



NELSON  
FORENSICS



# NELSON FORENSICS

- Providing expert forensics and consulting services to the legal, insurance, and private sectors
- Specializing in construction defects and insurance claims investigations
- Serving nationwide from 12 strategically located offices
- Headquartered in and providing materials testing services from facilities in Plano, Texas





# SERVICE OFFERINGS

- Forensic Engineering
  - Civil
  - Structural/Architectural
  - Mechanical
  - Electrical
- Forensic Architecture
- Roofing System Assessment
- Discovery Laboratory Testing
- Materials Science
- Cost Estimating & Appraisal
- Dispute Resolution & Umpiring
- Evidence Storage
- Chemistry and Environmental Science



# METHODOLOGIES OF FORENSIC ARCHITECTURE INVESTIGATIONS

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*Project Director*

Nelson Forensics  
Plano, TX

# BACKGROUND

- Master of Architecture
  - B.S. in Architecture
- Design and Forensics
  - 8 years of practice in design and forensic fields
- Registered Architect
  - In Texas and 11 other states
- Member of AIA and NCARB
  - Leading professional associations for architects



# BACKGROUND

## ■ Design Experience

- \$70 million six-story hospital addition in Washington
- \$6.3 million cancer center in Florida
- \$3.5 million office building in Texas

## ■ Forensic Experience

- Over 400 forensic evaluations
  - Design and construction defect
  - Building envelope failure, water intrusion
  - Tornado, hurricane, hail, and wind damage
  - Building code and accessibility requirements

# ARCHITECTURE

- Architecture is the art and science of the built environment.

