PHRC **Webinar Series**

November 8, 2011 1:00 PM

EXTERIOR PLASTER FINISH SYSTEMS

CODE REQUIREMENTS AND AVOIDING MOISTURE-RELATED FAILURES

Presented by Steve Long, E.R. Long Associates, Inc.

www.engr.psu.edu/phrc

Moderated by Mike Turns, PHRC

OVERVIEW OF EXTERIOR PLASTER SYSTEMS

(COVERED IN THIS PRESENTATION)

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EXTERIOR PLASTER FINISH SYSTEMS OVERVIEW

- 2009 International Residential Code
- Changes in construction that have increased risk of wall system failure
- Requirements for exterior plaster, etc
- Avoiding moisture- related failures

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EXTERIOR PLASTER
HARDCOAT STUCCO
ADHERED MASONRY VENEERS

Hardcoat Stucco

Adhered Masonry Veneer

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IRC 2009 :DEFINITION

- **Cement Plaster**. A mixture of Portland or blended cement Portland cement or blended cement, Portland cement or blended cement and hydrated lime, masonry cement or plastic cement and aggregate and other approved materials as specified in this code.

- "Portland Cement Plaster" and "Stucco" are interchangeable terms

-- Portland Cement Plaster Resource Guide, Northwest Walls and Ceilings, 3rd Edition

ADHERED MASONRY VENEER INCLUDES…

Precast stone veneers

Natural thin cut stone

Thin Brick systems

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MASONRY WALL

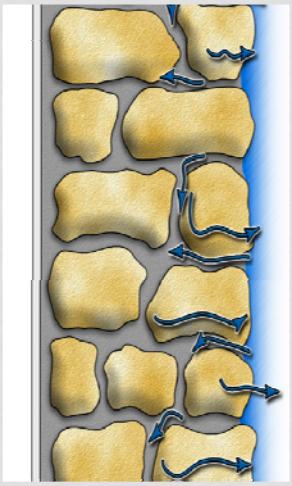
Load Bearing Masonry Wall

Too thick for moisture intrusion

Ability to absorb a lot of water

Expensive to build today

Hard to insulate



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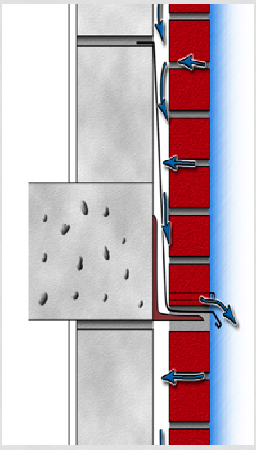
METHOD OF WALL CONSTRUCTION



Rainscreen or Cavity Wall Construction

- Assume water will penetrate cladding
- Water is Collected For Discharge
- Includes Stucco – Adhered Veneer Stone-Siding

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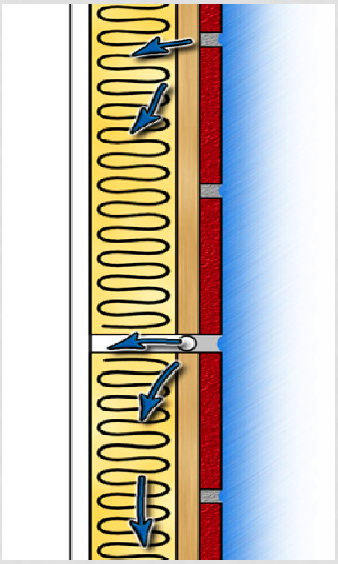
BARRIER WALL

No control of water

Tight Drainage Plane



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DESIGN FOR MOISTURE

- Flashing and overhangs first
- Nobody is perfect
- Allow for drying of the wall assembly

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STARTS WITH MOISTURE CONTROL

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MITIGATING RISK

- Water resistive barrier(s)
- Weep screeds
- Rainscreen assembly
  - Drainage mats
- Cavity wall
- Strapping or furring

Creating an air gap and drainage plane

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STUDIES OF THE APPLICATIONS

- Hangan, Horia & Surry, David. "Wind-Driven Rain Study for the Governor's Road Project." Canada Mortgage & Housing Corporation, 1999.
- Incluet, D. & Surry, D. "Simulation of Wind-Driven Rain & Wetting Patterns on Buildings." Canada Mortgage & Housing Corporation, 1994.
- Kerr Associates Technology Transfer. "The Rainscreen Wall System." Canada Mortgage & Housing Corporation, 2001.
- Patenaude, Armand. "Migration of Water by Capillarity." Canada Mortgage & Housing Corporation, 1993.

