

Designing and Specifying Traditional Portland Cement-based Plaster

Credits: 1 AIA LU/HSW; 0.1 IACET CEU*
AIA course number: WC0420MM

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International Building Codes 6th Edition (2018); ASTM C926-19 & C1063-19a

This presentation is written with the currently in-force 2018 version of the IBC, but with the currently approved newer versions of the ASTM Standards that will appear as referenced documents in the next version (2021) of the IBC .

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Course Objectives

- ❑ To provide a positive effect on the water- and vapor-resistive qualities of the building envelope through identification of underlying issues of the water-resistant barriers and the subsequent application of traditional Portland cement-based plaster (stucco).
- ❑ To foster an industry-wide improvement in the quality of water-resistant barrier and stucco applications.

Learning Objectives

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- Identify the features and benefits of traditional Portland cement-based plaster.
- Describe the relationship between the building codes and the industry standards for traditional Portland cement-based plaster.
- Explain the roles and contributions of the designer, contractor, plastering contractor and building official in achieving a successful stucco wall system.
- Discuss the design considerations, specifications and detailing requirements a successful stucco wall system.

Course Outline

- ❑ Benefits of traditional Portland cement-based stucco
- ❑ Review of building codes and ASTM standards
- ❑ Research reports on water intrusion
- ❑ Design features required to managing water intrusion and stresses in stucco
- ❑ Specification and detailing requirements and recommended best practices

Current Plaster Veneers

The most common plaster veneers used in today's construction markets include:

- ❑ Traditional Portland cement-based plaster
- ❑ One-coat stucco products
- ❑ Exterior insulation finish system (EIFS)

Plaster Veneer Systems

Traditional Portland cement-based plaster

- ❑ **Full-thickness** stucco meeting the material and application criteria of ASTM C926
- ❑ Considered a “hard” system because of its strength, durability and ruggedness
- ❑ Can be very effective in all climate regions when installed correctly. Attention must be paid to waterproofing and air barrier details as required by climate zones and local codes.

All plaster systems rely on the capability of the installer. The installers, though, must rely on the information received from the designer: specifications and details are necessary for success.

Plaster Veneer Systems

One-coat stucco products

- Proprietary cementitious products that **do not meet** the ASTM C926 criteria and are not referenced in the building code
- Evaluated by a code-compliance engineering report
- Submitted to and approved by the building official

These systems tend to perform better in drier climates. As in any system, all of the waterproofing details must be strictly adhered to in order to provide the code-required weather-resistant exterior envelope. Details are imperative.

Plaster Veneer Systems

Exterior Insulation Finish System (EIFS)

- Proprietary wall systems consisting of insulation board and acrylic base and finish coats
- Considered “soft” systems due to their limited durability and susceptibility to damage

EIFS systems have vastly improved over the last 20 years. These systems provide very rigid instructions, along with very specific detailing and single-sourcing requirements.

The “softness” referred to here is due to issues arising out of high-wind zone events that occur in some regions. Most of these concerns can be eliminated by selection of the correct system for the specific location intended. Most of these proprietary manufacturers will gladly help you choose the correct system for your location and conditions.

Benefits of Traditional Stucco

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- Meets the building codes
- Flexibility of design
- Strength and durability
- Resistant to water intrusion
- Lasting value \$\$\$
- Sustainability

Meets the codes even in Miami-Dade County (Zone 1).

Building Codes and Industry Standards

Building Codes are a set of absolute minimum criterion to which one must build. You may exceed the requirements of the Code but you may not diminish them. There are no penalties for building to levels that far exceed code requirements. Consider the Fortified Building approach of the IBHS (Institute for Building and Home Safety). ibhs.org

U.S. Building Codes

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International Code Committee (ICC)

- International Building Code (IBC)
- International Residential Code (IRC)



A Code-Referenced Standard is, by code definition, part and parcel of the code itself. Therefore, they must be followed or they must be exceeded but the requirements of these standards cannot be reduced in effectiveness to any degree.

ASTM* Stucco Standards

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Designation: C926

Standard Specification for
Application of Portland Cement-Based Plaster¹



Designation: C1063

Standard Specification for
Installation of Lathing and Furring to Receive Interior and
Exterior Portland Cement-Based Plaster¹

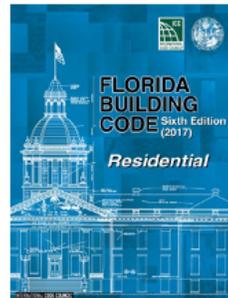
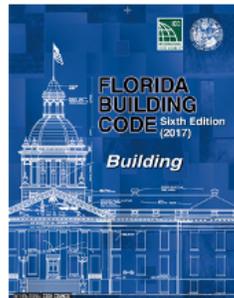


* A standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems and services

State Building Codes

i.e., Florida Building Codes

- Florida Building Code
- Florida Building Code, Residential



Design your project to meet the conditions of the intended location. Check with local AHJs (Authority Having Jurisdiction) and listen to the advice of local contractors for information prior to designing and specifying.

A one-size fits all approach to building design will lead to disaster. Things that work in Phoenix, Arizona, for example, likely will not fare as well on Biscayne Bay, Miami or the Gulf Coast from Florida to Texas.

ASTM Stucco Standards

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Designation: C926

Standard Specification for
Application of Portland Cement-Based Plaster¹



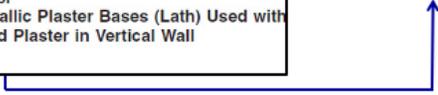
Designation: C1063

Standard Specification for
Installation of Lathing and Furring to Receive Interior and
Exterior Portland Cement-Based Plaster¹



Designation: C1787

Standard Specification for
Installation of Non Metallic Plaster Bases (Lath) Used with
Portland Cement Based Plaster in Vertical Wall
Applications¹



Even the standards that are referenced within the Code-Referenced standards are part of the code as well.

International Building Code

Section 2510 Lathing And Furring For Cement Plaster (Stucco)

2510.3 *Installation. Installation of these materials* shall be in compliance with **ASTM C 926** and **ASTM C 1063***

2510.4 *Corrosion resistance. Metal lath and lath attachments shall be of corrosion-resistant material."*

*Lath and fasteners must be corrosion-resistant.

International Residential Code

Section R703.7 Exterior Plaster.

*"Installation of these materials shall be in compliance with **ASTM C926** and **C1063** and the provisions of this code.*

703.7.1 *Lath and lath attachments shall be of corrosion-resistant materials...*

703.7.2 *Plastering with Portland cement plaster shall be in accordance with ASTM C926...Plaster shall be not less than three coats where applied over metal lath or wire lath and shall be not less than two coats where applied over masonry, concrete, pressure-preservative-treated wood or decay-resistant wood as specified in Section R317.1 or gypsum backing. If the plaster surface is completely covered by veneer or other facing material or is completely concealed, plaster application need be only two coats, provided the total thickness is as set forth in Table R702.1(1)...*

3 coats (scratch, brown and finish coats) over lath (metal or non-metallic).

2 coats over solid bases: cast-in-place and precast concrete, CMU, clay brick, stone and tile.

To the nominal thickness in Table 4.

Flexibility of Design

- ❑ Compatible with most building systems
- ❑ Used on a variety of substrates
- ❑ Various textures and architectural features
- ❑ Can be molded or sculpted



Almost all of the special shapes or architectural features, such as dentil work, you see at places like this are stucco – chosen for its ease of workability and its enduring capabilities.

Strength

The Strength of concrete:

The compressive strength of Portland cement-based stucco is approximately 2,500 psi, which is comparable to a normal concrete block, or a typical driveway or sidewalk.