# FAMOUS BUILDINGS

Pantheon

Notre Dame de Paris

Flatiron Building

Burj Khalifa



# Pantheon



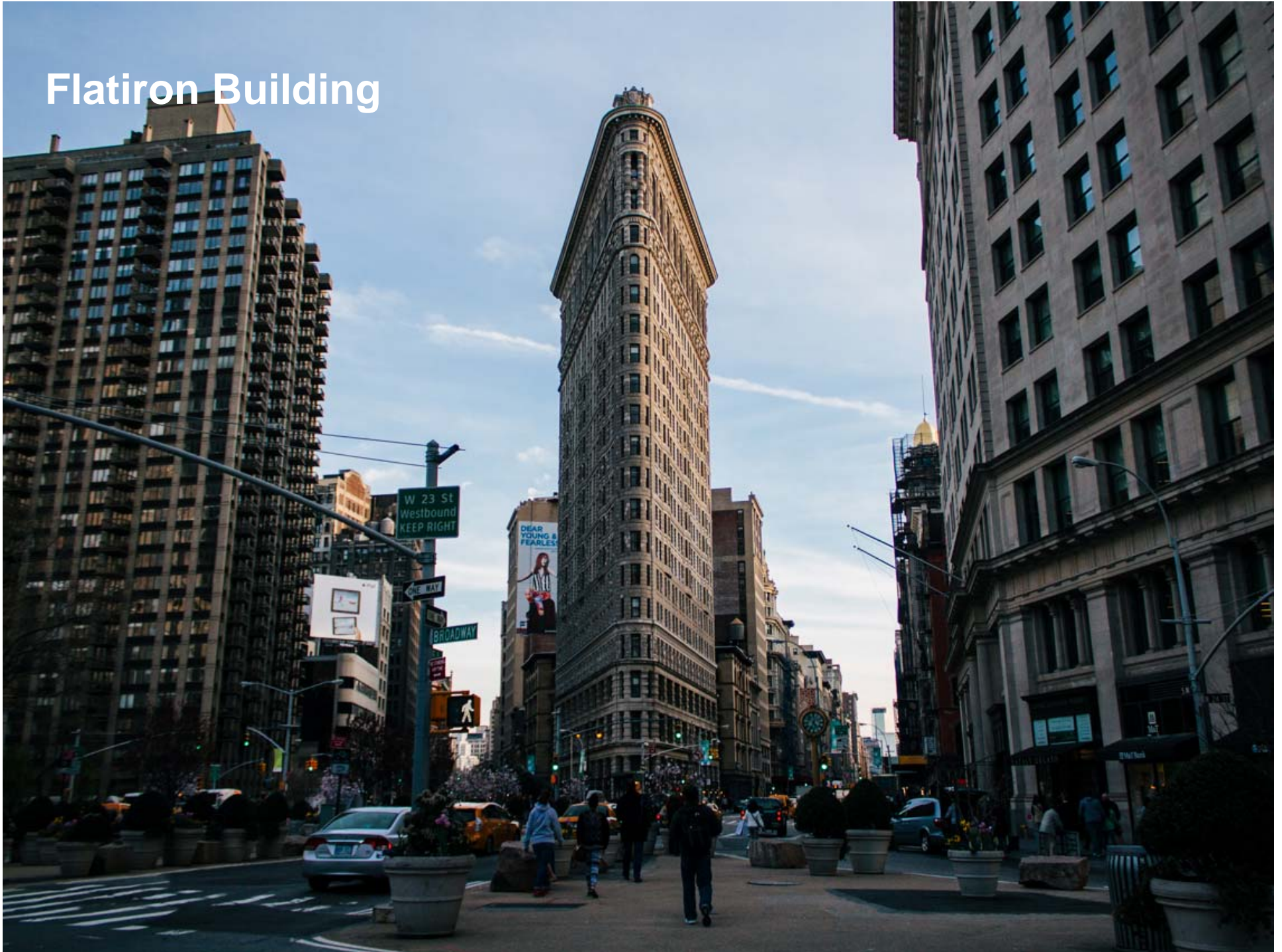


# Notre Dame de Paris





# Flatiron Building





# Burj Khalifa



# FAMOUS ARCHITECTS

Antonio Gaudi

Frank Lloyd Wright

Daniel Libeskind

Frank Gehry

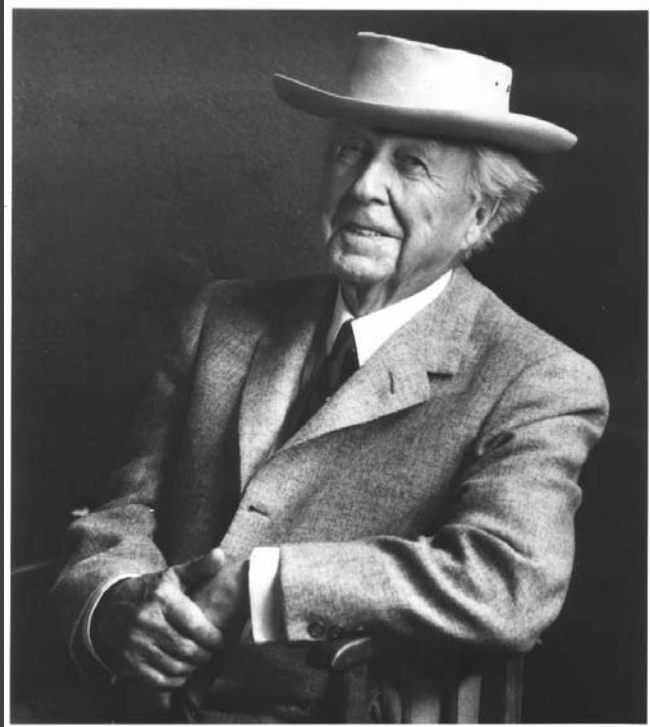


# Antonio Gaudi





# Frank Lloyd Wright



# Daniel Libeskind





# Frank Gehry



# TRADITIONAL ROLE OF THE ARCHITECT AND CONTRACTOR IN A CONSTRUCTION PROJECT

- Architect is responsible for the design of the building and setting the standard of quality for construction.
- Contractor is responsible for constructing the building within a set budget and meeting the quality of construction set by the Architect.
- When these responsibilities are not met by either party, problems arise.

# FORENSIC ARCHITECTURE INVESTIGATIONS

## What is Forensic Architecture?

- Investigation and assessment of damaged/failed buildings and structures.



# FORENSIC ARCHITECTURE INVESTIGATIONS

## What is Forensic Architecture?

- Evaluation of the building envelope.
- Interpretation of building codes, accessibility requirements, and construction documents.
- Analysis of the design/construction process, contracts, and standard of care of design and construction teams.

# FORENSIC ARCHITECT'S GENERAL PROJECT PROCESS

- Determine scope of work
- Site evaluation
  - Observations
  - Photographic and graphic information
  - Forensic testing
- Analysis of observations, testing, and documents/information
  - Determine cause
- Report of findings



CASE STUDIES:

# DESIGN AND CONSTRUCTION DEFECT

# WATERFRONT TOWNHOMES



Front Elevation



Rear Elevation

# ISSUES

- Balconies
- Roof Rake and Exterior Wall Junctures (Rake Lines)
- Windows
- Stucco
- Plumbing and HVAC
- Site Work
- Seawall



# ISSUE 1 - BALCONIES





# SEPARATIONS IN TILE GROUT AT BALCONY EDGE







NO GUTTER

BALCONY  
PROJECTS PAST  
ROOF EAVE  
APPROXIMATELY  
8 TO 10 INCHES

BALCONY CONFIGURATION



# DESTRUCTIVE TESTING AND EVALUATION

Nelson performed destructive testing at several unit balconies to determine the extent of damage to the balconies and cause(s) of damage.