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LEARNING FROM MISTAKES

- Eastern Pa. "The stucco failure capitol of the United States"
  - Joe Listiburek, Ph.D., P.Eng., *The Perfect Storm,* Building Science Corporation, February 2008
- "…the building department has issued permits for wall repair work for 344 out of the 670 stucco-clad homes built in Woodbury in the 1990s — **a failure rate of 51%**."
  - Ron Glubka, the chief building official, Woodbury, Minnesota, from *Energy Design Update*, May 2006

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BUILDING SCIENCE BASICS

MOISTURE MOVEMENT

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CHANGES IN CONSTRUCTION MID TO LATE 90'S

- Tighter buildings – larger moisture difference between inside and outside
- More insulation – Less energy flow – Less drying
- More windows- Lot of glass
- Variety of materials on same wall
- Vinyl windows- insulated glass
- Central air – Cooler on the inside (inward vapor drive)
- OSB instead of plywood
- Contractors only applying scratch & finish
- Furring strips not used anymore
- Synthetic Stucco? Less permeable?

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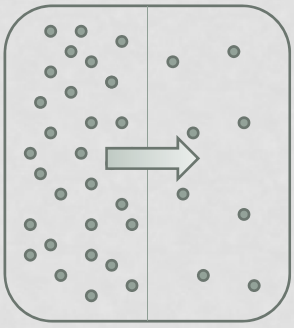
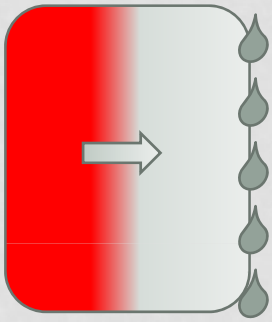
WATER VAPOR MOVEMENT

Vapor diffusion



Concentration gradient



Temperature gradient

Water vapor is the gas phase of water

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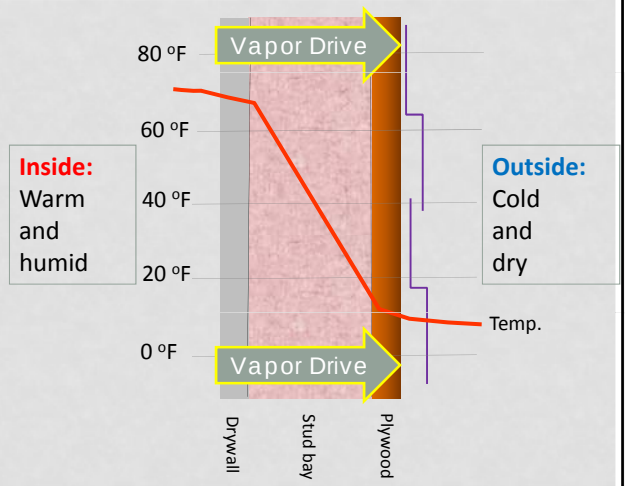
WATER VAPOR MOVEMENT

Winter Conditions



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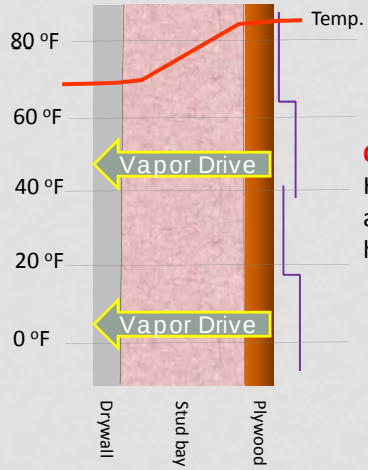
WATER VAPOR MOVEMENT

