A summary of Moisture Effects Behind Florida Stucco Systems

Developed by The Stucco Institute
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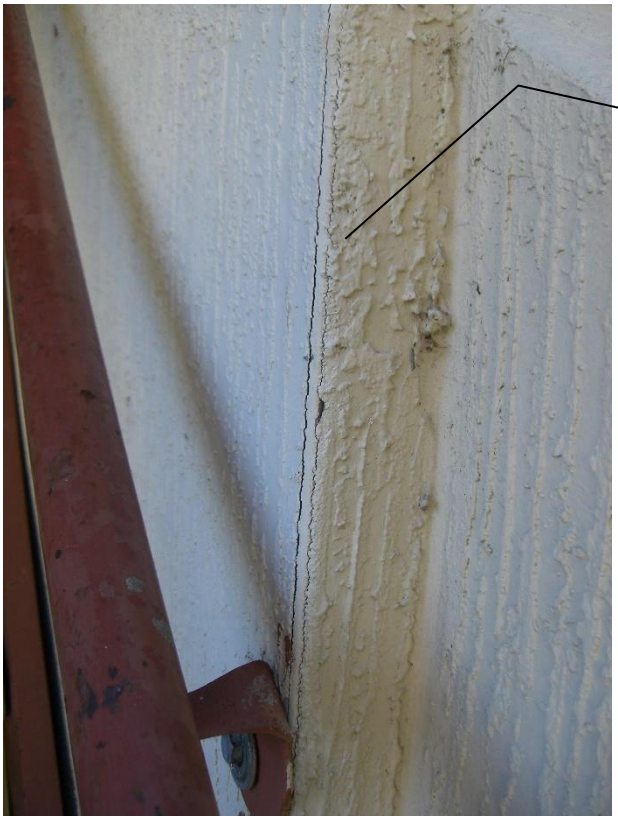
- Traditional stucco systems have began to intermittently fail across Florida.
- Attorneys, armed with so-called "experts", incorrectly blame contractors for stucco code violations and incompetent building inspectors for the problems – all for the sole motivation of profitable lawsuits. See "The Truth About Florida Stucco" publication at www.stuccoinstitute.com for a more complete discussion on that topic.
- This report will focus on the moisture problems causing the rusting of the metal lath attaching the stucco to the wall, its cure and prevention.
- In Florida, moisture is a major problem, if it gets behind the stucco thereby affecting the metal lath.
- The moisture has two modes of entry; ***bulk*** water intrusion (an actual crack, separation or opening that allows water to enter) and/or water ***vapor*** (elevated relative humidity (***R/H***) holding behind the stucco).

Rusting metal lath caused by bulk water entry at incorrectly installed control joint and insufficient coating and sealants.
All leading to high R/H behind stucco system

Introduction to Exemplary Conditions

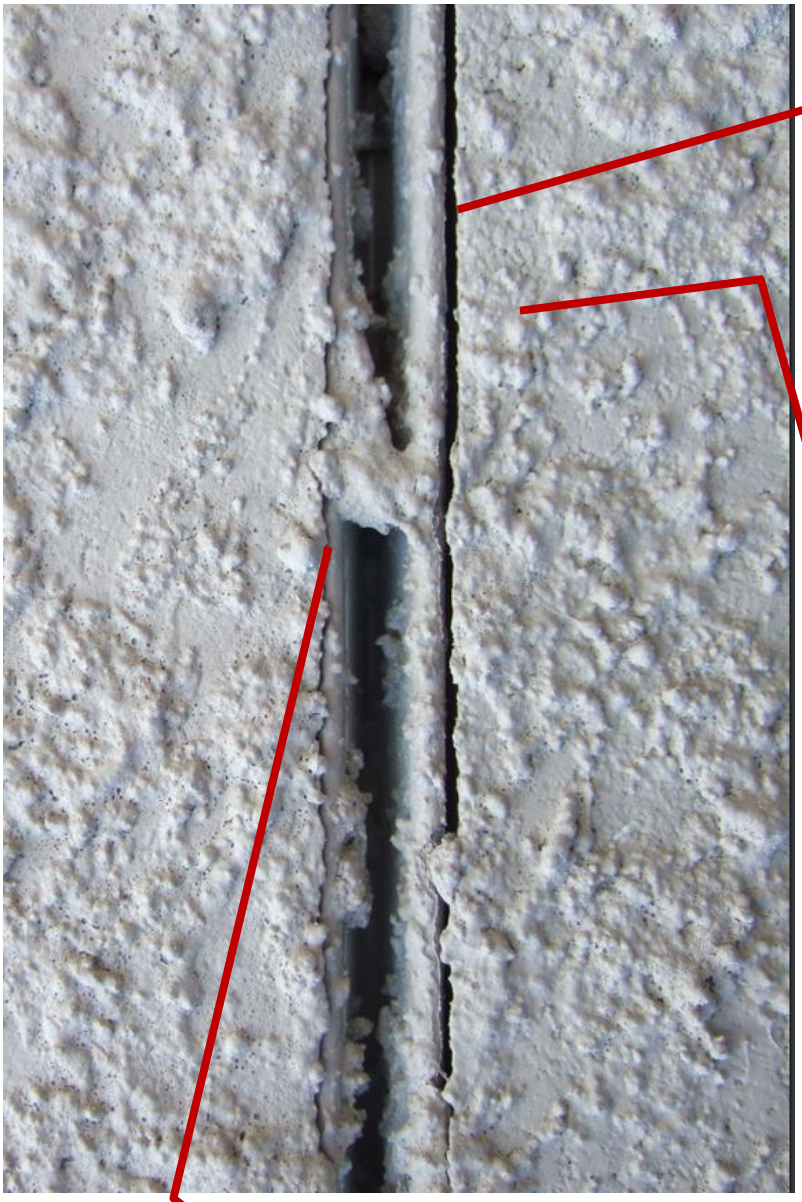
How Moisture Gets Behind the Stucco Assembly



