



STUCCO HANDBOOK FOR BUILDERS

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How Long Do You Want Your Stucco Job To Last?

60 DAYS • 2 YEARS • 10 YEARS • 100 YEARS

The architect and the builder need to answer this question, otherwise someone else may answer it for them. Last year a contractor responded to this question with the answer, “Until I get my check.” Hopefully he was joking. Would you be willing to bet your business that he was joking? The only way we can have quality is if quality is important to everyone connected with the job. It must be demanded from the top down.

This booklet provides an **introduction** to stucco. It is hoped that this booklet will help you understand stucco systems so you can build better stucco houses.

We encourage each builder to have written standards for stucco and to enforce those standards.

Remember:

You cannot expect something for which you do not inspect, and you cannot inspect if you do not have standards by which you judge the work. (Paul Taylor, 1998)

This booklet is aimed at residential builders who use stucco. Much of what is contained in this booklet is already being practiced by the commercial builders and contractors.

This booklet is designed as a guide only. It should not be taken as a substitute for:

- *sound engineering advice,*
- *sound architectural advice, and*
- *knowing and following building code requirements.*

This booklet will be updated from time to time. We need your opinions and suggestions for future editions.

Stucco has been around for centuries. Initially it started out as mud plaster over unburned brick (adobe). When the rains came, the plaster washed off the wall rather than the brick being washed out of the wall. After the rains the structure was replastered.

Plastering took a leap forward when the Egyptians learned to burn gypsum and hydrate it. It took another leap forward when the Greeks learned to burn lime. For nearly two millennia, the high-quality exterior plaster (stucco) on buildings was hydrated lime plaster. Making the plaster was simple. A lime-burning kiln was either built from brick or dug into an embankment and then loaded with limestone. The kiln was burned until the limestone turned red hot and collapsed. This was called quick lime. It was allowed to cool and then removed from the kiln. Quick lime and water were mixed to form a slurry (masses of steam were given off and rocks exploded) and then buried in a pit for a number of months. When it was dug up, it was a homogeneous lime putty. The lime putty was mixed with sand, and additional water was added. The lime plaster was applied not unlike plaster is applied today. As the plaster was exposed to the air, it absorbed carbon dioxide from the air, and the hydrated lime gradually turned back into calcium carbonate. The process was slow and labor intensive.

As mentioned above, plaster was applied to protect un-burned/under-burned brick. As time passed, innovative people came up with shortcuts. Lath was born and brick were no longer needed for a plastered building. Initially, lath was wooden strips.

Then, as now, the admixture market was active. Rather than fiberglass or polypropylene fibers, horse hair and other natural fibers were added to the plaster. To obtain a harder stucco, ox blood was added to the mix. In Mexico and the southwestern US, juice from crushed prickly pear cactus leaves was used.

When natural cements and later portland cements came on the market, small amounts of cement were added to the lime plaster to speed the set.

Building owners and plasterers noted that stucco cracked. Since straight cracks look better than map cracking, plasterers started scoring the first and second coats of plaster to make a weak place in the plaster so cracks would occur in a predetermined place. These were referred to as expansion joints or control joints.

As the percentage of portland in plaster increased, changes occurred in the application and the lath. Interior walls were built consisting of a layer of burlap that was stuccoed on each side. Metal lath started replacing the wood lath. Then the metal lath got lighter. Metal expansion joints were added to the lath supplies, replacing hand-cut expansion joints.

A. Lath

2.5 pound per square yard diamond mesh lath is the most common lath used for residential construction in the United States. 1.75 pound per square yard diamond mesh lath is designed for tile setting and should not be used to support three-coat stucco.

Diamond mesh lath comes in the following configurations:

Black	For interior use, away from water.
Galvanized	For exterior use and where water might be found.
Self-furring	Dimpled so it will stand out from the sheathing.
Non-self-furring	Furring strips need to be applied to the wall before hanging lath.
Paper-backed	Building paper is attached to the lath.
Non-paper-backed	Building paper should be attached to the wall prior to attaching the lath.

Self-furring diamond mesh lath has dimples about an inch in diameter protruding from the lath about 1/8 to 3/16 inch. The dimples face the sheathing and serve to keep the lath away from the sheathing.

This will allow stucco to be pressed through the lath and bond well.

If non-self-furring diamond mesh lath is used, furring strips should be installed to cause the lath to stand away from the sheathing.

If the lath is paper-backed, front and back are easily recognized. With paper-backed lath, care must be taken to insure that the paper is lapped so water is diverted to the stucco side of the wall. If paper-backed lath is not used, the wall needs to be protected with 15 pound building felt or the equivalent.

Diamond lath has a top and a bottom, as well as a front and a back. It should be hung so the plaster moves downward as it is pressed into the lath.