Summer Conditions

Inside: Cool and dry



Outside: Hot and humid

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EXTERIOR PLASTER SYSTEMS CAN BE **SLOW TO DRY**

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MOISTURE IN WALL

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GENERAL CODE REQUIREMENTS

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EXTERIOR PLASTER IRC 2009

R703.6 Exterior Plaster. Installation of these materials shall be in compliance with ASTM C 926 and ASTM C 1063 and the provisions of this code.

- ASTM C 926 *Standard Specification* ***for Application of Portland Cement Based Plaster***
- ASTM 1063 *Standard Specification for* ***Installation of Lathing and Furring***

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ASTM C 926

Standard Specification for Application of Portland Cement Based Plaster

- **1. Scope**
- 1.1 This specification covers the requirements for the application of full **thickness** portland cement-based plaster for exterior (stucco) and interior work.
- 1.2 This specification sets forth tables for proportioning of various plaster mixes and plaster thickness.

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ASTM C 1063

Standard specification for Installation of lathing and furring

- **1. Scope**
- 1.1 This specification covers the minimum requirements for **lathing and furring** for the application of exterior and interior portland cement-based plaster as in Specification **C 926** or Specification C 841.

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WATER RESISTIVE BARRIERS FOR EXTERIOR PLASTER

CREATING A DRAINAGE PLANE

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2009 IRC R703.6.3 – WATER-RESISTIVE BARRIERS [UNDER EXTERIOR PLASTER]

- WRBs shall be installed as required in section R703.2 **AND**, 703.6.3
  - Where applied over wood based sheathing, shall include a water resistive vapor-permeable barrier with a performance at least equivalent to **two layers of Grade D paper**
    - **Exception**: Where the water resistive barrier that is applied **over wood based sheathing, has a water resistance equal to or greater than that of 60 minute grade D paper** and is **separated from the stucco** by **an intervening**, substantially non watering-absorbing layer or **designed Drainages Space**

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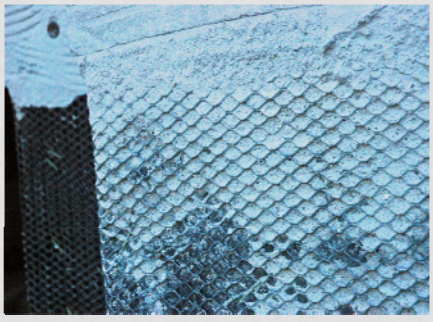
PROBLEM WITH A SINGLE WRB UNDER PLASTER



- Plaster bonds with felt or other WRB
- Eliminates drainage plane
- Intruding moisture trapped in wall

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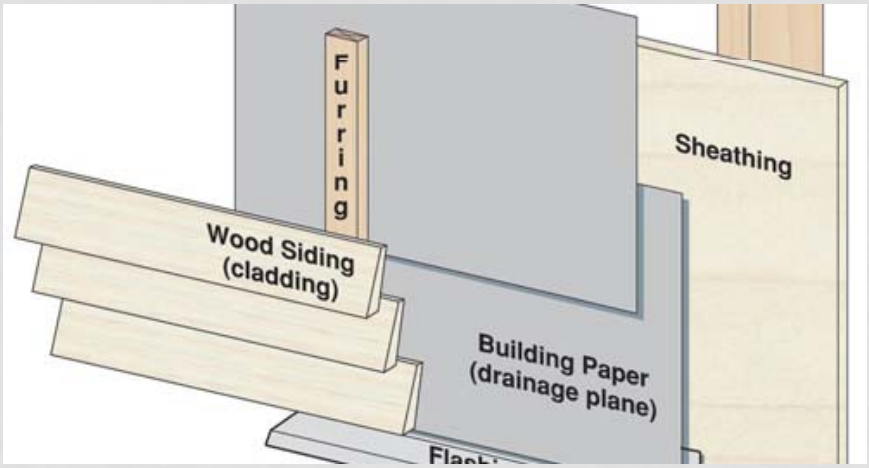
FURRING STRIPS USED AS DESIGNED DRAINAGE SPACE