Corner Bead cracking and allowing bulk water infiltration.
Coating so thin it is immeasurable.
Sealants needed.
All leading to high R/H behind stucco system

Control joint admitting bulk water entry.
Insufficient coating thickness. (3 mils)
Sealants needed.
All leading to high R/H behind stucco system

How Moisture Gets Behind the Stucco Assembly



Close-up of corner Bead cracking and allowing bulk water infiltration. Coating so thin it is practically immeasurable. Sealants needed. All leading to high R/H behind stucco system

Coating is supposed to be 12 mills.

How thick does this appear to be? Paper thin, too thin to obtain useable measurement.

Proper millage would bridge this gap and prevent water entry.

The old way was to cut a "V" groove on each side of the control joint interface and seal.

The sequence was; prime wall, install sealant, apply finish coats.

No self-respecting plasterer would ever leave a joint like this. It would have been cleaned, edges brushed, and a small "V" groove on each side for the painter to seal.

How Moisture Gets Behind the Stucco Assembly

Corner bead flanges not fully embedded within the plaster body admitting water.
Coating too thin; 2.5 to 4 mils.
All leading to high R/H behind stucco system.

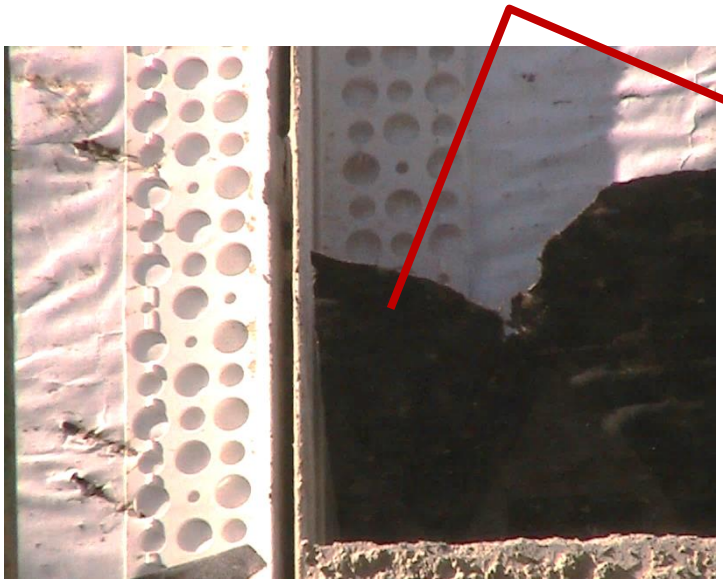
Mechanical Joint at bottom windowsill intersection.
Behind system condensation. Note decay starts behind flashing tape.
Coating so thin it is immeasurable.
Sealants needed.
All leading to high R/H behind stucco system.

How Moisture Gets Behind the Stucco Assembly

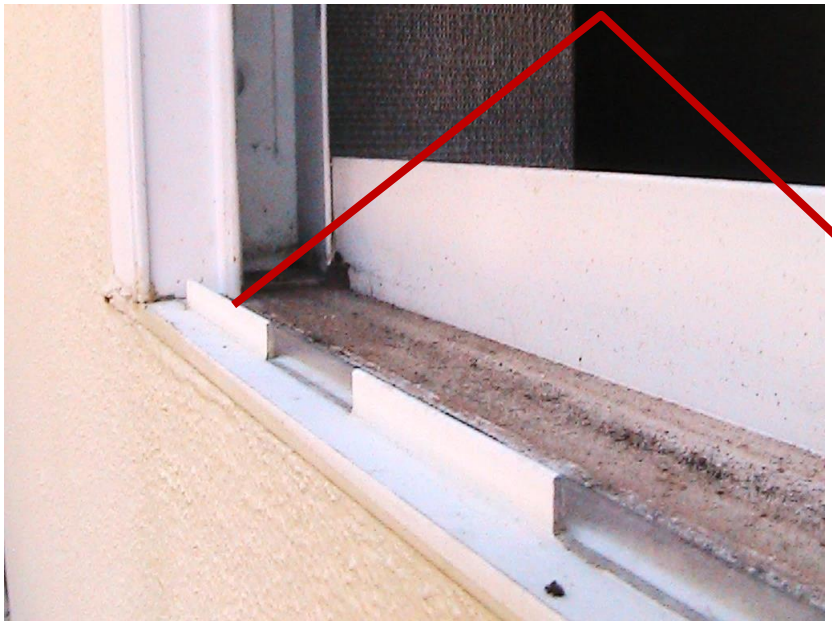
Roof flashing incorrectly installed.
Improper interface (flashing not "kicked-out").
All leading to bulk water and high R/H behind stucco system.