# RESULTANT DAMAGE































41578 Z WF



# CAUSES

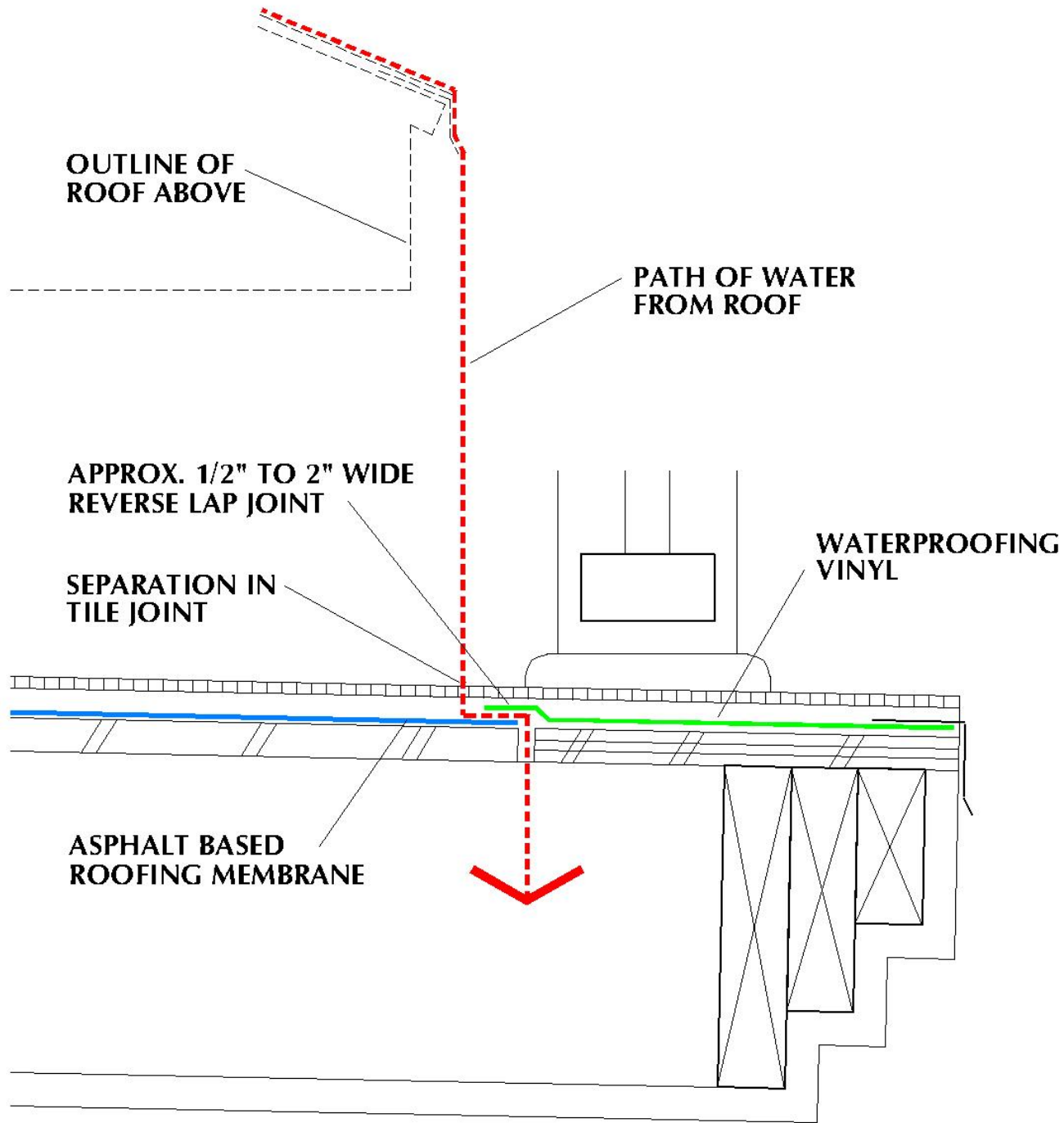
- Unprotected roof overhang allowing water discharge directly onto the balcony below.
- Reverse lapped porous waterproofing joint placed directly under the path of water drainage from the roof above.













# BALCONY DEFICIENCIES

- Safety letter was issued for 11 of the 44 (25%) balconies observed.