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60 MINUTE GRADE D AND DESIGNED DRAINAGE SPACE

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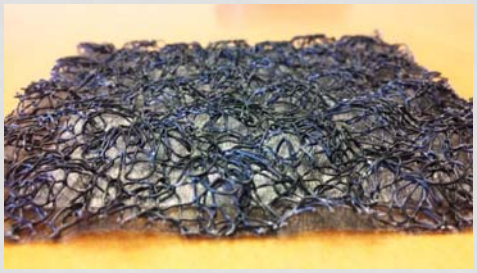
DRAINAGE MAT INSTALLATION (NOT REQUIRED BY CODE)



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DRAINAGE MAT INSTALLATION (NOT REQUIRED BY CODE)

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BENEFITS OF DRAINAGE MAT (NOT REQUIRED BY CODE)

- Drainage cavity to allow water to drain down to the weep screed & out of the wall system
- Air flow to allow moisture inside of the wall to be able to dry more quickly
- Prevent the mortar from coming through the lathe & attaching to the paper creating a mortar dam
- Helps the transition between dissimilar veneers that will be entryways for water
- Cavity wall construction

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PROPER FLASHING

MOVING WATER TO THE OUTSIDE

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WALL SYSTEM COMPONENTS

- Drainage Plane
  - Water Resistant Barriers
- Flashing
  - Windows
  - All other Openings
  - Base of the Wall
  - All Flashings Should Move Water Outwards
- Drainage
  - Above Windows & Doors
  - Above Base Flashings
  - Weep Screeds
  - Drip Edges

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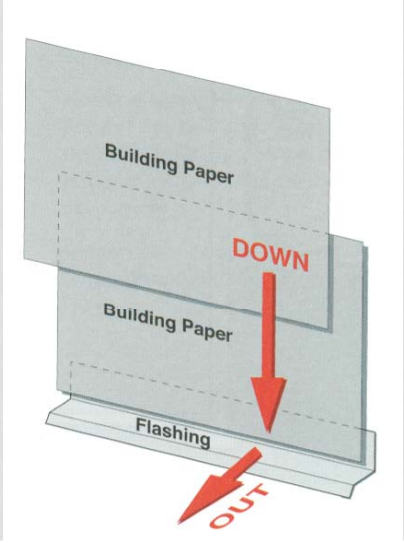
EVERYTHING SHOULD BE INSTALLED SHINGLE FASHION



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SIDEWALL FLASHING

- Step flashing minimum of 4" high x 4" wide
- Must direct water away from wall and onto roof or into gutter

NO KICK OUTS INSTALLED

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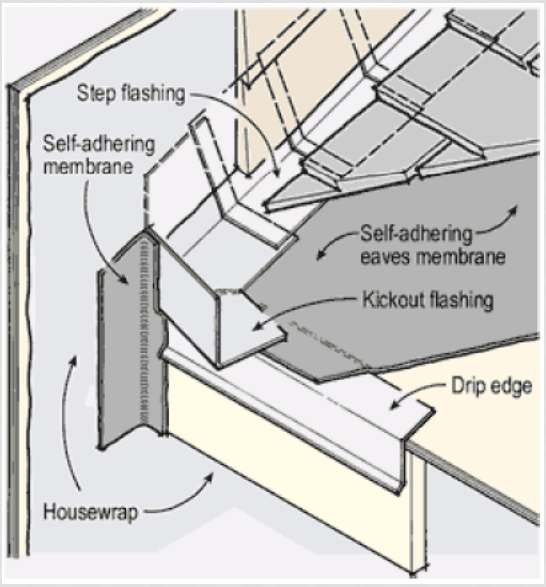