Horizontal Control Joint allowing bulk water infiltration.
Coating too thin (2-3 mils).
Sealants needed.
All leading to high R/H behind stucco system.

How Moisture Gets Behind the Stucco Assembly



Vertical Control Joint installed with paper over flange preventing flange embedment – source of bulk water entry.
Sealants needed.
All leading to high R/H behind stucco system.



Mechanical joint only watertight to 10% of design pressure.
Stressed by wall movement and high wind conditions,
Mechanical corners must be re-sealed when building is repainted.
Sealants needed.
All leading to high R/H behind stucco system.

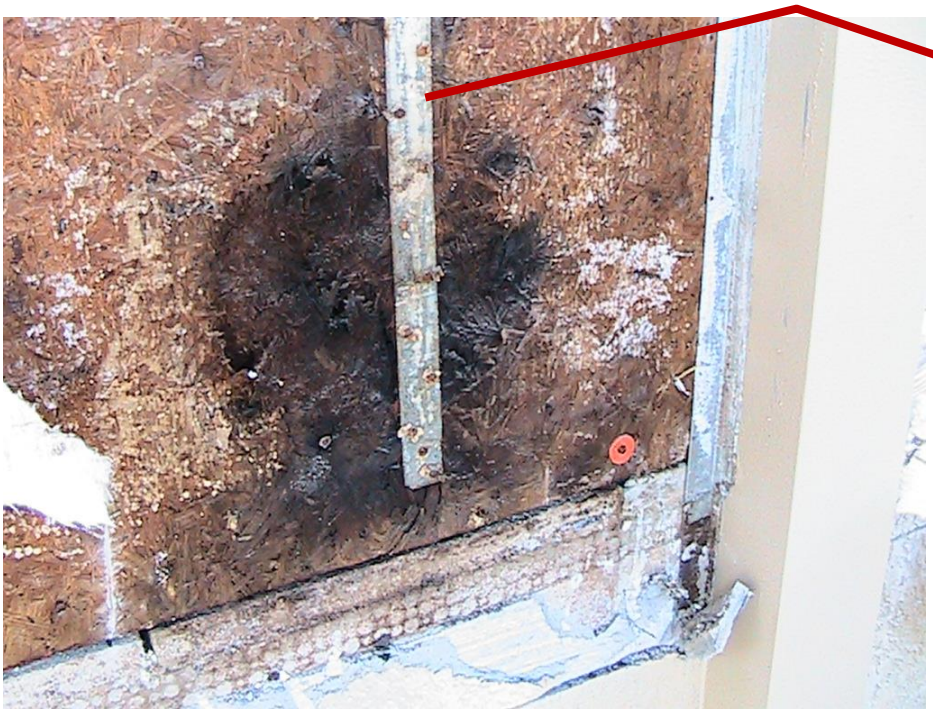
How Moisture Gets Behind the Stucco Assembly

Flush mount dryer exhaust mounted to wall instead of on top of the finished stucco. Localized intrusion. Can lead to high R/H behind stucco system.

Window mechanical corner joint failure. Moisture source behind flashing. Aluminum window jambs/sills are first condensing surface at dew point. Sealants needed. All leading to high R/H behind stucco system.

How Moisture Gets Behind the Stucco Assembly

Metal eave drip behind stucco.
Incorrect sequencing of work.
No sealant.
System not separated with "V" groove and sealed.
Bulk water entry.
R/H behind stucco system.
This was entirely preventable.



Condensation on fasteners and strap

Stucco must be applied tight to the wall with great hand pressure or sprayed with a machine

Hey, what is this, stucco being simply "laid-up" with a slicker? Hey, that won't work. But, most all have all been done that way. The industry is now moving to stop this practice. Look at the picture – 3 men "mudding" up the walls – no trowels.
This makes for a "fluffy" application that vapor can pass through a lot easier than a densely packed application. Proper face barrier however will prevent that passage.