# ISSUE 2 – ROOF RAKE AND EXTERIOR WALL JUNCTURES

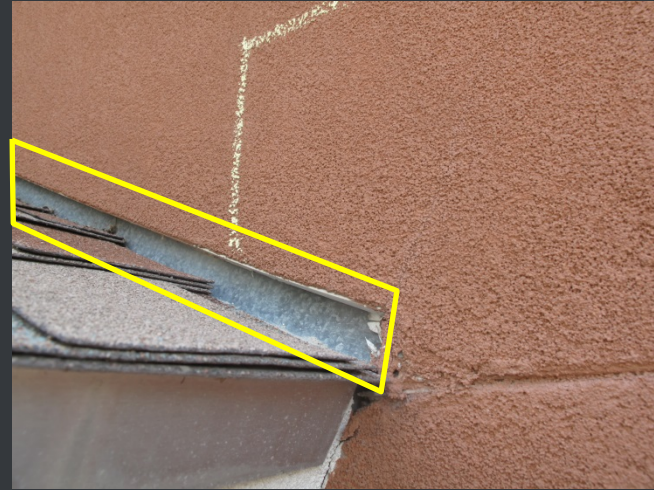




Kick-out flashing



Flashing separation



No kick-out flashing



No flashing separation





# RESULTANT DAMAGE







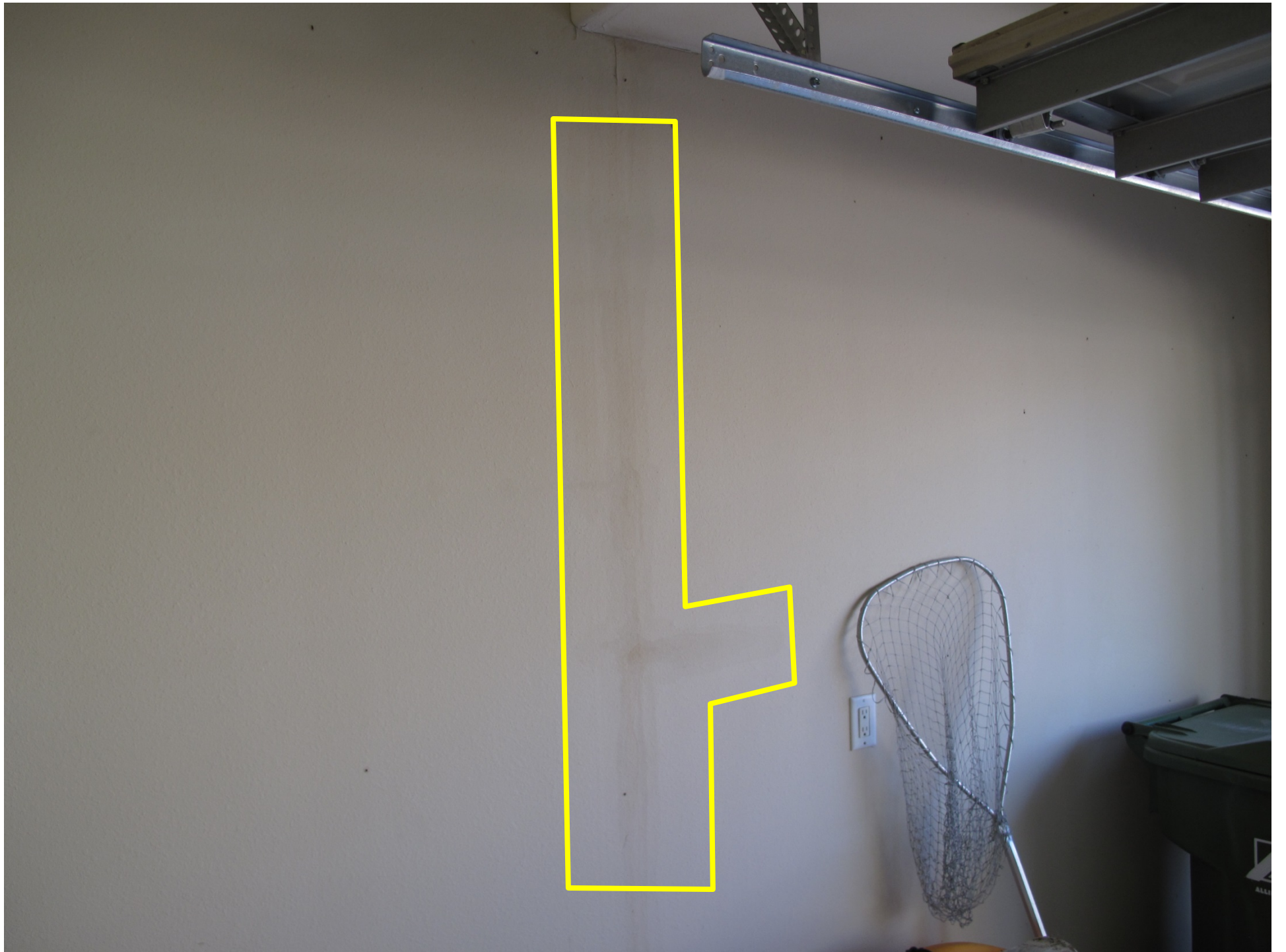














# CAUSES

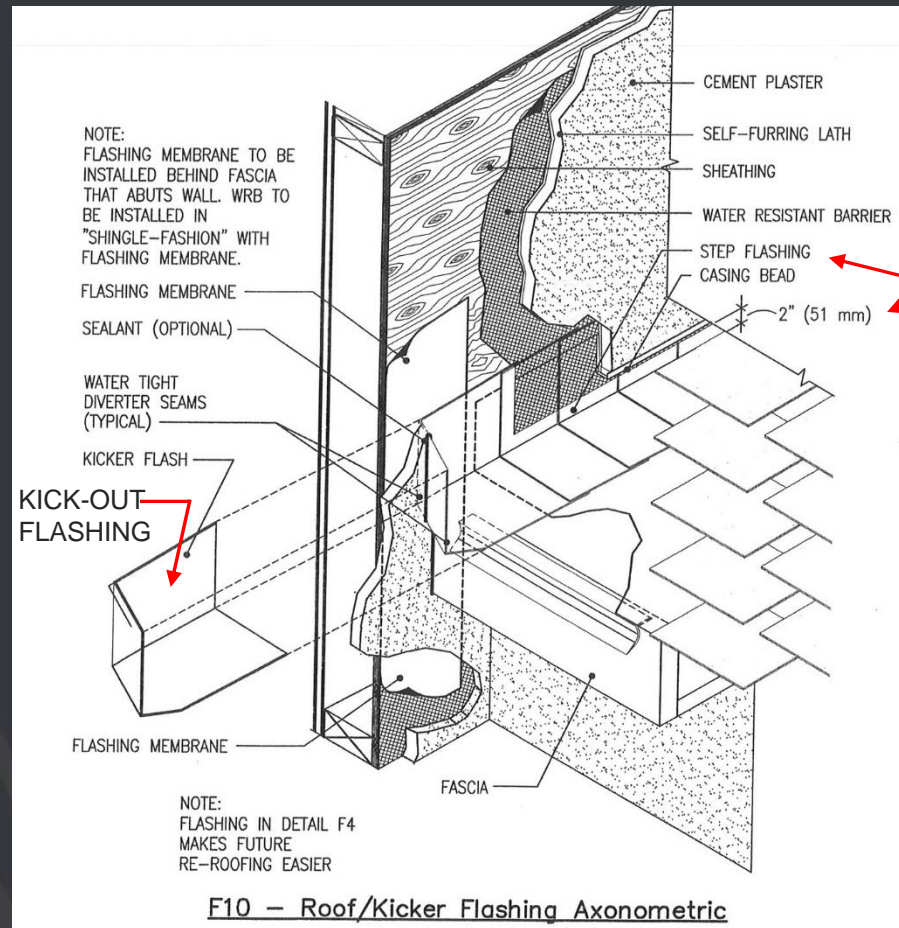
- Improper termination of the stucco at the roof line.
- Lack of kick-out flashing installed at the rake line termination.