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WINDOW FLASHING

- Section R612 Exterior Windows and Doors.
  - **Windows and doors shall be installed and flashed in accordance with the fenestration manufacturers written installation instructions.**
  - Window and door openings shall be flashed in accordance with Section R703.8.
  - **Written installation instructions shall be provided by the fenestration manufacturer for each window or door.**

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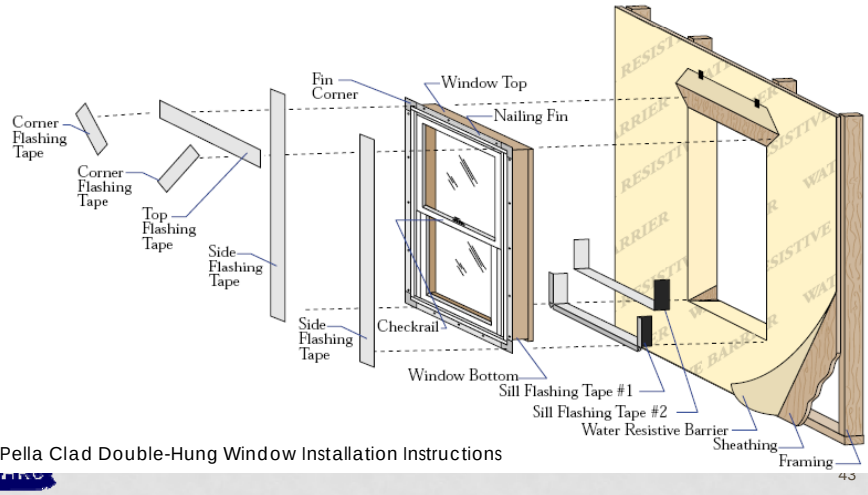
WINDOW MANUFACTURER'S FLASHING INSTRUCTIONS



Pella Clad Double-Hung Window Installation Instructions

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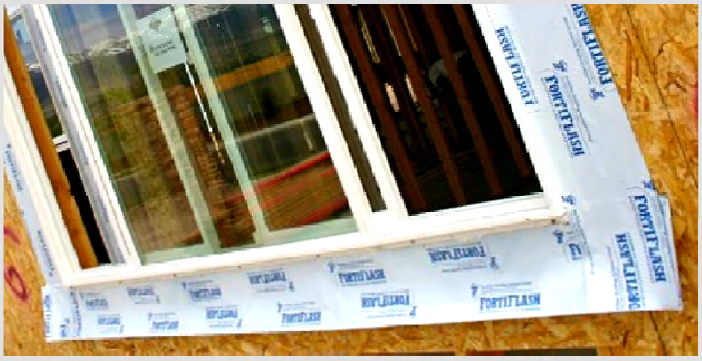
WINDOW FLASHING

- What if the stucco installer shows up and sees this?



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Common Practice Most Risky	Code Compliant Less Risky	Beyond Code Least Risky
• One layer of felt, building paper, or house wrap **code violation** **resulted in many failures** • OSB sheathing • Fiberglass insulation • Poly vapor barrier • Gyp board	• Two layers of Grade D building paper or equiv. house wrap • Plywood or OSB sheathing • Insulation of choice • Class II vapor retarder (e.g. Kraft facing) • Gyp board	• Same as code compliant, plus… • Drainage gap between stucco and sheathing

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PLASTER THICKNESS AND CURING

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PLASTER THICKNESS IRC 2009

- R703.6.2 **Plaster. Plastering with Portland cement plaster shall not be less than**
  - **three coats when applied over metal lath or wire lathe** and
  - two coats when applied over masonry, concrete, pressure-preservative treated wood or decay-resistive wood as specified in section R319.1 or gypsum backing.
    - **If the plaster surface is completely covered by veneer or other facing material or is completely concealed, plaster applications need be only two coats provided the total thickness is as set forth in table R702.1 (1)**
- **ASTM C 926 Table 1 Nominal plaster thickness for three and two coat work *(minimum 3/8" first and second coat 1/8" third coat)***
  - On wood-frame construction with an on-grade floor slab system, exterior plaster shall be applied to cover, but not extend below lath, paper and screed.