Slickers noted by arrows

The Face Barrier System needed in Florida

Manually applying and assuring with elastomeric coatings (acrylic elastomeric, i.e., quality paint) and high-grade sealants, that the moisture (bulk and vapor) is rejected at outside skin of the building

How much vapor do you think is passing through this wall? Paint so thin, measurable samples cannot be practically taken. Microscopic examination shows 0.75 – 1 mill.

Assume you had thickness of 3 mills, and you needed 9 mills; 2/3 of your product would be missing. Now, think of a standard roofing shingle, if you could cut off 2/3 of its thickness with a laser and placed the remaining 1/3 on the roof – how long would it last? Maybe 5 years?

Ironic that we are getting about 5 years of life out of these coatings that are being applied at 1/3 their required thickness.

Now think of all that passing vapor "trapped" behind the wall. When evening comes, temperature drops, dew point is attained, the vapor will condense on what? Maybe the back of the metal lath?, aluminum window frames?, metal straps?…. You get the point.

How Moisture Gets Behind the Stucco Assembly

This is a close-up of a cut-in stucco reveal above a window on the 2nd story of a newly built, newly painted, occupied home. The paint specifications SHOULD call for 12 mil thickness – but, as usual, they say nothing. In case you're missing it, the gray is bare stucco. Since a spray rig was used to paint (instead of brush and roller) the upward spray caught the upper side (the one you see from the ground) of the reveal but left the bottom (that will catch water) completely bare. Thickness on face of wall was less than 4 mils. Gee, I don't know why where're having these stucco problems!!!!

How Moisture Gets Behind the Stucco Assembly

Wall coating too thin, moisture condensing behind panels.
Building needs re-coating and new sealants
All leading to high R/H behind stucco system.
Action is needed now – not later, all is salvageable now with no further damage.

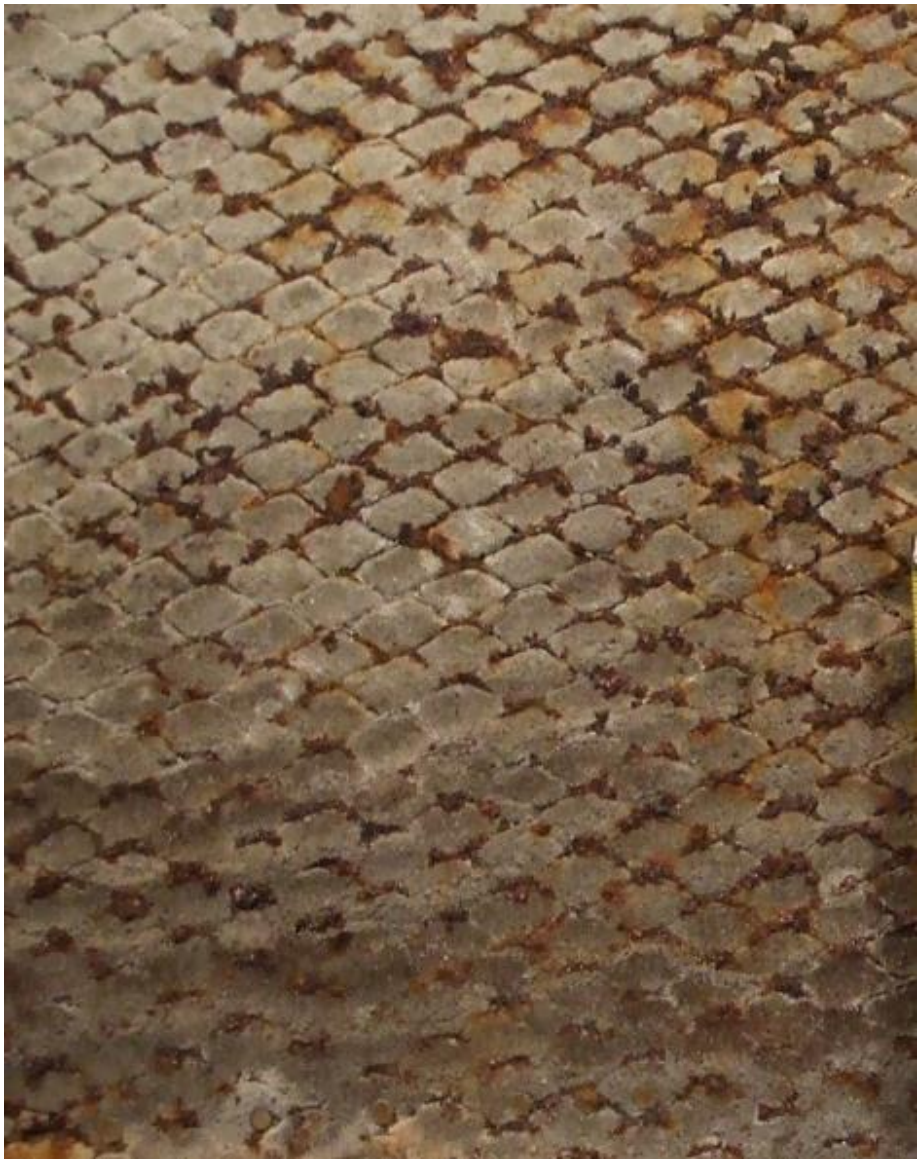
How Moisture Gets Behind the Stucco Assembly

Coating too thin
2.5 to 4 mils.
All leading to high R/H behind stucco system.
Aluminum dryer vent provide a perfect subsurface cavity condensing surface.