The weight of the stucco is supported by the nails that hold the lath. An 8 feet x 20 feet x 7/8 inch thick stucco panel will weigh 1,600 to 1,800 pounds. This cannot be held with a few nails.

Specifications for nailing the lath to different substrates are found in ASTM Specification C-1063 (Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster). With 16 inch studs, the lath needs to be nailed every 7 inches on a stud. This results in a nail for

every .78 square feet. Nailing requirements for other substrates are similar. The sheets of lath need to be lapped 0.5 inch on the sides and at least 1.0 inch on the ends.

Where end laps occur between joints, they need to be laced together with wire.

Stucco joins onto other materials. Accessories are fabricated to cleanly end runs of stucco.

Casing Bead, sometimes called J-Molding, is used below the soffit and around windows to end the stucco panel. This comes in a variety of thicknesses and serves as screed points on the wall. The casing bead is applied to leave sufficient space so the area between the casing bead and the window frame can accept a bead of caulk.

Foundation Weep Screed is installed at the base of the stucco wall below the floor line.

Through-the-wall flashing dumps water on the screed, which dumps the water outside the building. If the stucco goes all the way to the ground on a concrete foundation (we have seen this done for aesthetic reasons), water cannot get out of the wall to the outside. That means it must exit inside the building, or build up in the wall and cause rot and other problems.

Control Joints (also called Expansion Joints) are designed to allow the stucco to move. Stucco will crack; therefore, you can choose the location, or let the stucco choose the location for the cracks. If you look at curbing or sidewalks that do not have control joints, you will probably notice a crack every twenty feet or less. The same thing happens with stucco. ASTM C-1063 provides that a stucco panel should not be over 144 square feet in size for walls (100 square feet for horizontal surfaces), and should not be over 18 feet in any dimension, and the length to width ratio should not exceed 2.5 to 1. Also, the purpose of a control joint is defeated if the lath under the control joint is continuous. Control joints have a flexible plastic barrier covering the corrugations. If this is removed prior to the finish coat setting, and stucco gets between the corrugations, the purpose of the control joint is defeated. There are weak places in a stucco wall above doors, and above and below windows. If cracking is going to occur, it will usually start in these locations. Adding control joints in these areas solves that problem.

Corner Beads reinforce the corners and insure that a straight corner can be produced.

Casing bead, foundation weep screed, and control joints should be applied before the stucco lath is applied. Corner bead should be installed after the lathe is applied.

Remember, a flat wall cannot be produced if the lath is not installed flat. Lath cannot be installed flat if the framing is not installed flat. The builder is already paying a framing contractor for a flat-framed wall. Is he getting it? The stucco contractor's job will be easier if he insures that the builder insists on a flat-framed wall.

B. Formulas

Portland Cement Stuccos

The traditional stucco used in the United States for the past sixty years has been a mixture of portland cement, hydrated lime, sand, and water. When well formulated, the traditional mix works extremely well.

Proprietary stucco mixes, such as Magna Wall Scratch and Brown Mix, have come on the market during the past twenty years. Many of the proprietary mixes come in both sanded and un-sanded formulations. With the sanded formulations, the customer knows what he is getting, but the customer is buying sand in a bag.

The un-sanded mixes usually have a water-reducing admixture, or other workability admixture. Often they will trowel better than the traditional mix. The manufacturers of these mixes test them and usually warranty that the product will behave in a specific manner.

During the past twenty years a number of proprietary compounds that are designed to replace lime, collectively called mortar fat, have been marketed. They range from bentonitic clay to high-powered air entraining agents. The manufacturers' literature states that they work as well as, or better than, lime. Beware a manufacturer which states that their proprietary compound is approved by ASTM or is certified by ASTM. ASTM is not in that business. From our experience, most of these compounds work reasonably well if the manufacturers' directions are followed to the letter.

We have seldom seen the manufacturers' instructions followed to the letter in the field. Examples:

One admixture is to be added at a rate of one ounce per bag of portland cement. We have seen the man on the mixer pouring the admixture into the mixer from a gallon jug and estimating what one ounce is.

We have seen a contractor who added the admixture to a traditional portland/lime stucco. A sample collected from that job site revealed a seven day compressive strength of 160 psi rather than the anticipated 1,500 to 2,200 psi. The wall and the "elastomeric paint" that the contractor used cracked before his check had cleared the bank. This same contractor stated that he had used the admixture on an Air Force

job even though the specifications called for portland and lime. He said that he added it to the mix when the inspectors were present, and they never noticed.

We have seen these admixtures added to proprietary stucco mixes, even though the instructions on the bag say, “Do not add admixtures.”

The contractor is going to formulate a stucco that is easy to apply and cheap to make. Hopefully he is also concerned about long-time endurance of the stucco. The building owner is concerned about long-time endurance of the stucco. The builder is caught in the middle if the two do not agree.