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Scratch –brown-finish 3/8"-3/8"-1/8" (7/8" total)

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WEEP SCREEDS

IRC 703.6.2.1

- **Weep Screeds**. …shall be provided at or below the foundation plate line on exterior stud walls in accordance with ASTM C926

- The weep screed shall be placed a **minimum of 4 inches above the earth or 2 inches above paved surface areas…**

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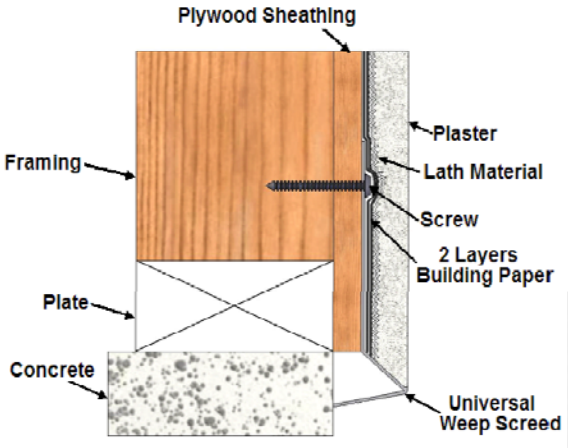
WEEP SCREED



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CODE VIOLATION -
WEEP SCREED NOT USED

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CODE COMPLIANT

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ASTM C 926

7.1.4 Separation shall be provided where plaster abuts dissimilar construction material or openings.

CODE VIOLATION PLASTER ABUTS FRAMING OF WINDOW

CASING BEAD

Casing Bead Installed

Backer Rod Inserted

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CASING BEAD THAT IS READY TO BE CAULKED ONCE INSTALLED

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LATHE INSTALLED OVER FLANGE

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FURRED LATH ASTM C 926

- 7.1.3 Portland –cement based plaster shall be applied on **furred metal** plaster base when the surface of solid backing consist of gypsum board, gypsum plaster, wood or rigid foam board or type products.

- **Not flat lathe**

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FURRED LATH ALLOWS PLASTER TO ENCASE WIRE

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ASTMC1063 CONTROL JOINTS

- Control joints- Control (expansion and contraction) joints shall be installed in walls to delineate areas **not more than 144 sq ft** and to delineate areas not more than 100 sq ft for all horizontal applications
- The distance between control **joints shall not exceed 18 ft in either direction** or a length to width ratio of 2 ½ to 1
- Wall or partition height door frames shall be considered control joints.

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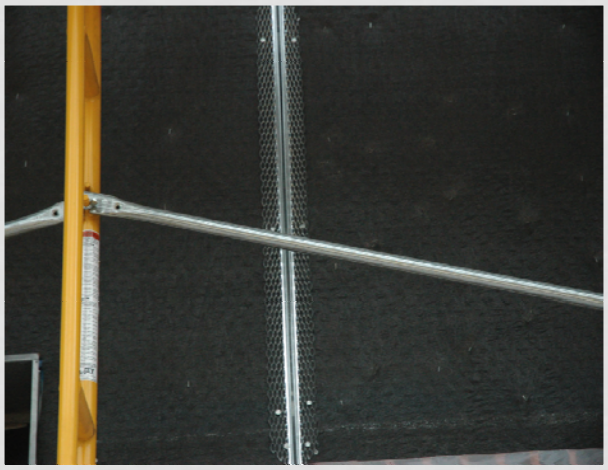
VERTICAL CONTROL JOINT



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CONTROL JOINT AT FLOOR LINE

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SUMMARY

- 2 Layers of Grade D paper used over sheathing
- 1 Layer grade D paper rated 60 minutes when separated from stucco with designed drainage space.
- Weep Screeds
- Furred lath
- 3 Coat stucco over lath 3/8, 3/8, 1/8
- Expansion break at all windows, doors and all dissimilar materials

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KEEP IT DRY! THANK YOU!!

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