Corner Bead cracking, allowing bulk water infiltration.
Coating so thin it is immeasurable.
Sealants needed.
All leading to high R/H behind stucco system.

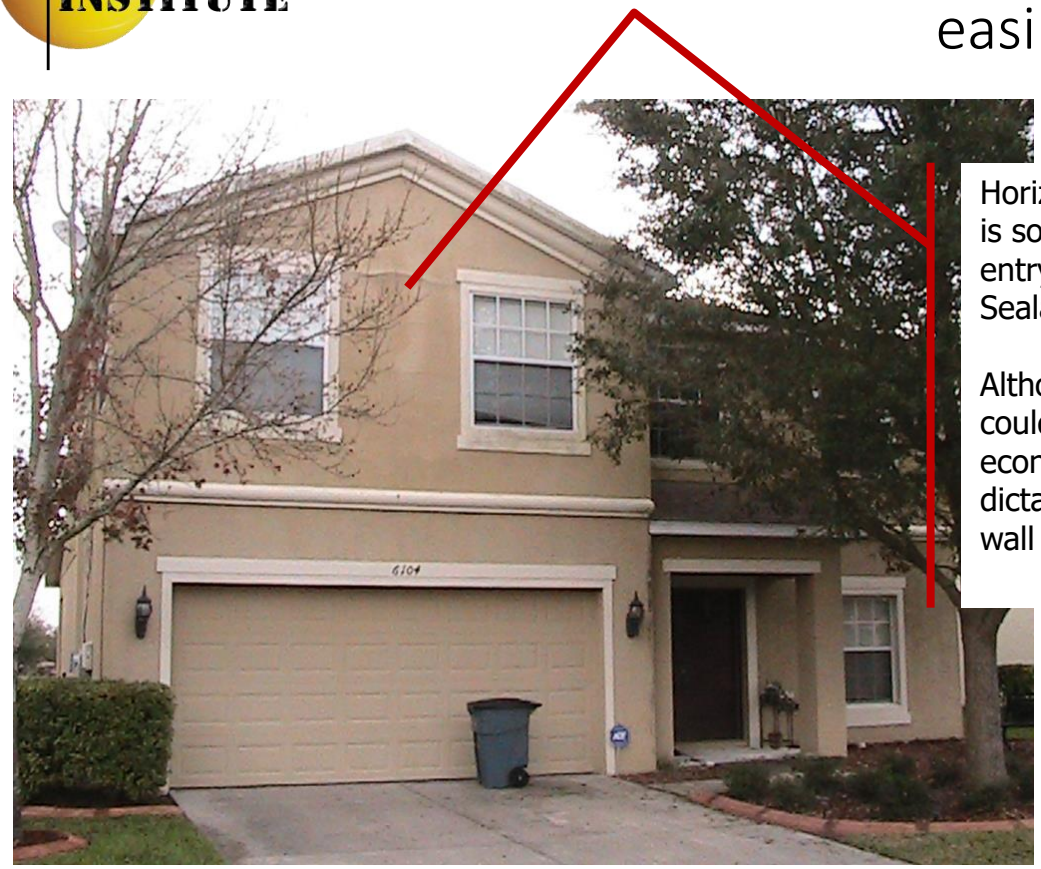
How Moisture Gets Behind the Stucco Assembly

Effects of condensation on metal lath at the back plane of the stucco assembly. Water vapor depositing moisture and salts. I was taught how to prevent this from happening by plasterers over 40 years ago. They knew this would happen if you did not install a stucco system for Florida's environment. More later on… Multiple layers of backing paper some of ASTM's international requirements make this problem WORSE!



De-Skins show the fallacy of recommending total stucco replacement

Walls that need removal can be easily identified



Horizontal control joint is source of bulk water entry.
Sealants were needed.

Although the wall could be repaired, economics would dictate removal of this wall only.

Unnecessary Stucco Removal…

These buildings are being de-skinned by the advice of a "con-sultant" masquerading as a stucco expert. Their reason for de-skinning; there were no drain planes or weep screeds so the system was deemed "non-code compliant". Otherwise, the jobs were perfect and around 8 years old. Note, there is no damage, no water migrating to be let out of a "weep" screed. The houses had face barrier systems that were working perfectly. These new code compliant replacement systems are now showing signs of failure as soon as 3 years.