# PROPERLY INTEGRATED ELEMENTS AT ROOF RAKE LINE & EXTERIOR WALL JUNCTURES



FLASHING WITH MINIMUM 2" SEPARATION OF STUCCO FROM ROOF



# ROOF RAKE LINE & EXTERIOR WALL JUNCTURES DEFICIENCIES

- No kick-out flashing at 9 of 23 (40%) buildings observed.
- No separation flashing at 22 of 23 (95%) of buildings observed.

# ISSUE 3 – WINDOWS





# STUCCO FRACTURES AT WINDOW CORNERS





# DESTRUCTIVE TESTING





















# RESULTANT DAMAGE









# CAUSES

- Lack of window flashing installed
  - Approximately 50% of windows tested had no flashing.
- Improper integration of window flashing and water resistive barrier (Tyvek or building paper).
  - Flashing installed improperly at approximately 35% of windows tested.

# PROPERLY INTEGRATED WEATHER BARRIER AND FLASHING









# HIGH-END RESIDENCE



Front Elevation



Rear Elevation



# BACKGROUND



- Latex painted gypsum board
- Enamel-finished wood trim
- Varnished hardwood paneling
- Wet-spray cellulose insulation in exterior stud wall assemblies

# MASONRY OBSERVATIONS

Stone removal revealed packed mortar



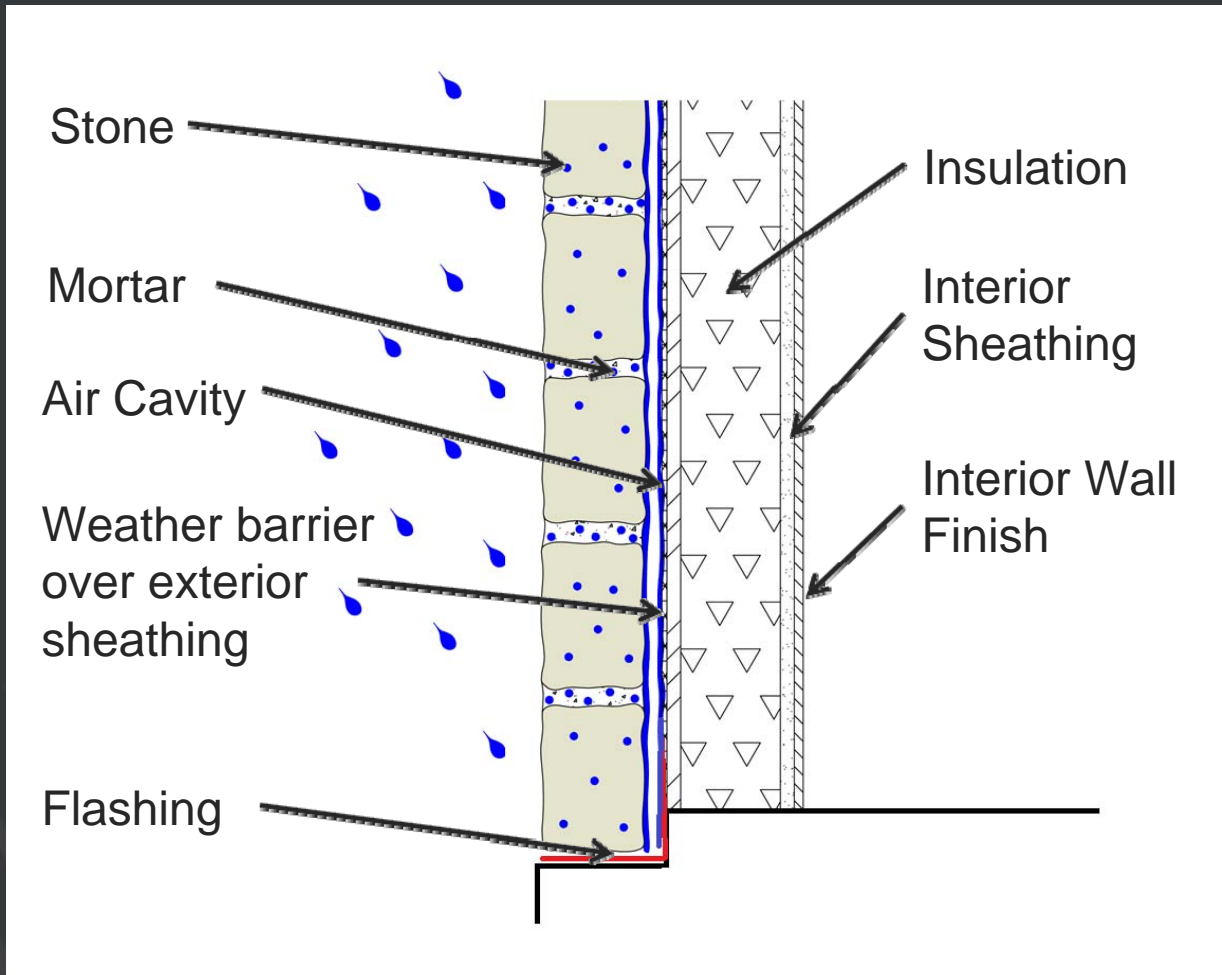


# MASONRY OBSERVATIONS

## Moisture behind Tyvek



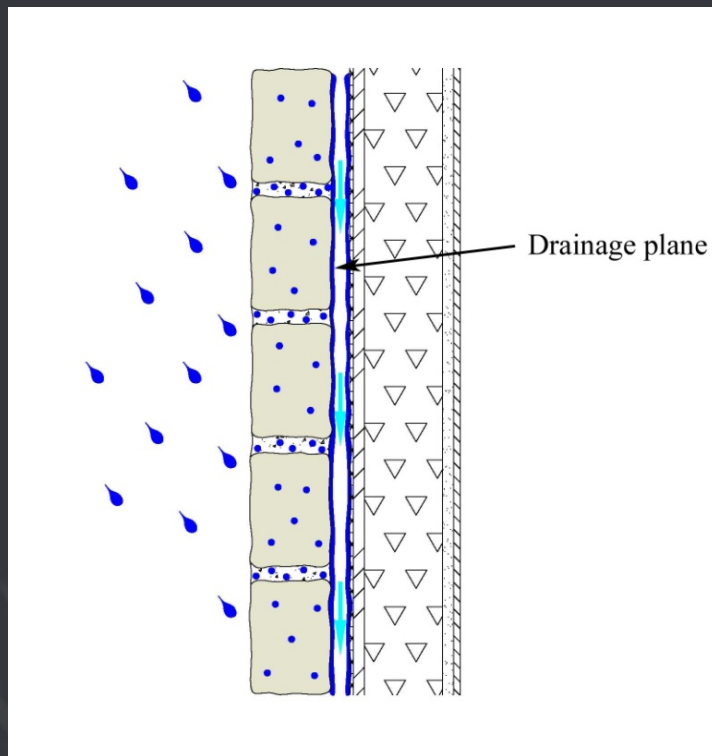
# MASONRY VENEER CAVITY WALL SYSTEMS



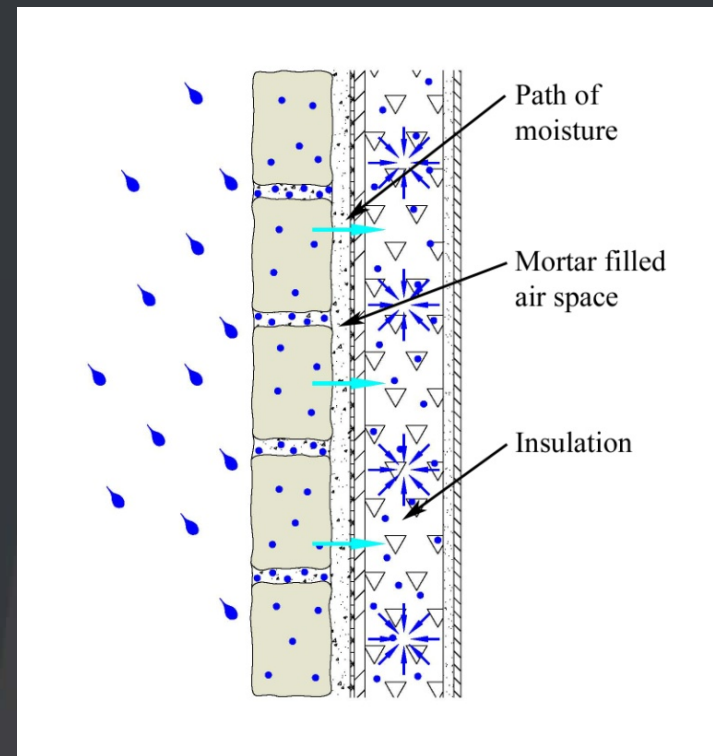


# A FUNCTIONING AIR SPACE IS VITAL!

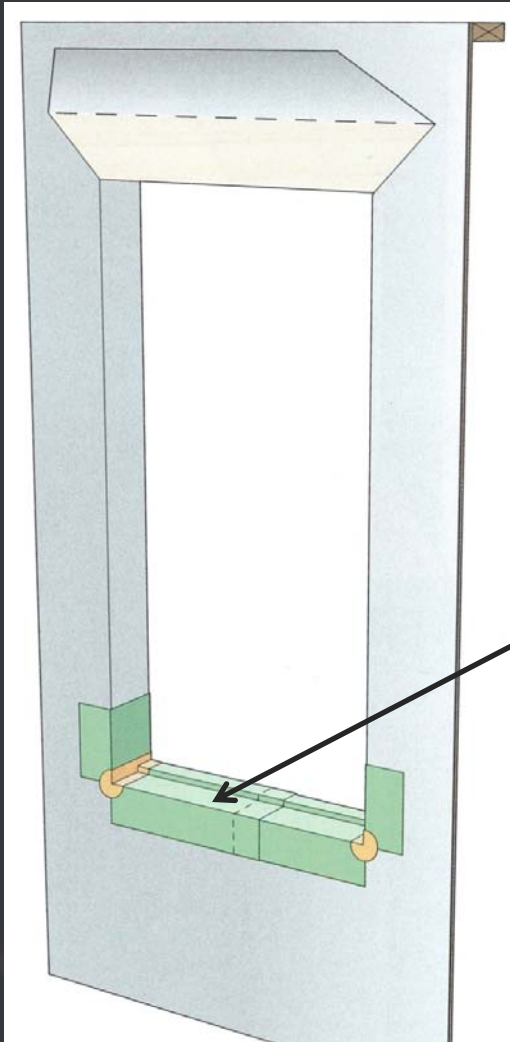
Capillary Break



No Capillary Break



