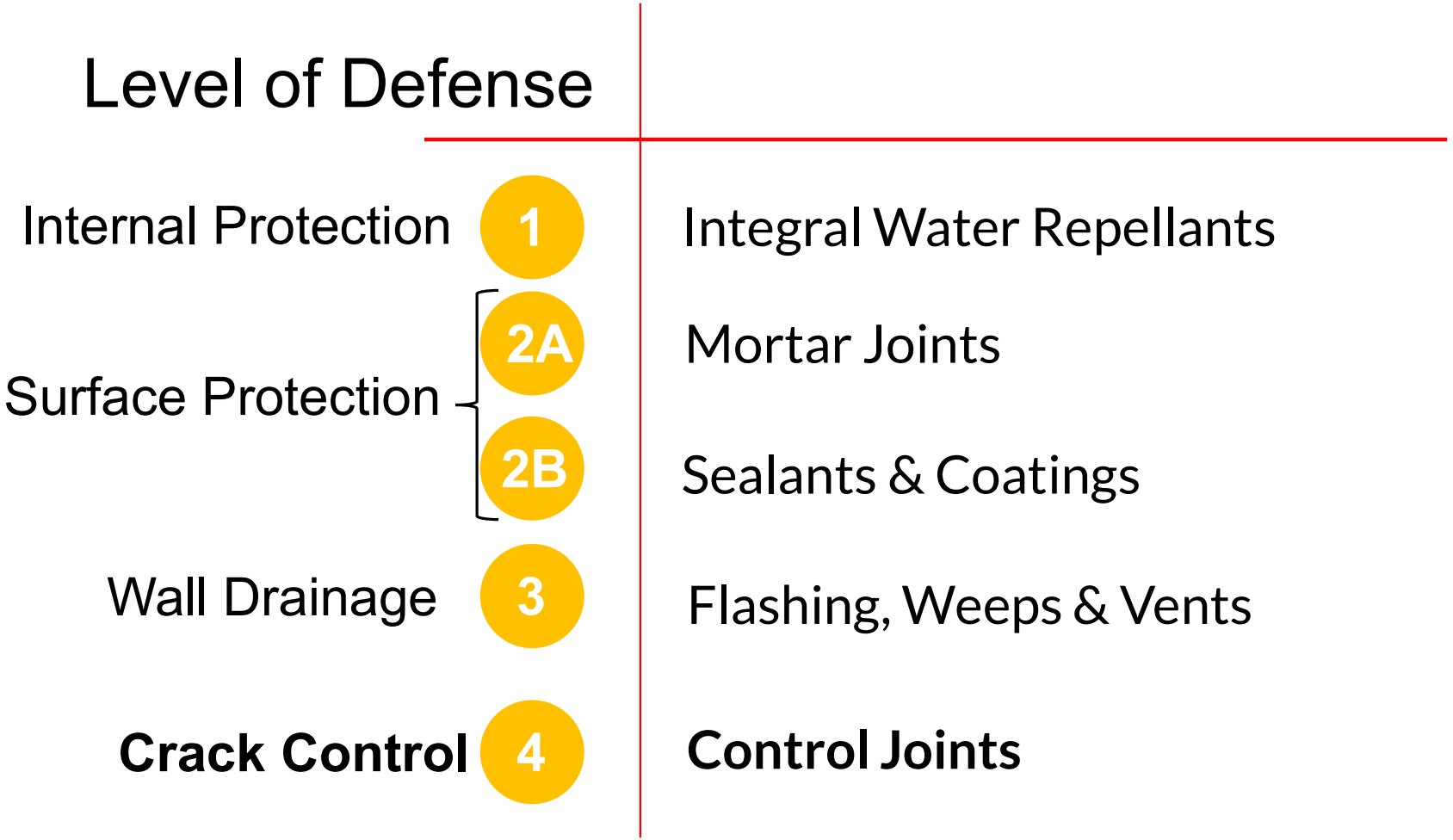


# Through-Wall Single-Wythe Block Flashing



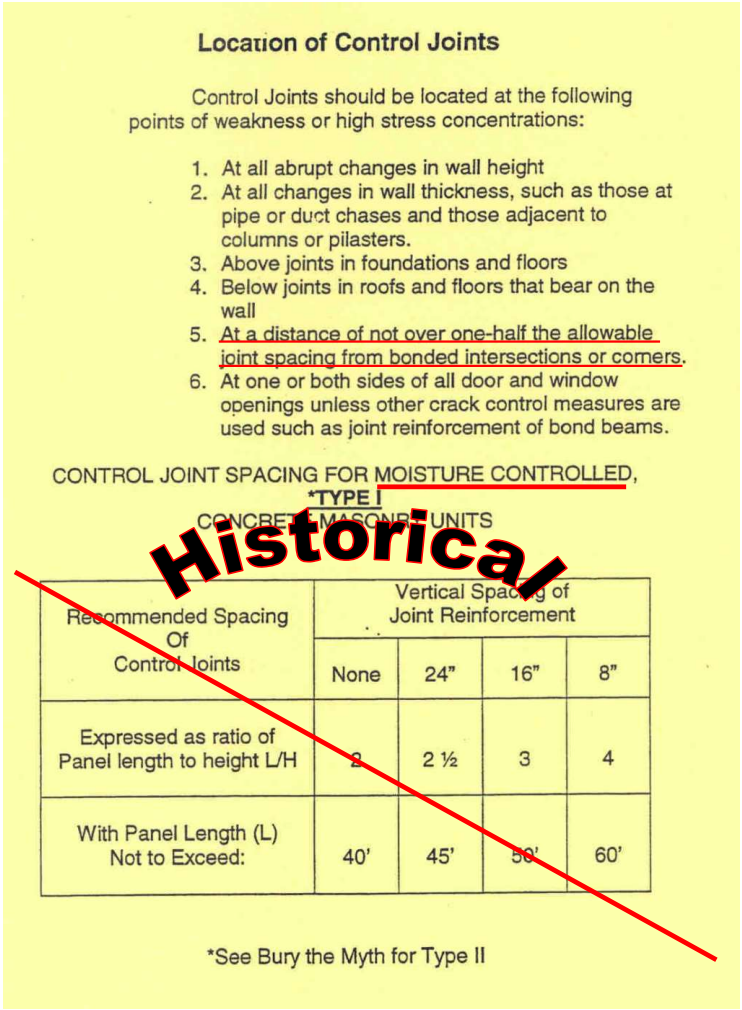


# Best Performance Is Achieved By Redundancy



# 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
- **<u>½ the allowable joint spacing from wall corners</u>**
- 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