Stucco, however, has little tensile or flexural strength. Therefore, these issues must be accommodated in the design of the system.

Durability/Ruggedness

Resistant to attack from:

- Heat
- Humidity
- Hurricanes
- Airborne debris
- Insects
- Woodpeckers
- Weed whackers
- Grocery carts
- BB guns
- Golf balls, etc.

You can't poke holes in the durability and integrity of stucco... it's a HARD system to beat.

Lasting Value \$\$\$

- ❑ Lower cost of construction

A fraction of competitive veneer systems (i.e., brick, stone or EIFS)

- ❑ Longevity

A 50+ year wall system

- ❑ Low maintenance

Won't:

- ❑ Rust
- ❑ Rot
- ❑ Blister
- ❑ Burn



There are portions of some of Europe's most famous medieval castles that still have original plaster on the exterior and interior walls.

And, for the most part, critters won't eat it.

Resistance To Water Intrusion



Stucco's Perception In Today's Media

"Stucco construction lawsuits have become a major growth industry in recent years, with water damage and mold being the two chief complaints."

The Berkley Dailey Planet

"Attorneys for Sun City Hilton Head residents who are suing the gated community's builder and developer over stucco say two recent developments signal that the years-long battle is gaining momentum".

The Island Packet

"In a lawsuit filed last week against six companies involved in the library's design and construction, the city is seeking damages, interest, costs and legal fees for a wall failure that included delamination of stucco and major water intrusion in parts of the roof, windows and skylights."

Jacksonville Times-Union

Hey, it's not a stucco problem...it's a weather-resistant barrier problem!

Unfortunately, this building system has more recently gained some unwanted notoriety due to problems caused by water intrusion.

✓ Fact Check

- ❑ Stucco has been the chosen veneer in the U.S. for decades based on its proven record of excellent performance.
- ❑ Recent research on water resistance of stucco has substantiated stucco's ability to perform under extreme weather conditions, when properly designed and constructed.

For example: There was a land boom in Florida from the mid-1910s to the crash in 1929. Many homes were built of coquina stone or block and stucco. Those that have survived the expansion since then are still performing well today with little more than an occasional patch and a quality paint job.

2004-2005 Hurricane Destruction

- The Federal Emergency Management Agency (FEMA) deployed teams to determine how residential buildings in Florida performed during the hurricane season.
- They found that the majority of the damage was concentrated to the building envelope systems such as roof coverings, soffits, doors and windows.
- The vulnerability of the building envelope was to be addressed, beginning with the window-wall interface and an evaluation of current window installation standards.



Similar steps were taken after Hurricane Andrew devastated the Miami-Dade area in 1992.



Water Intrusion Research



**RESIDENTIAL WINDOW INSTALLATION
OPTIONS FOR HURRICANE-PRONE
REGIONS**

By

CORY THOMAS SALZANO, PhD

This research was conducted at the University of Florida's College of Engineering Powell Laboratory, and was supported by the Florida Building Commission and the National Science Foundation.

This research was the basis for Dr. Salzano's doctoral thesis.

Test Methods

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- ❑ Hurricane Simulation (Category 3 Wind Speed)
- ❑ Negative Pressure (Static and Cyclical)
- ❑ Hydraulic Leakage Pressure
- ❑ Sealant Adhesion Strength

These are four of the test parameters the Dr. Salzano tested. The methodologies are standard test procedures today as specified by several agencies including FMA/AAMA and ASTM.

Test Methods



Typical Wall Systems Tested

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□ Barrier Wall Systems

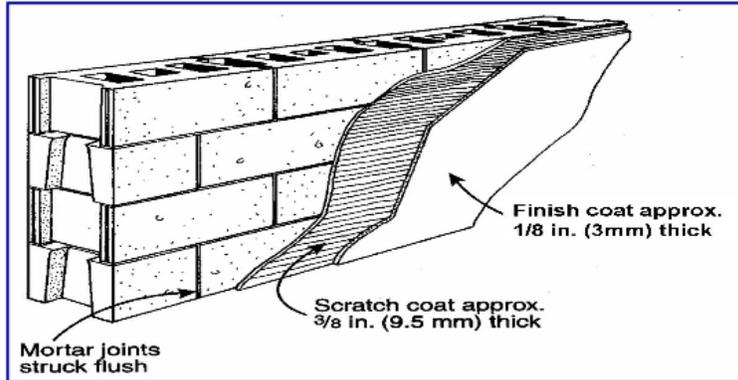
Type of wall system that is intended to manage all water at the exterior surface

□ Drainage Wall Systems

A type of wall system in which the cladding provides a substantial barrier to water intrusion, **plus a concealed water-resistive barrier** over which drainage, away from water-sensitive components of the wall, may occur

Barrier Wall

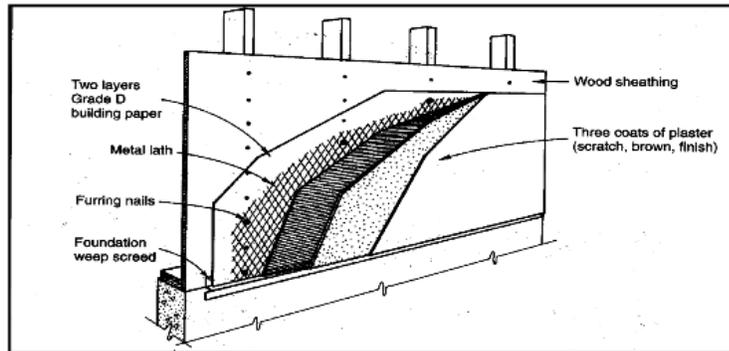
Typical Block & Stucco Construction



***Type of wall system that is intended to manage all water at the exterior surface**

Drainage Wall

Typical Frame & Stucco Construction



***A type of wall system in which the cladding provides a substantial barrier to water intrusion, plus a concealed water-resistive barrier over which drainage, away from water-sensitive components of the wall, may occur**

Consider all the extra steps that need to be taken in this type of wall system vs. a direct-applied barrier wall system.

Barrier systems can be accomplished over lath and framing; though, there are strict guidelines for constructing what is called a Face-Barrier system.

Rain-Screen systems are Drainage walls but can be built to be Face-Barrier walls.

Results of Block Wall



"Water barrier installation methods simply employ a continuous exterior seal around the window perimeter. These installation methods performed well on the CMU wall specimens"

Notice that this wall has no fluid-applied barrier on the head, sill, jamb or block face. It simply has a well sealed buck: both behind the buck and at the exterior perimeter.

Results of Frame Wall



"The effectiveness of the drainage method installations relies on the ability to redirect infiltrating water to the drainage plane of the wall."

Notice the gap between the window and the plasterstop. This code-required separation provide a sealant tray for the application of backer rod (closed cell) and a warrantable sealant bead configuration.

NCMA Water Intrusion Research

National Concrete Masonry Association

Funded by the NCMA Education and Research Foundation
NCMA Research & Development Laboratory, Herndon, Va.

Paper: *Journal of ASTM International*, March 2010

Russell T. Flynn and Jim Gulde

"A Laboratory Evaluation of Plastic (Stucco) Cement-Based
Plaster as a Barrier to Water Penetration of Concrete Masonry
Construction at Hurricane Force Wind Speeds."

Wall Specimen Construction



This is a stucco cement that meets both ASTM C91 and ASTM C1328. It is not a cement/lime mix. Both are acceptable under the code. In this case, this is simply the prevalent product in the Florida market from which these test were done.