# FLASHING OBSERVATIONS



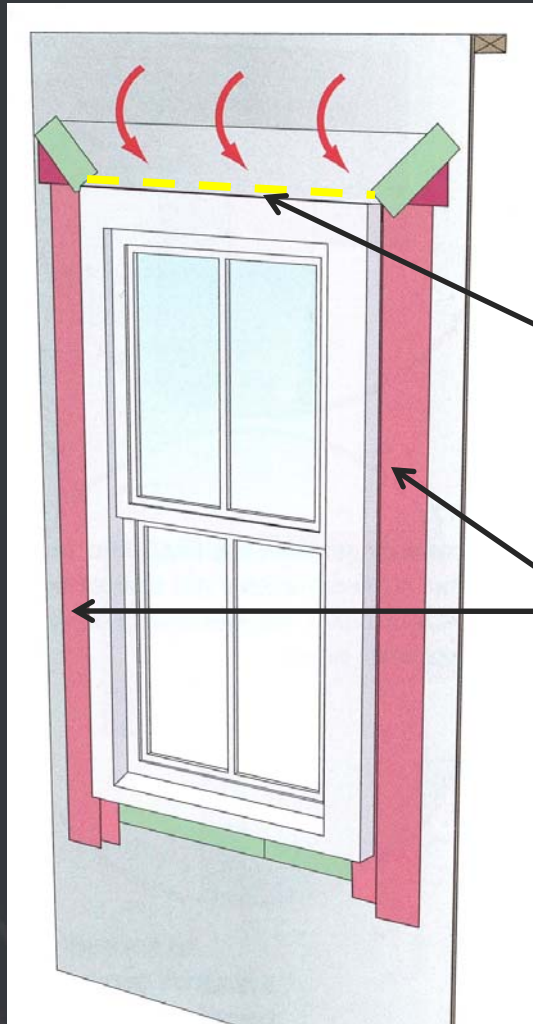
Sill flashing



No sill flashing at window sill



# FLASHING OBSERVATIONS



Location of  
Drip Cap

Jamb  
Flashing



No flashing at window jamb

# WATER SPRAY TESTING



*AAMA SIMPLE NOZZLE TEST*



# WATER SPRAY TESTING

Areas around windows chosen based on reports of distress at interior  
Determined leak present at south window of family room



# VAPOR RETARDER

Vapor retarder – a material with a vapor permeance rating of 1.0 perm or less

Material	Vapor Permeance (perms)
Tyvek home wrap	58
Brick veneer	40
1/2" gypsum board with 2 coats of latex flat paint	19.54
OSB sheathing	2
Oil paint on wood (3 coats)	0.88
Vinyl wall covering	0.08 – 0.13