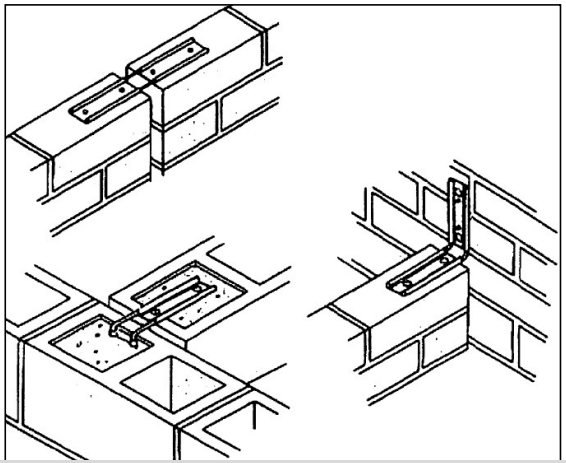
Historical

| 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' |

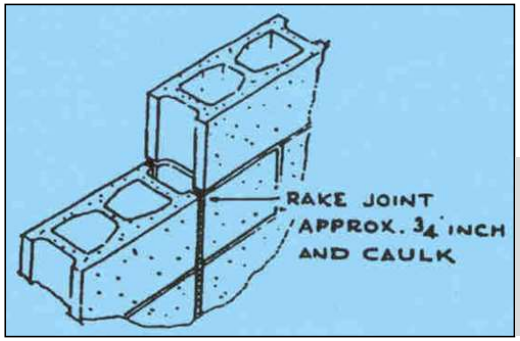
*See Bury the Myth for Type II

# Control Joints

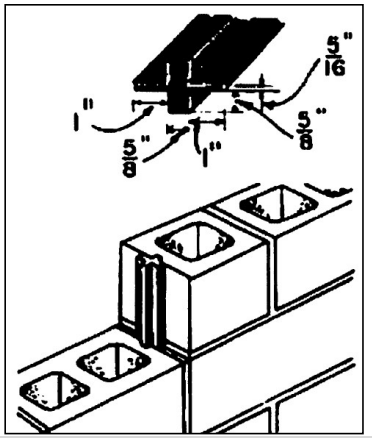
**The 4 most Common Control joints**



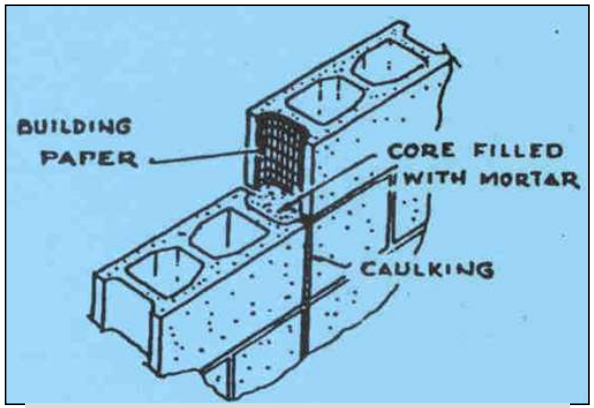
Mechanical Slip Connectors




Standard Raked Joint (No Keyway)




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) |

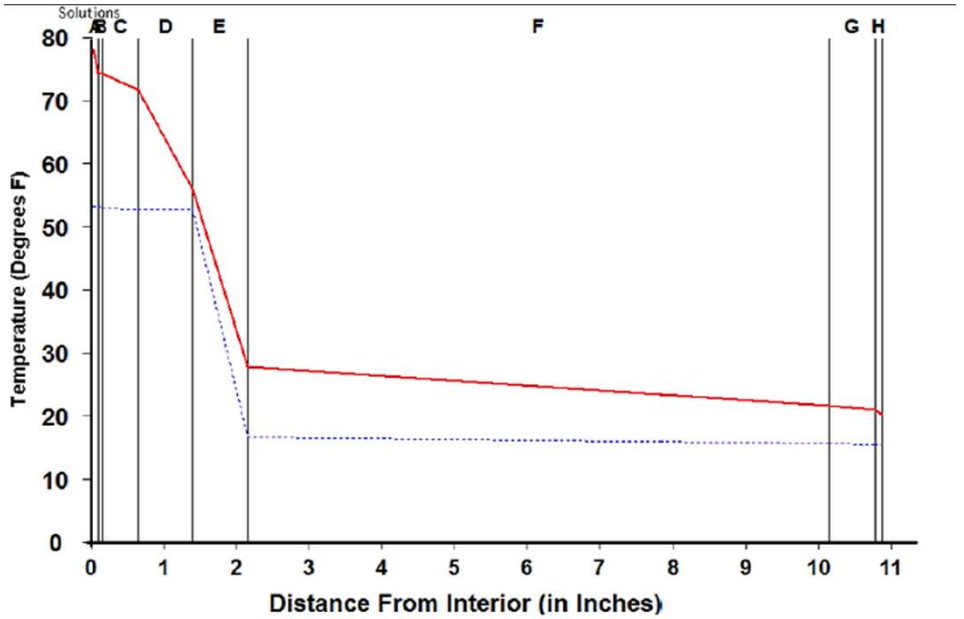
[A] Notes:

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

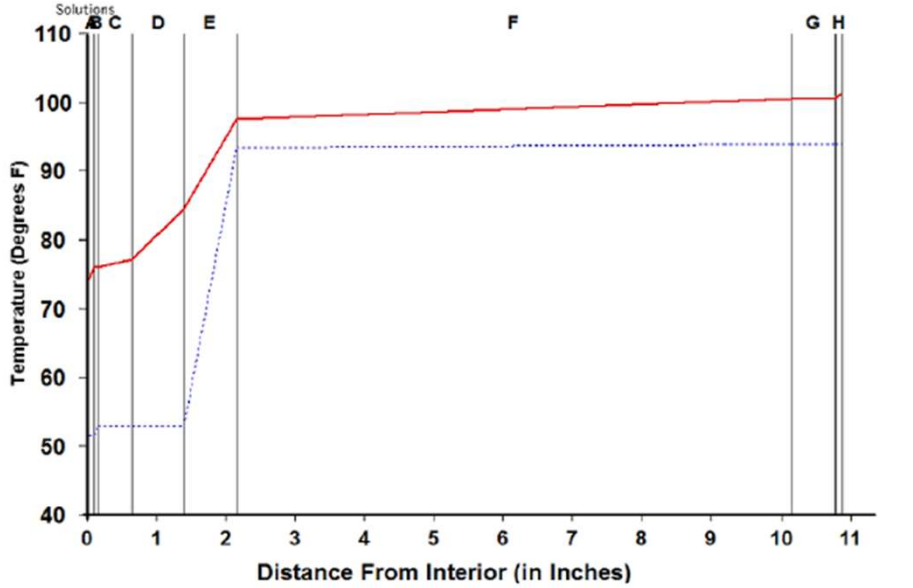



| | Component Name | Thickness | R-Value | Rep |
|---|---|---|---|---|
| A | Interior Air Film | 0.100 | 0.68 | 0.001 |
| B | Latex Paint 2 Coat | 0.050 | 0.01 | 0.500 |
| C | Drywall .5in | 0.500 | 0.45 | 0.014 |
| D | Wall Air Space Reflect | 0.750 | 2.80 | 0.006 |
| E | TUFF-R Insulation | 0.750 | 5.00 | 30.000 |
| F | Block Cinder & Gravel | 8.000 | 1.10 | 0.400 |
| G | Stucco | 0.625 | 0.10 | 0.030 |
| H | Outside Air Film Winter | 0.100 | 0.17 | 0.001 |
| I | | | | |
| J | | | | |
| K | | | | |
| L | | | | |
| | TOTAL | 10.875 | 10.31 | 30.952 |

| Interface | Temperature Actual | Temperature Dewpnt | Accum (cc/day-cqft) |
|---|---|---|---|
| -A | 78.00 | 53.06 | 0.000 |
| AB | 74.17 | 53.06 | 0.000 |
| BC | 74.12 | 52.71 | 0.000 |
| CD | 71.59 | 52.70 | 0.000 |
| DE | 55.84 | 52.69 | 0.000 |
| EF | 27.71 | 16.48 | 0.000 |
| FG | 21.52 | 15.48 | 0.000 |
| GH | 20.96 | 15.40 | 0.000 |
| HI | 20.00 | 15.40 | 0.000 |
| IJ | | | |
| JK | | | |
| KL | | | |
| L- | | | |

# Stucco on Block -Orlando Summer

## Interior XPS Insulation Attached Directly to Block

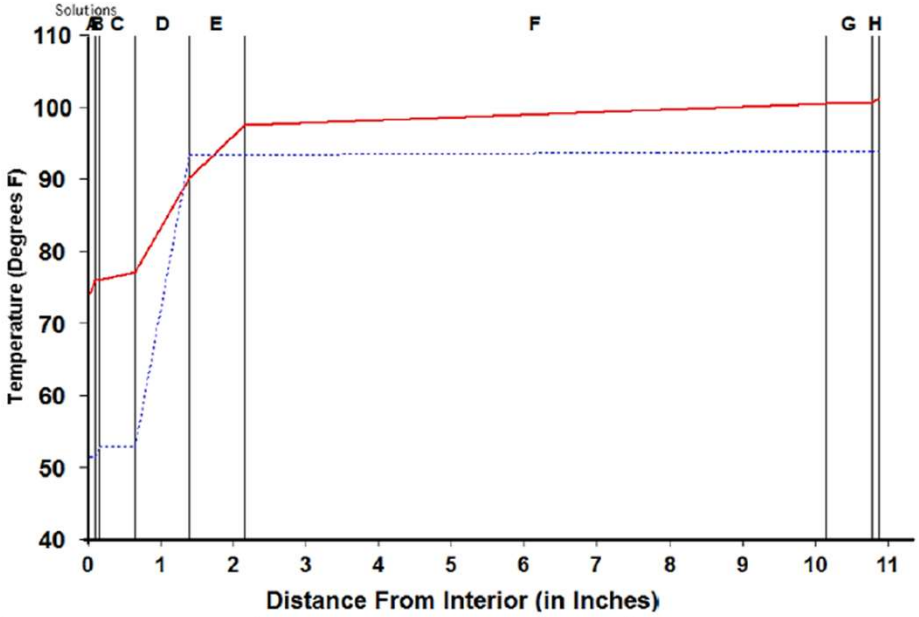



| | Component Name | Thickness | R-Value | Rep |
|---|---|---|---|---|
| A | Interior Air Film | 0.100 | 0.68 | 0.001 |
| B | Latex Paint 2 Coat | 0.050 | 0.01 | 0.500 |
| C | Drywall .5in | 0.500 | 0.45 | 0.014 |
| D | Wall Air Space Reflect | 0.750 | 2.80 | 0.006 |
| E | TUFF-R Insulation | 0.750 | 5.00 | 30.000 |
| F | Block Cinder & Gravel | 8.000 | 1.10 | 0.400 |
| G | Stucco | 0.625 | 0.10 | 0.030 |
| H | Outside Air Film Winter | 0.100 | 0.17 | 0.001 |
| I | | | | |
| J | | | | |
| K | | | | |
| L | | | | |
| | TOTAL | 10.875 | 10.31 | 30.952 |