For more information, see the FLAPB's Technical Bulletin, "Choosing the Right Materials for Stucco in Florida", TS-TB-05-14 at FLAPB.com

Results of Phase 1

Test Criteria: 4 Hours at 62 mph....followed by 24 hours at 110 mph



Bare block wall without stucco: Testing was ceased at 4 hours due to obvious water intrusion.



Wall with 1/2-inch stucco after 28 hours showed no moisture intrusion.

The spray rig is metered to 3.4 gal/ft²/hour. This is a volume of water that far exceeds most storm records at @ 25½ inches of sustained simulated rain under extreme pressures. .

The ASTM E514 test calls for the parameters of this left photo. This could be just a summer shower in Florida, so we expanded the test parameters to those conditions suffered in Hurricane Andrew but for a much greater duration.

Results of Phase 2

Test Criteria: 4 Hours at 155 mph.....followed by 24 hours at 180 mph



Wall with 1/2-inch stucco wall after 4 hours at 155 mph showed no water intrusion.



Followed by an additional 24 hours at 180 mph, showing minimal signs of water intrusion.

4 hours of sustained 155 mph equivalent wind pressures is still more than most hurricanes will produce.

After 56 total hours of sustained wind-driven rain, these properly installed and unpainted block/stucco walls showed one damp spot less the 3 square inches with no measurable amount of water in the capture tray.

✓ Fact Check

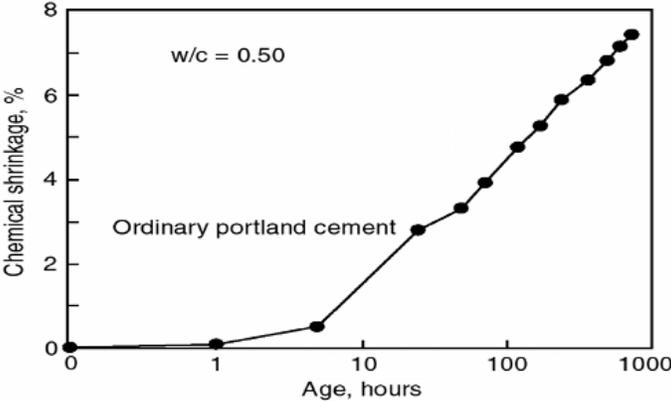
1. Properly designed, both block and frame walls, constructed with a stucco veneer will provide excellent resistance to water intrusion.
2. Rain water doesn't pass through a 1/2 inch of properly applied stucco, not even at hurricane wind speeds!





**Understanding
Volume Change
(Shrinkage & Cracking)**

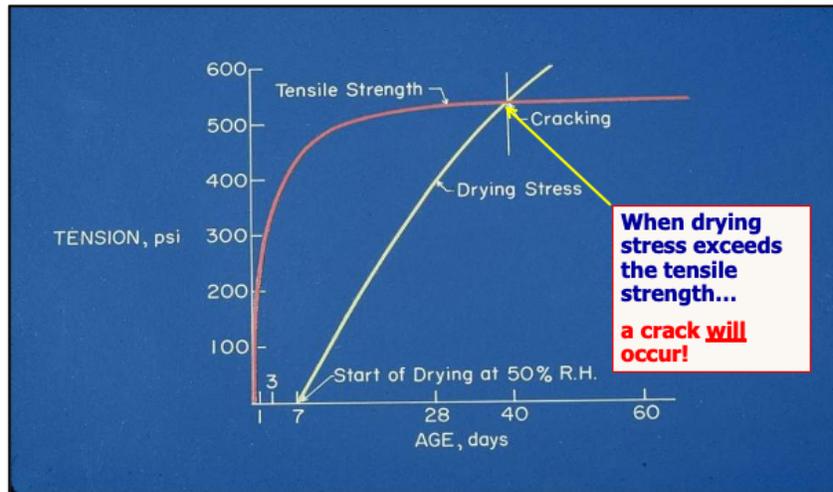
Normal Portland Cement Shrinkage



Stucco, like all Portland cement-based products, has a similar and normal shrinkage characteristic.

Shrinkage potential must be accommodated within the system and provided for in the drawings and specifications.

Strength vs. Stress



This slide illustrates 2 of the processes that are occurring within a Portland cement-based product with time:

- 1) The development of strength due to the normal hydration process of Portland cement. The compressive, flexural, and tensile strengths are developed quickly at the early ages and flatten out considerably after 28 days.
- 2) There is an internal stress caused by the normal drying shrinkage of Portland cement. Eventually the drying stresses become stronger the tensile strength, at which point a crack will occur. It's nobody's fault...it's normal and should be anticipated.

Stress Relief in **Frame Walls**

In addition to the normal shrinkage, stucco in frame walls is going to be subjected to various other stresses including:

- ❑ Internal Stress – rapid loss of moisture due to weather
- ❑ Building Settlement – foundation/compaction issues
- ❑ Structural Movement – deflection of structural members, shrinkage of the framing or sheathing, excessive construction or structural loading
- ❑ Weather – increased shrinkage due to wind/humidity/temperature
- ❑ Thermal Shock – extreme/rapid change in temperature

The Solution: break the panels up into smaller areas, and provide for expansion and contraction through the use of joints.

Stucco will not hold the building together. If the building moves, the stucco is going to move. When that movement stress exceeds the tensile or flexural capabilities of the stucco, a crack will appear.

The code requires all dead load to be placed prior to plastering. Drywall should be hung before stucco is applied. The weight of the drywall, along with vibration from driving nails or screws into framing opposite fresh plaster will cause the plaster to crack.

Control Joints in **Frame Walls**

Specify, locate and detail appropriate control joints

ASTM C926 A2.3.1.2 "Prefabricated control joint and expansion joint members shall be installed prior to the application of plaster. Their type, location, depth and method of installation shall be determined by the characteristics of the substrate and included in the contract documents."

One-piece control joint



Two-piece expansion joint



Question: Who writes the "construction documents"?

This statement is intended to have CJs shown on the drawings.

CJs are intended to accommodate the thermal expansion and contraction of the plaster in plane as it cures. The effectiveness of CJs after curing is limited at best.

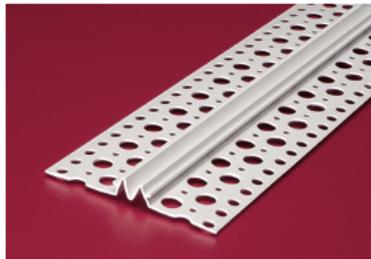
Typically, for new construction, the Designer of Record writes these documents. However, remodel and remediation projects may or may not have a professional Designer of Record, in which case it falls to whomever the owner authorizes.

Control Joints

ASTM C1861 4.6.2

*Control Joint—Lathing accessory used as a screed to assist in cement plaster thickness control; to reduce cracking by accommodating movement of the cement plaster cladding assembly **caused by shrinkage and thermal variations**, along predetermined, usually straight, lines; to separate cement plaster from dissimilar materials, load bearing members and penetrating elements; and to provide an edge, end, or termination for a cement plaster panel area.*

One-piece control joint



By definition, a CJ is one piece. An Expansion Joint (EJ) is 2 or more pieces. It is important to know the difference (described in the next slide) but also to know that an EJ can be used where a CJ is needed but not the other way around.

CJs accommodate stresses in the plane of the plaster.