The ASTM standard referenced by the code has an important provision within its text that reads: **"unless otherwise specified".** The consultant should have determined if the contractor had in fact, "specified otherwise" before claiming code violations and ordering un-necessary de-skinning.

Unnecessary Stucco Removal…

No weep screed, no drain plane, perfect performance – yet, the order to deskin was given by the "professional". Anyone see any damage?, any water dammed at the bottom? Face barrier system performing perfectly. Un-knowledgeable, un-professional consultants….. This is what is ruining our profession. We can fix the job problems – we cannot seem to fix the professional incompetence.

Unnecessary Stucco Removal…

Again, a complete waste of money, time and effort – and the new so called "code compliant" systems being re-installed (although they really are not compliant) are now are on their way to failure. Boy is this going to be a mess 10 years from now..

STUCCO INSTITUTE

General Issue Discussion….

- Although the subject of stucco problems within Florida is rife with complexities and variables, the majority of the problems are being misdiagnosed as "non-code compliant" installations. This is a misdiagnosis by and of itself, by those who remain untrained in the proper design and application of Florida specific code compliant stucco installation methodologies.
- Applying ALL of the code provisions, modifications, exclusions and conditional provisions to a Florida stucco assembly is an extremely complex task that requires understanding Florida's plastering history.
- Traditional ("old time") plasterers installed their stucco assemblies directly over a layer of felt paper. "V" grooves were cut and "brush sealed" at all intersections of dissimilar materials to allow for proper sealant seating, tooling and bonding.
- These jobs were all done with **flat un-galvanized lath, nailed tight to the wall** (no furring) and continue to perform flawlessly for well over 40 years.
- When the ASTM C-926 and 1063 eventually made their way into the code, regional (Florida) plasterers recognized it as a western developed standard that could not be entirely applied in Florida's high humidity, high salt, and high wind environment.
- The ASTM stucco and lath standards then, as today, were developed for lath over open framing, and finished with colored stucco, i.e., no paint. Accordingly, water that enters the system through cracks, migrates down the back of the lath and exhausts out a "weep" screed at the bottom of the wall. All is fine in those low R/H or "dry" climate locations.

- Florida plasterers knew that this methodology would never work in their environment. Any water migrating from the surface, through to the back of the stucco assembly, would carry migrating salts. Additionally, allowing humid air to circulate behind the assembly, could create frequent dewpoint conditions occurring behind the plaster assembly. The resultant condensation would initiate rusting of the lath, and the then metal accessories.
- Since the ASTM stucco and lath standards are "International", they need to be (and are) subject to regional modifications.
- Accordingly, regional plasterers and designers relied on the "unless otherwise specified" statement in those standards providing a method for regional modifications when needed. This allowed the old time Florida's plasterers to continue with their time tested and proven installation methodologies…
- To continue historical installation methodologies in the building envelope science, the painting contractor then "brushed and rolled" two coats of the specified coating to its required mil thickness.
- Sealants (as opposed to "beauty beads") were applied and tooled in place. The sealants, applied into the ""V" grooves provided by the plasterer, along with the required coating, melded into a outer "skin" that was not only water proof, but bridged further cracking and stabilized the wall covering system.

- This coating inefficiency (or more correctly, “deficiency”) is the prime source of the current stucco situation.
- Aggravating the situation is the fact that we now use OSB as a substrate whereas plywood or angular wood sheathing planks were the Florida substrate material of our predecessors.
- Although OSB and Plywood both fall into the “Vapor Semi-Permeable” classification (materials with a permeance of 10 perms or less and greater than 1.0 perm), OSB has some characteristics that are not conducive to high moisture conditions if trapped behind a stucco assembly.
- OSB resists the passage of vapor far greater than plywood.
- Let’s consider a stucco assembly in Florida’s environment:

Average Annual Temperature:

- 88.5° Avg. High
- 70.7° Avg. Low

Average Annual Relative Humidity:

- 88% Sundown
- 59% Sunrise
- Next, consider a stucco system in this environment that has a drain plane allowing for introduction and movement of this air behind the stucco assemblage.
- Then add an improper or unsealed face barrier, allowing for mass migration of vapor through the face of the stucco exterior to the back side of the stucco system.

- Now, encourage the installation of the stucco to provide thousands of contiguous reservoirs of wrinkles, pockets and voids terminating at a mechanism made with intended voids to let moisture out (and thereby air in); a/k/a; weep screeds.
- All of these ASTM stucco and lath methodologies are designed and sequenced to promulgate such unfettered drainage (and therefore unfettered air circulation) behind the “drained” stucco assembly.
- Given such a system, the vapor conditions (R/H) on the inward side (behind) the stucco will mirror, or very closely mirror, those on the outward (front) of the assembly.
- This collective high humidity will remain after sundown, wanting to migrate towards the cooler, dryer condition space or component .
- If that migration is effectively restricted, the vapor will remain and begin to cool. Soon the outward assembly will become the cooler surface.
- Whenever surrounding materials cool too the vapor’s dewpoint, the vapor will seek a condensing surface such as metal lath or metal window members which act as a thermal bridge.
- Using the average Florida temperature and humidity conditions, Dew point would occur when surrounding materials cool to approximately 84°. Fahrenheit
- The back side of the metal lath and metal accessories will be the first (and best) condensing surface.
- This chronic condition will lead to rusting of the lath, expansion of

the metal and bulging (tented) stucco ruptures in the wall region.