| Interface | Temperature Actual | Temperature Dewpnt | Accum (oz/day-sqft) |
|---|---|---|---|
| -A | 74.00 | 51.33 | 0.000 |
| AB | 75.78 | 51.33 | 0.000 |
| BC | 75.81 | 52.69 | 0.000 |
| CD | 76.99 | 52.72 | 0.000 |
| DE | 84.32 | 52.74 | 0.000 |
| EF | 97.41 | 93.33 | 0.000 |
| FG | 100.29 | 93.64 | 0.000 |
| GH | 100.55 | 93.66 | 0.000 |
| HI | 101.00 | 93.67 | 0.000 |
| IJ | | | |
| JK | | | |
| KL | | | |
| L- | | | |

# Stucco on Block – Orlando Summer

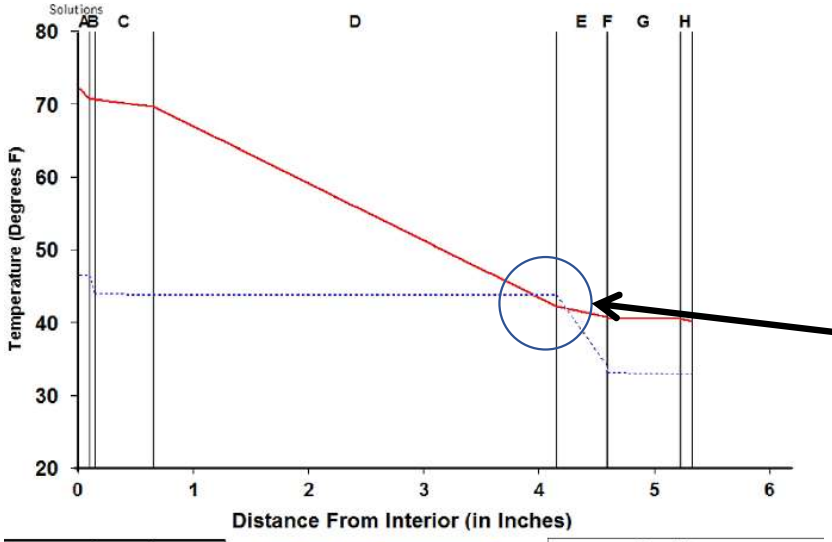
## Interior XPS Insulation Over Furring on Block




| | Component Name | Thickness | R-Value | Rep |
|---|---|---|---|---|
| A | Interior Air Film | 0.100 | 0.68 | 0.001 |
| B | Latex Paint 2 Coat | 0.050 | 0.01 | 0.500 |
| C | Drywall .5in | 0.500 | 0.45 | 0.014 |
| D | TUFF-R Insulation | 0.750 | 5.00 | 30.000 |
| E | Wall Air Space Reflect | 0.750 | 2.80 | 0.006 |
| F | Block Cinder & Gravel | 8.000 | 1.10 | 0.400 |
| G | Stucco | 0.625 | 0.10 | 0.030 |
| H | Outside Air Film Winter | 0.100 | 0.17 | 0.001 |
| I | | | | |
| J | | | | |
| K | | | | |
| L | | | | |
| | TOTAL | 10.875 | 10.31 | 30.952 |

| Interface | Temperature Actual | Temperature Dewpnt | Accum (oz/day-sqft) |
|---|---|---|---|
| -A | 74.00 | 51.33 | 0.000 |
| AB | 75.78 | 51.33 | 0.000 |
| BC | 75.81 | 52.69 | 0.000 |
| CD | 76.99 | 52.72 | 0.000 |
| DE | 90.08 | 93.32 | * 0.019 |
| EF | 97.41 | 93.33 | 0.000 |
| FG | 100.29 | 93.64 | 0.000 |
| GH | 100.55 | 93.66 | 0.000 |
| HI | 101.00 | 93.67 | 0.000 |
| IJ | | | |
| JK | | | |
| KL | | | |
| L- | | | |