Expansion Joints

ASTM C1861 4.6.1

Expansion Joint—Lathing accessory used as a screed to assist in cement plaster thickness control; to reduce cracking by accommodating movement of the stucco cladding assembly caused by movement of the building or its components beyond cement plaster shrinkage and thermal variations; to separate cement plaster from dissimilar materials, load bearing members and penetrating elements; and to provide an edge, end, or termination for a cement plaster panel area. An expansion joint lathing accessory shall be formed from two or more separate pieces with solid attachment flanges and a movement gap.

A two or more piece expansion joint may be used where a control joint is required; but, a control joint may not be used where an expansion joint is required.

Two-piece expansion joint



EJs can accommodate some movement both in and out of plane.

Joint Criteria for Frame walls

ASTM C1063 Section 7.4.10 to 7.4.10.4

- ❑ *Install Control Joint lathing accessories in conformance with 7.3.1.5.*

Lath shall not be continuous through control joints' but shall be stopped and tied at each side.

- ❑ **Area**
 - ❑ Walls: not more than 144 ft²
 - ❑ Horizontal applications: not more than 100 ft²
- ❑ Distance between control joints shall not exceed 18 ft. in either direction
- ❑ A length-to-width ratio of 2^{1/2} to 1
- ❑ Where the ceiling framing or furring changes direction.
- ❑ Where an expansion joint occurs in the base exterior wall.

Horizontal areas, in this context, means ceilings or soffits. Regional environmental (weather) conditions must be taken into account by the designer prior to using stucco on a weather-exposed surface (this is a code-defined term). For example, in hot, wet Florida, we don't recommend stucco for wall caps at all.

Your choice is not either/or. All three conditions must be taken into account. So, if you have a wall area 18 feet long, it must be less than 144ft² and therefore can only be 8 feet high.

In ceilings, where the support framing changes directions due to truss configurations, a joint must be provided along that intersection as the two sides will move in differing directions and cause a crack.



Roles and Contributions

Shared Roles and Contributions

The contributions in providing a successful plaster veneer are shared by the:

- Architect
- General contractor/home builder
- Plastering contractor
- Building official

The Architect's Contributions

Designs the building and site:

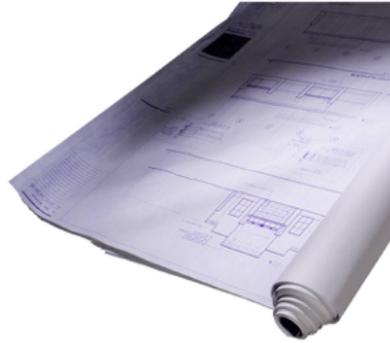
- According to owners concept
- Utilizing contemporary designs
- Utilizing appropriate and compatible materials and methods (concrete, steel, glass, wood, masonry, plaster, etc.)
- In compliance with current codes and referenced standards
- Develops project documents

See the Construction Specifications Institute's , "Project Resource Manual" for a list of what constitutes "Project Documents" vs. "Contract Documents."

The Architect's Contributions

Develops Project Documents

- Contracts
- Specifications
- Plans and details**



The Architect's Contributions

Specifications

Specifies criteria for materials and construction practices including the plaster, lath plaster base, accessories, workmanship, etc.

Application of Plaster – ASTM C926

- Materials – Cements, Sand, Admixtures, etc.
- Mixture – Designation, Proportions, Mixing, etc.
- Application – Coats and Thicknesses
- Curing - Appropriate Protocol

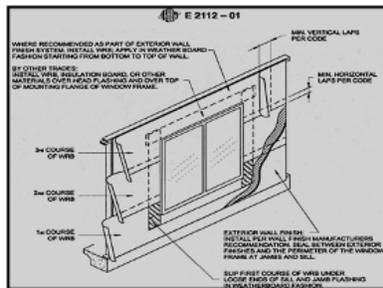
Installation of Metal or Non-Corrosive Plaster Base - ASTM C1063

- Materials – Lath Base, WRBs, Accessories, etc.
- Installation – Attachment, Tolerances, Sealants, etc.

As Code-Referenced Documents, these standards, and all other standards cited with them are part and parcel of the Code.

The Architect's Contributions

- ❑ Requirements and criteria for flashing
- ❑ Provides for drainage of exterior walls
- ❑ Provides for sealing of plaster panels

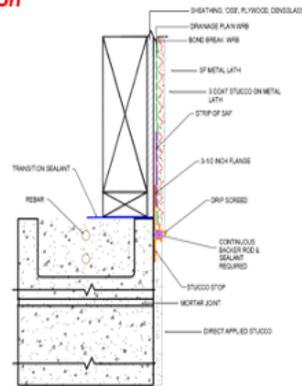


Section 107.2.4 of the IBC 2018

International Building Code Criteria

[A] 107.2.4 "Exterior wall envelope ... The **construction documents shall provide details** of the exterior wall envelope as required, including:

- Flashing
- Intersections with dissimilar materials
- Corners
- End details
- Control joints
- Intersections at roof eaves or parapets
- Means of drainage
- Water-resistive membrane
- Details around openings



Question: Who writes the "construction documents"?

CDs come from the architect/engineer or the builder ... but rarely from the plasterer.

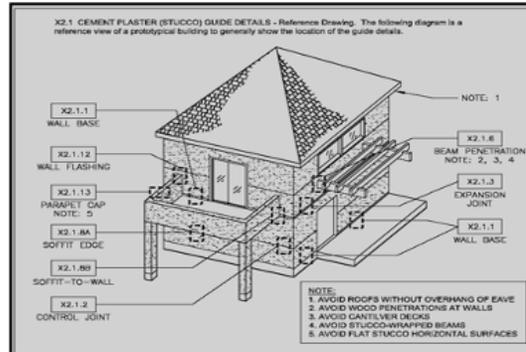
The Architect's Contributions

On Frame Walls

- ❑ Defines shape and size of plaster panels
- ❑ Identifies type, depth and location of accessories

Resource:

ASTM E2266
“Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion”



The General Contractor's Role

- ❑ Select a plastering contractor with a history of successful projects, knowing that the lowest bid isn't always the best bid.
- ❑ Initiate appropriate jobsite meetings to resolve any questions or issues prior to the application of the plaster.
- ❑ Coordinate with the other subcontractors for the completion of their work prior to the application of the plastering.
Question: Who has responsibility for ensuring that the flashing and WRB are installed properly, if not included in the plastering contractor's scope of work?
- ❑ Provide a suitable plaster base that will enable the plastering contractor to complete his work according to the plans and specifications.
- ❑ Check tolerances for plumb, true to plane and bond ability.

The general contractor and the subcontractor in whose scope the work is defined. The GC should be verifying that the work is ready for the next subcontractor prior to releasing the work.

The Plastering Contractor's Role

- ❑ Thoroughly review the specifications, plans, and drawings.
- ❑ **Ensure that bids are in compliance with the contract documents, building codes, and standards.**
- ❑ Inspect the subsurface prior to the application of the plaster; and report any unsatisfactory conditions.
- ❑ Complete the work in accordance with the specifications, plans and drawings:
 - ❑ ASTM C1063 or C1787 Installation of Lathing
 - ❑ ASTM C926 Application of Plastering

Reporting unsatisfactory conditions is a requirement of the plasterer. However, the GC should have checked this and ordered any necessary remediation prior to releasing the work to the plasterer.

The Building Official's Role

IBC/IRC – Examination of Documents

107.3 The *building official* shall examine or cause to be examined the accompanying submittal documents and shall ascertain by such examinations whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances.

***Plans reviewer must check for all the items in 107.2.4 – Slide 56**

*Some jurisdictions have a lath inspection to check the substrate prior to the application of the plaster. This is an excellent opportunity to verify that the flashing, WRB, and sealants are properly installed.