Polymer Modified Stuccos

These stuccos are similar to the traditional stuccos, but a polymer has been added to modify the behavior. Acrylic, vinyl, or styrene polymers are usually used. Originally the bags of stucco were furnished with a bottle of latex to add. Now the procedure is to mix a dry re-dissolvable polymer with the cement and other ingredients. Polymer modified stuccos are usually used where increased flexural strength is needed, where a thin coating is needed, or where freeze/thaw conditions are severe. The only polymer modified stuccos that we are familiar with in central and south Texas are one-coat stuccos and the base coat for EFIS systems.

Polymer Stuccos

As far as we know, all polymer stuccos are used as top coats. Usually an acrylic or a vinyl polymer is used. It is mixed with non-staining sand and a number of other components to make it spreadable and long lasting. The gradation of the sand is changed to change the visual effect of the stucco.

C. Impact of Sand

Sand has a major impact on cementitious stuccos. Changing from one silica sand to another can impact the compressive strength by over 50%. Most plasterers use the best plaster sand in the area where they are located. Other things being equal, as much sand as possible should be used while still keeping the stucco workable. In this manner, the sand particles are touching. This reduces plastic shrinkage cracking. If additional cement paste is used, map cracking will occur in the panel as it dries. The same problem occurs when a fine sand is used.

D. Fibers

Fibers will not solve all of the plasterer's problems.

Fiberglass fibers are excellent for limiting plastic shrinkage cracks. These fibers are cheap, but they become brittle when exposed to an alkaline environment. Since most, if not all, stuccos are alkaline, the effectiveness of the fiberglass fibers is reduced with time.

Some nylon fibers are on the market. They are permanent and expensive.

Polypropylene fibers are more expensive than fiberglass fibers, but they are considered permanent. Not only do these fibers limit plastic shrinkage cracking, but they reinforce the wall for years to come and give it a toughness. They are available as monofilament and with ragged edges to give extra bonding. Recently an extremely fine polypropylene fiber has been introduced. It is virtually invisible.

Fiberglass salesmen periodically point out that heat from a fire can melt polypropylene fibers. Which is better at 300 degrees F, a brittle fiberglass fiber with no tensile strength, or a fiber that is starting to soften from the heat? This is a moot point, since neither fiber will provide reinforcement in the event of a fire, and neither fiber is intended for that purpose.

Some stucco manufacturers use the fiberglass fibers, while others, including **Magna Wall**, use the polypropylene fibers.

E. Bond Breaks

Stucco has a different coefficient of expansion than wood or metal. If, for example, stucco is applied to a metal conduit, a crack will occur along the conduit. If stucco is applied to wood, the situation is a little more complex. If the wood gets wet and swells, it may break the bond with the stucco, or it may crack the stucco. If the stucco remains bonded to the wood, the alkali of the stucco combined with the moisture that the wood may absorb from the stucco may cause the wood to deteriorate.

It is good practice to cover all wood and metal (except lath) with a layer of felt paper.

F. Application of Scratch and Brown Coats

Most stucco that is applied to homes is machine mixed and applied by hand.

Hand mixing should be avoided. Experts have told us that no one with under sixty years' experience mixing stucco should be allowed to hand-mix stucco.

Machine application is very messy, thus it requires expert masking and shielding. The more "curb appeal" a house has, usually, the harder to machine apply the stucco.

The **SCRATCH COAT** is applied to key into the lath and to cover the lath. If the lath is not furred, the scratch coat cannot key into the lath as well as it should. Normally the scratch coat is about three-eighths of an inch thick. After it is applied, horizontal scratches are made on it so there will be a mechanical bond between the scratch coat and the next coat to be applied.

The **BROWN COAT** is used to build thickness, and to provide a flat surface for the finish coat to be applied. When the brown coat is applied, this brings the stucco out so the surface is in line with the face of the casing bead and other lath accessories on the wall. A darby is used to level the stucco, with the lath accessories used as screed points. As a result, if 3/4 inch casing bead is used, after the brown coat is applied, approximately 3/4 inch of stucco will be on the wall. If the original wall is not flat, at this point the surface of the stucco probably will not be flat. Do not blame the stucco contractor—blame yourself for failing to insist that the framing contractor do his job.

Standards at one time required the scratch coat to cure for 7 days prior to adding the brown coat.

ASTM standards now allow the brown coat to be applied as soon as the scratch coat has set sufficiently to hold it. This results in the brown coat being applied the same day as the scratch coat. This allows a chemical as well as a mechanical bond between the brown coat and the scratch coat, but it does have, in our opinion, a major downside.