# Stucco on Wood Frame – Orlando Winter




**Condensation in the Batt Insulations Against the Outside Sheathing**

| | Component Name | Thickness | R-Value | Rep |
|---|---|---|---|---|
| A | Interior Air Film | 0.100 | 0.68 | 0.001 |
| B | Latex Paint 2 Coat | 0.050 | 0.01 | 0.500 |
| C | Drywall .5in | 0.500 | 0.45 | 0.014 |
| D | R-13 Fiberglass Batt | 3.500 | 13.00 | 0.010 |
| E | OSB at 7/16 in | 0.438 | 0.70 | 1.500 |
| F | WEATHERMATE Housewrap | 0.010 | 0.01 | 0.130 |
| G | Stucco | 0.625 | 0.10 | 0.030 |
| H | Outside Air Film Winter | 0.100 | 0.17 | 0.001 |
| I | | | | |
| J | | | | |
| K | | | | |
| L | | | | |
| | TOTAL | 5.323 | 15.12 | 2.186 |

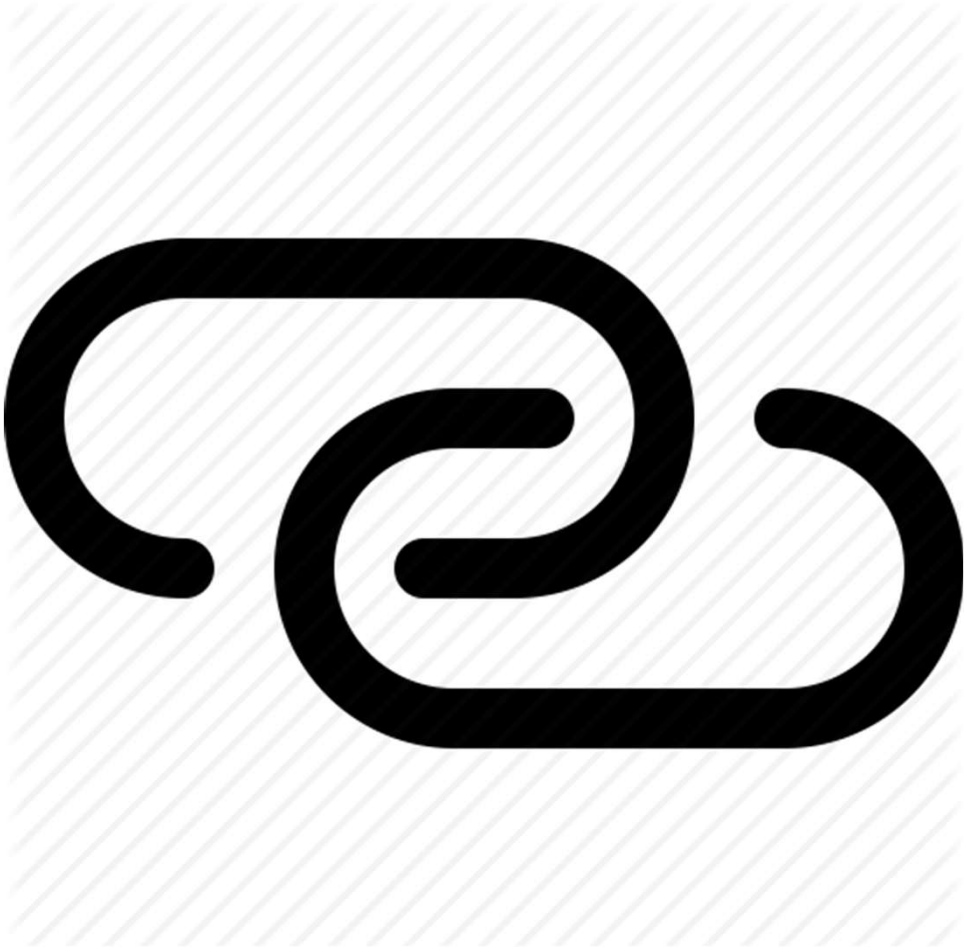
| Interface | Temperature Actual | Temperature Dewpnt | Accum (cc/day-sqft) |
|---|---|---|---|
| -A | 72.00 | 46.39 | 0.000 |
| AB | 70.56 | 46.38 | 0.000 |
| BC | 70.54 | 43.76 | 0.000 |
| CD | 69.59 | 43.69 | 0.000 |
| DE | 42.07 | 43.63 | * 0.002 |
| EF | 40.59 | 34.00 | 0.000 |
| FG | 40.57 | 32.99 | 0.000 |
| GH | 40.36 | 32.76 | 0.000 |
| HI | 40.00 | 32.75 | 0.000 |
| IJ | | | |
| JK | | | |
| KL | | | |
| L- | | | |

**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?