The Plans Reviewer should look for this detailing and require it if missing!

This section states that these details are required by the code for commercial & residential construction.



Design Considerations



Design Considerations For Block Walls

Stucco on block walls works just fine!

- ❑ If possible, avoid liquid-applied barriers (LABs) over solid bases.
 - ❑ Limit to sill and jambs of openings and avoid the face of the masonry
 - ❑ May inhibit adequate bond
 - ❑ May aggravate shrinkage and increase cracking potential
- ❑ If possible, avoid lath over solid bases
 - ❑ Requires compliance with ASTM C1063 or C1787 metal plaster base jointing criteria.
 - ❑ Aggravates shrinkage and cracking potential
 - ❑ **Increases cost 4-6 times**
 - ❑ Specify an exterior bonding agent if bond is a concern
- ❑ Provide for sealant beds around door and window openings; and electrical and plumbing penetrations.
- ❑ When painting, always follow the manufacturer's recommendation regarding curing time, moisture content, and pH. **Don't paint too soon!**

FABs inhibit the bond of the plaster to the substrate. Therefore, they should not be placed on the exterior wall face. The AAMA instructions call for head, jamb and sill only!

Bonding agents for stucco must be non-reemulsifiable, non-re-wetting, non-retackifying and tinted when used as a surface-applied agent under stucco!

As a Designer, if you do not specify & detail these items, they will not get done or they will not get done correctly. Be Aware! Failure to provide this information is a code violation.

ASTM C926 Coats and Thicknesses

TABLE 4 Nominal Plaster Thickness^A for Three- and Two-Coat Work, in.

BASE	Vertical				Horizontal			
	1st Coat	2nd Coat	3rd Coat ^B	Total	1st Coat	2nd Coat	3rd Coat ^B	Total
	Interior/Exterior							
Three-Coat Work:^C								
Metal Plaster Base	3/8	3/8	1/8	7/8	1/4	1/4	1/8	5/8
Solid Plaster Base:								
Unit Masonry	1/4	1/4	1/8	5/8	Use two-coat work			
Cast-in-Place or precast concrete	1/4	1/4	1/8	5/8				3/8
Metal plaster base over solid solid base	1/2	1/4	1/8	7/8	1/2	1/4	1/8	7/8
Two-Coat Work:								
Solid plaster base:								
Unit Masonry	3/8	1/8		1/2				3/8
Cast-in-place or precast concrete	1/4	1/8		3/8				3/8

^A Exclusive of texture.

^B For solid plaster partitions, additional coats shall be applied to meet the finish thickness specified.

^C For exposed aggregate finishes, the second (brown) coat shall become the "bedding" coat and shall be of sufficient thickness to hold the aggregate.

Nominal! In name only.

Specifying thicknesses greater than those for conditions as posted in this table requires design by a professional architect or engineer.

Importance of Stucco Thickness

Too Thick



The total plaster thickness exceeds the bonding capability of the scratch coat.

Too Thin



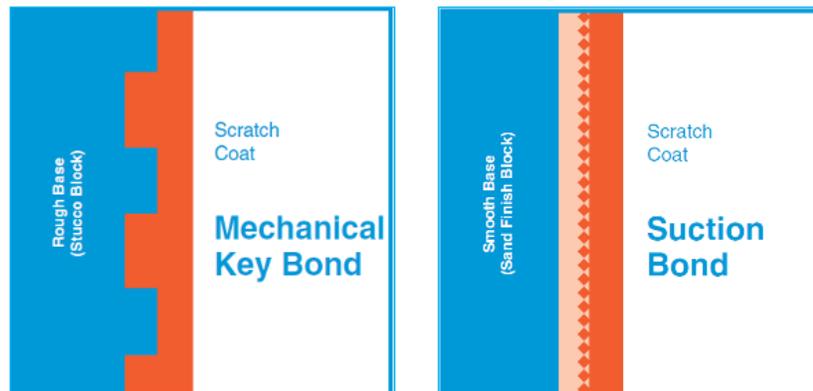
Very thin scratch coats are subject to "dry out" and subsequent bond failure.

To the left: the stucco weighed more than this very smooth block face could hold. A C932 bonding agent here would have helped.

To the right: A scratch coat this thin is not capable of holding anything.

Understanding Bond

Mechanical Key vs. Suction Bond



Mechanical bond is created by the fissures in the substrate. Plaster is forced into these fissures where it hydrates. As it does it creates a crystalline structure that locks the plaster in.

Suction or chemical bond is created by the absorption of the moisture in the plaster into the substrate. This really only occurs when you have direct-applied stucco to a solid base (cast-in-place or precast concrete, clay brick, stone or tile). The moisture transfer will carry cement paste with it which will fill microscopic spaces between aggregates and capillary voids with cement that then hydrates as above and locks it all together.

Issue with Sand Finish or Sponged Block

Bond Failure



Little Mechanical Keying



Always scratch horizontally so that the brown coat hangs on the scratch.

To the right:

This wall was sponged to cover up poor masonry (“bee-holes” and missing mortar joints) with cement paste too thin to hydrate that fills the mechanical keys in the face of the block. More than likely, this CMU was not properly wetted, as required, prior to this application.

Issue with Sand Finish or Sponged Block

Block texture may vary regionally – for example:

- ❑ Southeast Florida block has a rough “popcorn finish”
- ❑ Central Florida block has a smooth “sand finish”
- ❑ Other Florida block markets vary

Note to specifier

Specify an open texture block, if they are available locally. Or specify an exterior bonding agent, or a dash bond coat if there is a concern of bond to the local block.

Lathing over solid bases like CMU should be avoided at all costs. It will crack due to the differential movement characteristics of the metal and the plaster/masonry.

FL&PB Technical Bulletins



FLORIDA LATH & PLASTER BUREAU

Technical Bulletin

TB 17-06-12
Choosing the Right Block For Stucco

BEST RECOMMENDATION

The ability of the stucco to bond to the concrete block is key to the performance of the system. There are two mechanisms that influence bond, the texture of the surface of the block and the ability of the block to absorb water.

In a general sense, the rougher the block texture, the better the bond. However, in some parts of Florida a "sand finish" or "smooth finish" block texture is the optimal texture to use.

ALTA One the standard for concrete blocks only directly the purchaser to check with the local concrete block suppliers regarding the availability of particular textures of the block, such as surface texture, if desired features are available, they should be specified.

An illustrated below, a mechanical bond is created in the manufacturing process of the block. A rough texture creates good mechanical key for the stucco, while a sand finish or smooth finish block lends the mechanical key.




Figure 1 - Mechanical Key Bond Figure 2 - Section Bond

NOTE:

Despite the smoother texture, a "sand finish" block can still provide an excellent base for stucco. This is done through a mechanical sanded section bond, as illustrated above. The success of section bond depends upon the consistent amount and size of sand that the water used on each face are absorbed into the surface of the block. Too much or too little sand will diminish the extent of bond between the stucco and the block.





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FLORIDA LATH & PLASTER BUREAU

Technical Bulletin

TB 14-06-12
Stucco on Block

THE BLOCK

Concrete block makes an excellent base for multi-coat cement-based plaster systems. The two textures are made from the same basic ingredients and are extremely consistent. Properly done, it's a great combination.




Figure 1 - Mechanical Key Bond Figure 2 - Section Bond

Concrete block is made from sand, lime or water, and is 100% solid in the core. In contrast, with the texture of the cells (making a hollow core block), Fig. 1)

In some parts of Florida the standard concrete block has a sand finish. This type of block provides the mechanical key for the stucco, but it may still be considered a mechanical key. A section bond can be the better.