Permeable MS10

Semi-impermeable & Impermeable



**Slide 76**

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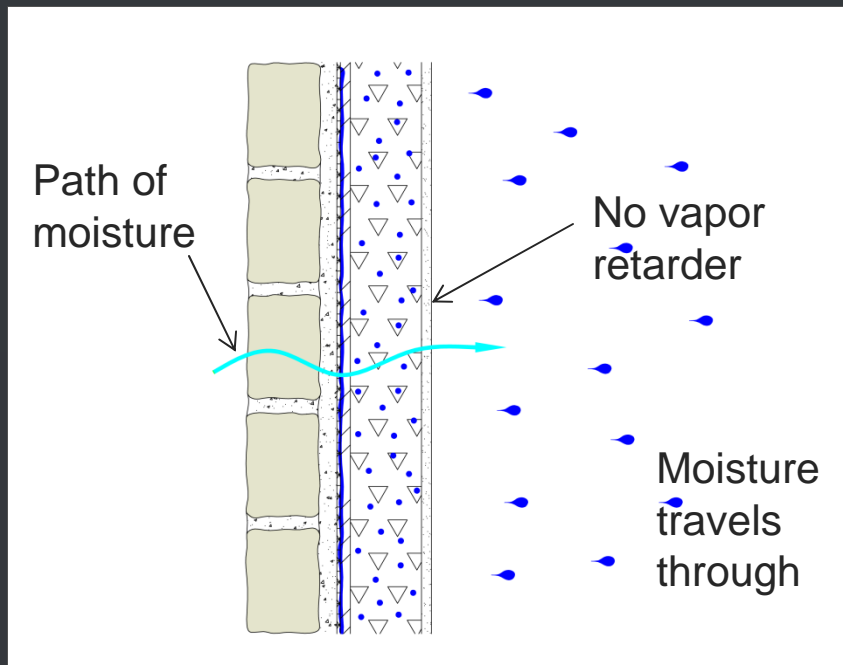
**MS10**

what is permeable and what is semi-impermeable & impermeable? kind of confusing as to which materials you are referring to.

Megan Smith, 6/19/2013

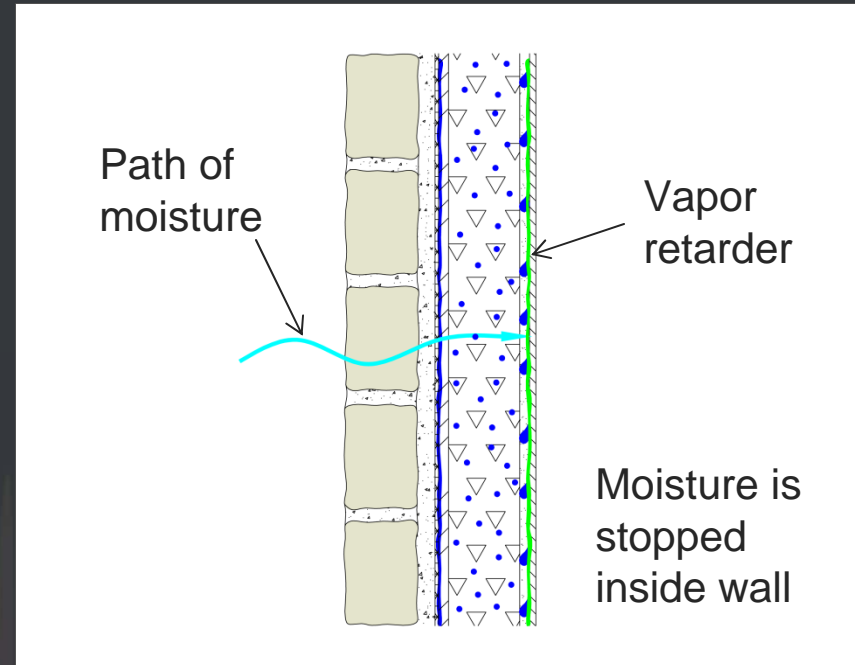
# INTERIOR VAPOR RETARDER

## No Vapor Retarder



Small amounts of moisture can pass all the way through building envelope

## Vapor Retarder on Interior Side



Once moisture enters building envelope, vapor retarder halts diffusion, trapping moisture



# MOLD ASSESSMENT

Construction  
Building Materials

+

H<sub>2</sub>O

=

Fungal  
Growth



## Removal of interior finishes - **Mold** at exterior walls





# MOLD ASSESSMENT

Mold **behind** and **on** hardwood paneling

Mold on gypsum board **behind** wood trim



# FINDINGS AND OPINIONS

- Clogged drainage plane
- Poor flashing installation and details
- Defective windows
- Excess moisture migration through wall assembly
- Unintentional vapor retarder
- Distressed finishes and mold growth



# DESERT RESIDENCE



Front Elevation



Rear Elevation

# ISSUES

- Cracking of Stucco
- Interior Moisture Intrusion



# ISSUE 1 – CRACKING OF STUCCO













# CAUSES

- Lack of stucco control joints.
- Moisture intrusion behind the stucco.
- Improper bonding of the stucco/improper installation of the metal lath.
- Other contributing factors include thermal movement and weathering.



## ISSUE 2 – INTERIOR MOISTURE INTRUSION



















# CAUSES

- Moisture entering the building envelope via fractures and voids in the stucco at exterior walls and parapet walls.
- Termination of the stucco directly to grade or concrete patios.
- Site grading and drainage was not a contributing factor.













THANK YOU!

Contact us at:

[www.nelsonforensics.com](http://www.nelsonforensics.com)

877.850.8765

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