- Plywood has somewhat more forgiving properties for passage of the moisture.
- In the report, posted at www.stuccoinstitute.com in its entirety)

"Moisture performance properties of exterior sheathing products made of spruce plywood or OSB", (Tuomo Ojanen & Jarkko Ahonen, 2005), some important properties of OSB were noted from the report:

Water vapour permeability

The vapour permeability of both OSB and plywood were in a relatively low level under dry conditions, but the level increased a lot after certain relative humidity level. There was a significant difference between the products in this respect.

The vapour permeability level of plywood was under 80% / 58 % RH condition measurements from 5 to 11 times higher than those measured under dry cup conditions for the same product. With OSB these values were only about 1.23 times higher than under dry cup conditions. When the relative humidity test conditions were 97 %/ 72 % RH, the vapour permeability of OSB had increased to be about 4 to 9 times higher than in the dry cup tests, while the plywood vapour permeability level was 12 to 20 times higher, depending on the product.

- This data shows that plywood is much more permeable (able to pass vapor) than OSB which is more restrictive .

- Plywood has a greater ability to increase its permeability (and therefore pass) higher levels of relative humidity to the interior under higher humidity levels. OSB simply remains a better vapor barrier under elevated humidity.
- Essentially the OSB (acting in concert with the housewrap and paperbacked lath (or 2nd grade 'D" paper layer) is a barrier to passage of vapor and allows the drain plane crevices, voids and spaces to act as vapor collection reservoirs in the space between the back of the lath and drain plane.
- Once either side of the wall cools to dewpoint, the back side of the metal lath and metal accessories will become the first (and best) condensing surfaces.
- This chronic condensing condition will lead to rusting of the lath, expansion of the OSB, expansion of the stucco, expansion of rusting metal accessories, etc..... all resulting in bulging (tented) stucco ruptures in the wall region.

Additionally, from the same study:

"Moisture performance properties of exterior sheathing products made of spruce plywood or OSB", (Tuomo Ojanen & Jarkko Ahonen, 2005), examined the capillary capabilities of OSB. From the study:

Capillary water absorption

The final moisture content level of these four OSB products was about 2.5 times higher than that of plywood products.

- Lastly (and of most importance) the effect of moisture an dimensional stability was examined in that study:

Dimensional Stability

The dimensional stability of the product has an effect on the air and moisture tightness, thermal performance and even on the strength of the structure. High swelling of the material could be detected mainly in the board thickness. The relative dimensional change on the longitudinal direction was significantly lower than that of the thickness.

<u>The relative change of OSB board thickness under capillary contact was in the range of 19 - 28 % and with plywood it was from 3 to 6 %.</u> Most of the swelling of plywood boards took place in the hygroscopic area, but about half of the swelling of the OSB boards took place between 87 % RH and the capillary saturation conditions.

- Change in the thickness of OSB board to an attached brittle stucco system will induce cracking, will induce water, which will rust lath, which will induce more cracking, etc... The dog chases its proverbial tail.
- Now I told you that to tell you this…..
- In Florida, If you do NOT keep the water and vapor blocked at the face of the stucco system – you will allow water to migrate through and behind the stucco with devastating results. We have known this since we began stuccoing!!

- To successfully install a stucco cladding system in Florida, you will need to modify the ASTM C-926 and C1063 provisions using the "unless otherwise specified" provision.
- Essentially, we need to modify it to represent the provisions of the old South Florida Building Code used by Miami/Dade for years. But that code has been replaced.
- Since it takes years of experience or a lot of special training to understand Florida's unique building envelope conditions in order to know if, and when, and to what extent details interrelate to correct code applications, **how are plans examiners and code officials to know whether the modifications are right or wrong?**
- Code officials simply cannot, are not, and should not - be tasked with this responsibility.
- Now you have arrived at the reason, purpose and need for the Sealed Stucco System. We needed to recommitment to those proven details, provisions, methodologies and traditions, adding newer improvements.
- The next step was to get the whole system tested and approved for code approval so contractors and code officials would not have to deal with the "con-sultants" feeding lawsuits over so-called "code violations" from necessary modifications of the ASTM referenced documents.
- Go to: www.sealedstuccosystem.com

For further information on that topic.

Some more examples – with discussion…..

Recently, some of us were discussing the following condition. The following is my explanation of the causes of these types of problems.