Stucco used in the preparation of joint and partition masonry must be applied into the surface of the block. This bond creates a holding effect on the surface of the block (Fig. 2).

It is a commonly simple procedure to remember if a hole will not penetrate the block, apply the water into water. If the water is absorbed into the block, water must be provided. However, if the water is not absorbed, the water must be provided. If the water is not absorbed, the water must be provided. If the water is not absorbed, the water must be provided.

ALTA One the standard for concrete blocks only directly the purchaser to check with the local concrete block suppliers regarding the availability of particular textures of the block, such as surface texture, if desired features are available, they should be specified.





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FREE DOWNLOADS

Control Joints On Concrete or Block?

- ❑ Control joints are **not required** for stucco applied directly to concrete or concrete block. They are of similar materials, and have similar expansion and contraction characteristics.
- ❑ It is **not recommended**, to have unnecessary control joints. They are a potential point of water penetration and should be avoided.
- ❑ However, it **is necessary** to place a stucco expansion joint at the same location as the building expansion joint in a block or concrete wall.

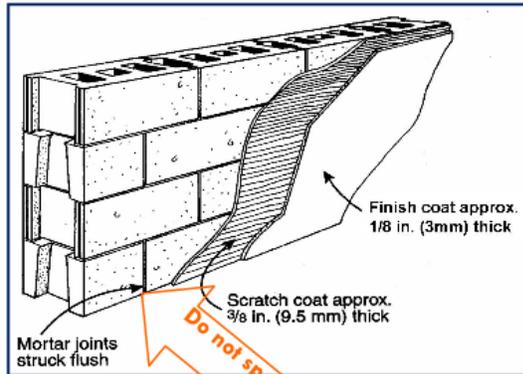
CJs are not required except where there is a joint in the underlying wall or where a solid base wall meets a framed wall (dissimilar materials); though at present, a strip lath is approved for this dissimilar material condition.

In multi-story masonry construction, it is a good idea to place a CJ along the bottom edge of a floor slab.

Industry Recommendation

71

Two Coat Application On Block



- Two coats
- Half-inch thickness
- Double-up method
- No waiting period between coats
- Promotes monolithic curing

Image courtesy: PCA Manual

Do not sponge mortar joints!

The mason IS NOT helping when he sponges the wall. He is spending extra labor on both an unnecessary and detrimental act that is prohibited by the Code-Referenced Standards.



Design Considerations For Framed Walls

Design Considerations for Framed Walls:

Design to function as a drainage wall by following the criteria in ASTM C926, C1063 or ASTM C1787, including:

- Provide for and detail the required flashing at openings, perimeters, and terminations, and to prevent water from getting behind the stucco.
- Provide for and detail stucco accessories to repel and manage the drainage of water including:
 - Control & Expansion joints – in accordance to ASTM C1063, C1787 criteria
 - Casing beads –with backer rod between dissimilar materials (window & door openings)
 - Weep screeds – at the bottom of all framed exterior walls
- Provide for sealing all butt joints, inter-sections and ends. Embed in sealant.
- Provide for sealing around door and window openings; and electrical, plumbing and all other penetrations.

Inclusion in the specifications and drawings is required

IBC: Weather Protection Criteria

International Building Code 1404.2 Weather protection.

Exterior walls shall provide weather protection for the building.

1404.4 Flashing

The exterior wall envelope shall:

- Prevent moisture from entering the wall or redirect moisture to the exterior.*
- Shall be provided at:*
 - Perimeter of exterior door & window assemblies;*
 - Exterior penetrations and terminations;*
 - Exterior intersections with roofs, chimneys, porches, decks, balconies, built-in gutters and any similar locations where moisture could enter the wall;*
 - Flashing with projecting flanges shall be installed on both sides and the ends of copings, under sills and continuously above projecting trim;*
 - Where self-adhered membranes are used as flashings of fenestration in wall assemblies, those self-adhered flashings shall comply with AAMA 711, and;*
 - Where fluid applied membranes are used as flashing for exterior wall openings, those fluid applied membrane flashings shall comply with AAMA 714.*

Question: What constitutes a “means for draining?”

Plasterstop? With “weep holes”?

This would depend upon the design of the detail. It is easier to just specify a weep screed. Those 1/8 inch holes in the ground flanges of PVC casing beads or plasterstops will not function well as weep holes because they will fill with plaster and get painted shut.; thereby causing moisture buildup behind the water-resistive barriers.

IRC: Water-resistance Criteria

International Residential Code Section R703.1.1 Water resistance.

The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior cladding as required by Section R703.2 and a means of draining to the exterior water that penetrates the cladding.



IRC: Water-resistive Barrier Criteria

International Residential Code, Residential Section R703.2 Water-resistive barrier.

One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such No.15 asphalt felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm). Other approved materials shall be installed in accordance with the water-resistive barrier manufacturer's installation instructions. The No. 15 asphalt felt or other approved water-resistive barrier material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1.



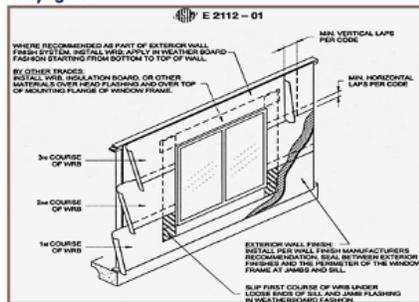
2 layers under lath.

Continue to the top of the wall. The soffit material goes on after the stucco, not before.

Flashing

ASTM C926 "A2.1.2 The **construction specifier** shall describe, in the appropriate section of the contract specifications, **the requirements for furnishing and application of flashing.** Flashing shall be specified at openings, perimeters, and terminations to prevent water from getting behind plaster".

Reference: ASTM E2112 Standard Practice for Installation of Exterior Windows, Doors and Skylights



Specify the correct materials:

- Metal flashings must be:
 - Suitable for the application and environment
 - Compatible with fasteners & other in-contact materials.
- Specify membrane flashings when appropriate.

"The construction specifier" in this section will become the , "The Contract Documents shall ... " in the latest version of this standard due to be adopted in this code cycle.

E 2112 is another standard not code-referenced but full of sound guidance.

Stucco Accessories



C1063- 7.4.10.2 Install control joint lathing accessories at locations to delineate cement plaster panel areas of 144 ft² (13 m²) maximum for walls and 100 ft² (9 m²) maximum for horizontal installations, that is, ceilings, curves, or angle type structures.

7.4.10.3 The distance between control joints shall not exceed 18 ft. in either direction or a length-to-width ratio of 2^{1/2} to 1.



7.4.6 Casing Bead - Install a casing bead lathing accessory or other suitable means, at locations to separate cement plaster from dissimilar materials, penetrating elements, load bearing members and to avoid transfer of structural loads.



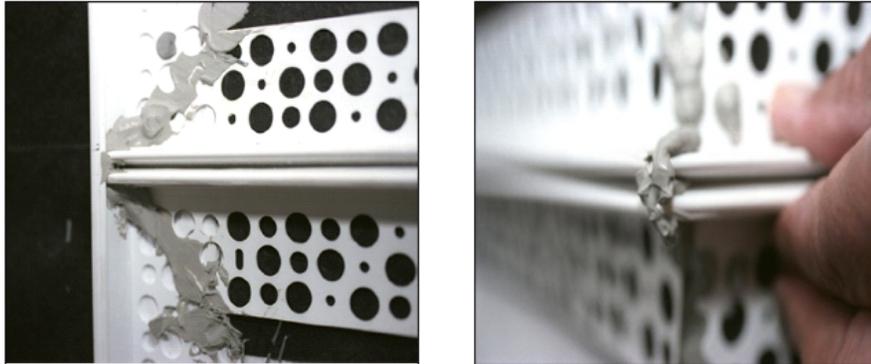
C926 – A2.2.1 At the bottom of exterior drainage walls where the drainage plane is interrupted by a floor, supporting structure, or foundation, or when drainage wall assemblies are constructed above barrier wall assemblies, a designated drainage screed, flashing, or other effective means to drain away water that may get behind the plaster shall be provided.

These are code requirements directly out of the standards.

Sealing

ASTM C926 Annex A2.1.3 *"Sealing or caulking of V-grooves, exposed ends, and edges of plaster panels or exterior work to prevent entry of water shall be provided."*

***Except where a vertical accessory terminates at a weep screed.**



Embedment vs. buttering:

Embedment is the action of placing the sealant and then pushing the ends of the accessory into it to fill and seal from behind.

Buttering is simply applying a little sealant over the top.

Which process do you think is more effective at preventing water intrusion?

ASTM C926 Coats and Thicknesses

TABLE 4 **Nominal Plaster Thickness^A for Three- and Two-Coat Work, in.**

BASE	Vertical				Horizontal			
	1st Coat	2nd Coat	3rd Coat ^B	Total	1st Coat	2nd Coat	3rd Coat ^B	Total
	Interior/Exterior							
Three-Coat Work:^C								
Metal Plaster Base	3/8	3/8	1/8	7/8	1/4	1/4	1/8	5/8
Solid Plaster Base:								
Unit Masonry	1/4	1/4	1/8	5/8	Use two-coat work			
Cast-in-Place or precast concrete	1/4	1/4	1/8	5/8				3/8
Metal plaster base over solid base	1/2	1/4	1/8	7/8	1/2	1/4	1/8	7/8
Two-Coat Work:								
Solid plaster base:								
Unit Masonry	3/8	1/8		1/2				3/8
Cast-in-place or precast concrete	1/4	1/8		3/8				3/8

^A Exclusive of texture.

^B For solid plaster partitions, additional coats shall be applied to meet the finish thickness specified.

^C For exposed aggregate finishes, the second (brown) coat shall become the "bedding" coat and shall be of sufficient thickness to hold the aggregate.

Nominal!

Specifying thicknesses greater than those for conditions as posted in this table offers little, if any, improvement and requires design by a professional architect or engineer.

The Importance of Densification & Thickness



Galvanized lath still needs to protection provided by bi-directional application, densification and stucco thickness!

Bi-directional: up and over then back again.

Industry Recommendation

82

Three Coat Application On Metal Or Plastic Lath

- ❑ Three coats
- ❑ 7/8" thickness
- ❑ Regardless of substrate
- ❑ Double-up method on 2 of the coats
- ❑ Promote monolithic curing

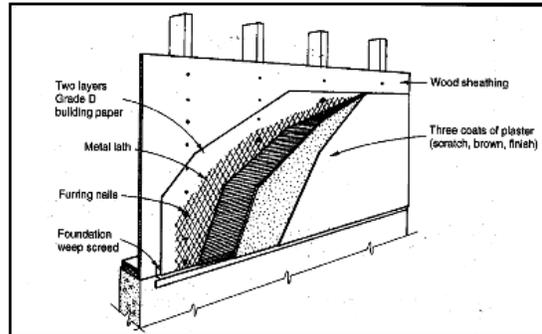


Image courtesy: PCA Manual

The Double-up or Double-back method is controversial. Some may prefer to scratch, wait for curing, then brown and wait again to finish. This is a designer's choice issue but should be specified to avoid any confusion.



Specification Considerations

Specify Proven Products*

84

- Cementitious Materials**
 - Masonry/Stucco Cement - ASTM C91/C1328 (Florida)
 - Manufactured specifically for Florida's construction environment
 - Preferred over PCL for better workability and less shrinkage
- Fine Aggregate**
 - Stucco Sand - ASTM C897 (FDOT Sand)
- Plaster Bases**
 - Expanded Metal Lath - ASTM C847
 - Welded Wire Lath – ASTM C933
 - Non-Metallic Bases – ASTM C1788
- Bonding Agents** (apply to concrete and smooth block)
 - Exterior Bonding Agent – ASTM C932
 - Portland Cement Dash Bond Coat
- Water Resistive Barrier**
 - Two layers of paper, wraps or other approved methods

Cement/Lime plasters are acceptable by the code and standards. Some areas of the country prefer masonry cements for a variety of reasons. For example, in Florida, all masonry cements are manufactured to meet both C91 and the C1328 standards.. These are preferred for several reasons including the ability to handle salt-air environments better.

Specify Best Practices

Flush mortar joints ... not sponged!

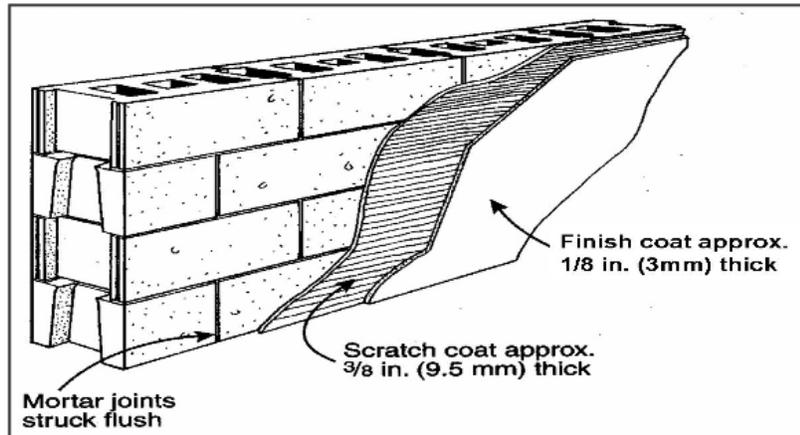
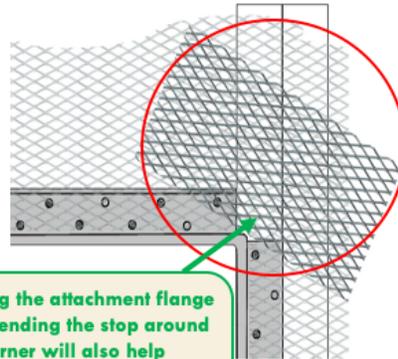


Image courtesy: PCA Manual

Sponging of mortar joints is prohibited by the code/standards.

Specify Best Practices

Reduce corner cracking at openings of framed construction



- Specify diagonal strip lath (butterfly) across corners

Cutting the attachment flange and bending the stop around the corner will also help prevent water intrusion and diagonal cracking here.

Notice that there is no required separation at the window. Based upon the width, this crack appears to be aggravated by water intrusion (though verification would be needed).

No sealant at the interface.

Butterflies work to a degree. For better protection at this interface, provide a proper separation with backer rod & sealant to absorb some of the stress induced on the plaster.

In addition, a butterfly of EIFS mesh embedded in the brown coat prior to application of the finish coat will offer much more significant reduction in crack potential here.

Specify Best Practices

Specify a 1/8-inch gap between sheathing

ASTM C 1063 6.1.4

Plywood and oriented strand board sheathing panels shall be installed with 1/8 in. (3 mm) minimum panel edge gaps, and panel edges shall be offset 4 in. (10 cm) minimum from wall opening reentrant corners.