Group, in this case, classic control joint defects is the initiator. We have traced them on many jobs. Paper over control joint flange. Water enters, travels down until a paper lap, or void, turns and migrates it horizontally. Aw is elevated behind the assembly, OSB swells (in its thickness stressing the brittle stucco coat), cracking (minute at first) is then further initiated, leading to the introduction of ambient R/H (vapor). Vapor cools at night, condenses on the first available condensing surface (back side of the lath) causing rusting, which expands….etc….

Exacerbating factors; drain plane allows vapor to accumulate and circulate behind the stucco assembly, slickers used to lay on first coat, insufficient mil thickness allow the whole wall to become permeable.

Small amounts of vapor should be able to pass through (when we used wood or plywood) the sheathing, but OSB is virtually a vapor barrier unto itself. So the vapor is blocked or severely impeded at this plane. Again, small amounts still would not be a problem by and of itself. However the amount grows exponentially and after a few years it can become catastrophic when coupled together with other exacerbators such as; base coat by slicker, air circulating drain plane allowing the free entrance of moisture laden air, insufficient mil thickness allowing the passage of vapor and allowing the stucco to become wet after each rain, stucco control joints installed incorrectly allowing bulk water

and vapor admission behind the wall that that is seriously restricting the vapor migration (discharge) through to the conditioned side of the wall. Dew point behind the stucco assembly occurs almost every night causing condensation on the first available condensing surface; the exposed metal lath, and, if we could make it worse, the depositing of migrating salts on the same metal surface, now factor the stress of thermal swings to the front and back of the assembly coupled with wet/dry areas…

This is what is going on. There are other items connected to specific installation anomalies, roof leaks behind the assembly, incorrectly sloped soffit, window leaks at mechanical joints, incorrectly installed banding, etc… But the root of problem is summarized above.

The generations of plasterers before me, who taught me how to apply stucco in Florida, applied plain UNGALVANIZED (black coated), flat (no dimples or ridges masquerading as "self-furring") lath, nailed TIGHT, and I mean tight – against the wall. They wanted no air pockets or air circulation, no weep screeds and no so called "control" joints. Lath was randomly nailed to the wall to ensure it laid flat in order for withdrawal resistance to be distributed for wind loading.

The substrate was plywood or diagonally applied wood sheathing (rough sawn 1x10) covered with 15 lb felt . We 3 coated, (cement & lime & sand – densifying the brown coat) and cut "V" grooves at all penetrations and stops (for sealant application),

rodded all corners (no external beads or exterior control joints allowed in the wall plane) with either sand floated or textured finishes. This was followed with an actual PAINER applying a coating (by roller) the 3 coats required; prime, and then 2 coats of exterior paint, to the proper mil thickness. All "V" grooves were sealed by the painter (no "beauty beads").

I can drive anyone all day long (or months long), to house after house, with these systems intact, no (other than normal) cracking, no spalling, no defects, performing perfectly, some now 80 YEARS old! Homes NEVER had stucco problems in Florida AT ALL until we started the drain plane concept, weep screed concept, putting in control joints (incorrectly), began painting (not coating) with airless sprayers from ladders to achieve a visual acceptance of the paint (thereby diminishing the mil thickness required to "coat" the wall), stopped the "V" grooving, and quit sealing and started "beauty beading".

- And we wonder what is going on in Florida…. Really?

SEALED STUCCO SYSTEM

- For more information on the standards and installation practices, refer to the Sealed Stucco System at: www.sealedstuccosystem.com
- The sealed stucco system is simply the traditional stucco application process used in Florida's type climate for over 40 years with some modern modifications and products.
- The system has been laboratory tested and approved.
- My Florida Code is a Public Code Discussion Forum for Florida Code, Construction and Licensing Issues, Downloads and Links

FLORIDA CODE DISCUSSIONS

Construction Industry Professionals
Sharing Knowledge
and Ideas.

www.myfloridacode.com

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Robert Koning has been involved with the plastering, stucco, masonry, roofing and waterproofing industry for over 40 years.

Beyond that, the Koning family's involvement in the Florida industry dates back to the 1920's. These combined provide both an indispensable knowledge of ever-advancing products, methods, and standards, and a discernment against persistent myths and outdated requirements.

His numerous licenses and certifications include: Bachelor of Science in Construction Engineering – Certified Arbitrator & Mediator – Director of Construction Education at Contractors Institute – Certified General, Building, Roofing, Plumbing, Underground Utilities, Air Conditioning, Master Electrician, Solar, Mold Assessor, Mold Remediator, Home Inspector, and BPI Building Analyst.

Robert Koning is a Code Certified: Level 1 – Building, Roofing, Plumbing, Mechanical, and Electrical Inspector; Level 2 -Building, Plumbing, Mechanical, and Electrical Plans Examiner; Level 3 – Chief Building, Plumbing, Mechanical and Electrical Code Analyst; Level 4 -Code Enforcement and Administration Professional; State Certified Standard Building Code Administrator