APA Technical Bulletin

A minimum 1/8-inch space is recommended between panels at edge and end joints to allow for panel expansion at higher moisture conditions.



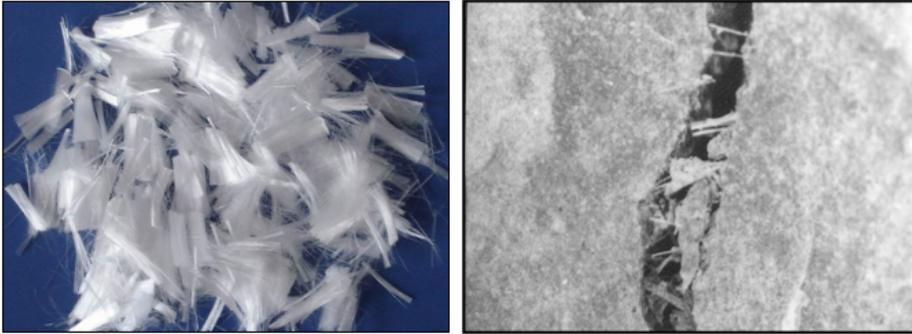
Though only recommended by APA, this is a code/standard requirement for wood sheathing to which stucco is the intended cladding.

Specify Best Practices

Stucco Fibers

ASTM C 926 provides for the addition of stucco fibers to the stucco mixture to reduce cracking. Its use is recommended in the **scratch and brown coats of stucco to be applied only to metal and plastic bases.**

Follow the manufacturer's recommendations.



There exists a school of thought that because fibers eventually disappear, their absence leaves tiny capillaries that may carry moisture into the plaster.

Non-ceramic fibers (glass, polypropylene and others) only work during the plastic state of the plaster. Once cured their effectiveness diminishes and they eventually fade away.

Specify a Curing Protocol

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ASTM C926 Curing and Time Between Coats

- ❑ 7.8.1 Provide sufficient moisture ... to permit continuous hydration ... curing and time between coats will depend on climatic and job conditions.
- ❑ 7.8.2 Sufficient time between coats shall be allowed to permit each coat to cure or develop enough rigidity to resist cracking or other physical damage when the next coat is applied.
- ❑ ASTM C926 does not assign responsibility for stucco curing. The Contractor is not obligated to cure the stucco. Placing the stucco curing requirements in the specifications makes it contractual.



Curing is a requirement of the Standards and, therefore, the Code. However, the Standard, in this case C926, is not a scope of work. Therefore, curing is a contractual obligation and must be included in someone's scope.

There is no way to test today whether something was "cured" or not at the time of application. You can determine the extent of curing at present; but, unless you were present at the original application, you cannot say with certainty that an attempt to cure was not made. In other words, if you wet a wall down in the afternoon but you have 20 mph winds and less than 75% relative humidity, that moisture will evaporate before it has a chance to do its job. This is why you must specify how to cure and who is responsible for doing so.



Painting Traditional Plaster

Painting Stucco

While traditional Portland cement-based plaster provides excellent resistance to water intrusion, the first line of defense against water intrusion becoming a serious problem is providing for adequate sealing and coating of the wall system.

Inadequate coverage or film thickness can “telegraph” mortar joints through the plaster (ghosting); or allow efflorescence to develop and bleed through the coating.

Always follow the paint manufactures recommendations regarding application procedures and film thickness requirements.



Prevention of ghosting requires these steps:

- 1) Pre-wet the masonry wall as required by the standards;
- 2) Apply the stucco in at least two coats to 1/2 inch;
- 3) Moist cure.

Primer and paint can hide some of this; but, following these steps will prevent it.

Painting Stucco

Depending on their chemistry, paints are susceptible to moisture and pH. Both are present in freshly applied stucco. Always follow the paint manufacturer's recommendation as to when to apply the paint.



"Stucco

Allow new stucco to cure at least 30 days before painting. If painting cannot wait 30 days, allow the surface to dry 5-7 days and prime with Loxon Concrete & Masonry Primer. Repair cracks, voids, and other holes with an elastomeric patch or sealant." (Source: Sherwin-Williams Website)

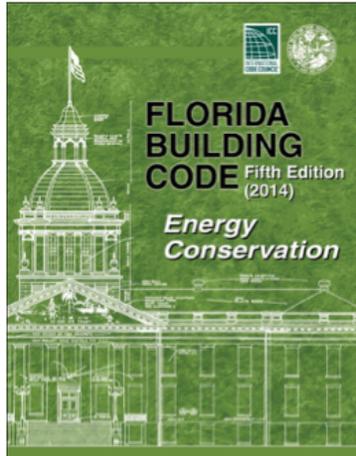
92

Fresh plaster will have a pH of @ 13. Most paints want the pH to be under 10. pH is reduced by curing and water is the catalyst for this reaction. Therefore, the longer you keep the plaster damp, the faster it will cure and lower the pH.



Stucco Systems And Energy Conservation

Florida Energy Code



C402.1.2 U-factor alternative.
An assembly with a U-factor, C-factor, or F-factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the R-value in Table C402.2.

.....

All of Florida is in either Zone 1 or 2. Energy requirements for your project specific location must be addressed and appropriately accommodated in your design, specifications and details.

CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY (Utilizing 'U' Value Calculations)

Table C 402.1.2 Opaque Thermal Envelop Assembly Requirements

Climate Zone	1	1	2	2
(Building Type)	All Other	Group R	All Other	Group R
Mass(CIP or CMU)	U- 0.142	U- 0.142	U- 0.142	U- 0.123
Metal Building	U- 0.079	U- 0.079	U- 0.079	U- 0.079
Metal Framed	U- 0.077	U- 0.077	U- 0.077	U- 0.064
Wood Framed and Other	U- 0.064	U- 0.064	U- 0.064	U- 0.064

By taking the advantage the mass factor characteristic of concrete or concrete masonry units, the U- factor calculation method offers a significantly more attractive alternative to framed construction methods.

This slide is specific to the Florida Building Code-Energy.

Options for Reducing 'U' Values

Due to its mass factor, walls constructed of concrete masonry can meet the requirements of the Florida Energy Code without having to install a continuous insulation system to the exterior.

Opaque Thermal Envelop Assembly Requirements (Values from Energy Conservation, Table C402.1)	U Values
Example: Office building in Orlando Through Wall 'U' Value Prescriptive Requirements	0.142
Plain Concrete Block Wall	0.770
Foamed Cells with Exposed Interior	0.206
Interior ¾" Reflective Insulation	0.174
Interior 1½" Reflective Insulation	0.121
Interior ¾" Polyisocyanurate Board + ¾" Reflective Air Space	0.101

This slide is specific to the Florida Building Code-Energy.

Energy Conservation Summary

Thermal insulation on an exterior wall can be:

1) Placed continuously on the wall (**inside or outside**) per Section C402.2.3 and accepted by meeting the prescriptive *R*- value requirements from Table C402.2 for the specific layer of continuous insulation.

Example: a continuous board insulation layer on the outside of a wood or steel framed wall.

2) Incorporated integrally per Section C402.1.2 and accepted by meeting the prescriptive *U*- value requirement for the overall wall listed in Table C402.1.2.

Examples would be:

a) **interior** reflective insulation on a masonry wall

Note: This advantage enables the stucco to be applied directly to the block, thus avoiding the additional expense and maintenance of a metal plaster base to the outside of the building.

This slide is specific to the Florida Building Code-Energy.

Thank you for your time.

This concludes the American Institute of
Architects Continuing Education Systems course.

Questions?

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