If conditions are such that the scratch coat will crack (either plastic shrinkage cracks, or stucco over incompatible materials), and if the brown coat is applied before the scratch coat has fully cracked, the brown coat will crack as well. The crack leaves a conduit for water to get behind the stucco. If the felt paper and flashing are installed in an appropriate manner, water will not get into the building. If shortcuts have been taken, problems can develop. If the brown coat cracking is severe, a skim coat must be put over the brown coat before a finish coat is applied. At a future date, the crack may show through the finish coat.

If the brown coat is applied the same day as the scratch coat, insure that the stucco contractor has taken all steps necessary to prevent the scratch coat from cracking. If you do not get involved, the brown coat may crack. The Uniform Building Code requires a 48 hour cure before adding the brown coat.

G. Curing

Stucco is a cementitious product. Cementitious products require water to cure. If the stucco dehydrates prior to curing, it will not gain an appropriate amount of strength and may powder. On cool damp days, curing is not a problem. On summer days and on dry windy days, the stucco may dehydrate before it is cured. To prevent the dehydration of the stucco, walls should be misted several times per day for the first 48 hours at least. Misting serves several purposes, including:

1. It helps to prevent plastic shrinkage cracks, and
2. It allows the cement to cure longer and develop greater strength.

If the wall does not feel cool to the touch on a summer day or if it appears dry, it needs to be misted.

Stuccos are based on portland cement. Portland cement gains strength slowly. Usually they gain about:

*40% of their strength in 3 days,
65% of their strength in 7 days, and
90% of their strength in 28 days.*

Many contractors let walls dry out and never mist them. When this happens, you do not get the strength for which you paid. It is up to you.

H. Sealers

Some contractors like to add sealers to the brown coat. The sealers are usually watered-down bonding agents or polymers. They are reputed to harden the surface of the stucco, glue cracks together, and help the finish coat to bond to the brown coat. If the job has been done in a workmanlike manner, the sealers are usually not needed, but they do not do any harm. If the job has been rushed, the stucco has been either over-sanded or under-sanded, or the stucco has not been moist cured, then the sealers will correct some, but not all, problems.

I. Finish Coat

The finish coat is used to add texture and color to a wall. Each type of finish coat has its place, but you cannot substitute an inexpensive finish coat and hope to keep the building owner happy if he was anticipating a higher class finish coat. Page 13 discusses the different finish or top coats that are available.

J. Fire Ratings

Fire ratings are not addressed as often in residential construction as they are in commercial construction. Most building codes rate 7/8 inch conventional stucco (3/4 inch plus 1/8 inch finish coat) as having a one-hour fire rating if they are built according to specifications listed in the code.

Much of what has been written about three-coat stucco is applicable to one-coat stucco. This section assumes that you are familiar with the three-coat stucco and will point out differences between the two systems.

Even though the product is called one-coat stucco, it is not a one-coat system. It still has to be finished; thus, normally two coats of material are placed on the wall.

One-coat stuccos are developed to meet more rigid specifications than the three-coat stuccos.

Since one-coat stuccos are used thinner than three-coat stuccos, flexural strength becomes extremely important.

Most one-coat stuccos are designed and tested using a specific wall system. If that wall system is not utilized, the test results are not valid. Most three-coat stuccos are designed to meet the standards set forth in ASTM C-1328 or a similar standard that addresses the cementitious product separate from the wall system.

A. Lath

Since the thickness of the stucco base is half that of the three-coat stucco, lath should be applied in a meticulous manner. Do not take shortcuts. In addition to the diamond mesh lath, 18 gauge, 1.5 inch aluminum wire stucco lath is often used with one-coat systems. This lath is often called “chicken wire”. Chicken wire is usually galvanized steel and comes in one inch mesh or two inch mesh. Much of it is 22 gauge which does not provide the needed support. Even though the stucco netting is referred to as chicken wire, we have seen very little real chicken wire used as a substitute in one-coat systems.

B. Formulas

One-coat stuccos have to go through an expensive testing program. No matter how qualified a contractor may be, do not let him mix his own one-coat stucco on the job. Do not let him add additives that are not listed on the bag as safe to add. From this statement, you have probably concluded that one-coat stuccos are proprietary mixes. If you allow the contractor to modify the proprietary mix, it becomes your proprietary mix.

C. Impact of Sand

As with three-coat stucco, add as much sand as you can without losing workability. With one-coat stucco, the scratch coat and the brown coat are combined, so one cannot hide cracking that is caused by under-sanding.

D. Fibers

Most one-coat stuccos contain fibers.

E. Application

Application is similar to three-coat stuccos, except that the scratch coat and the brown coat are combined in one thin coat. Since we are dealing with a thinner coat, moist curing is more important than with three-coat stucco.

F. Finish Coat

The same finish coats are available for one-coat stucco as are available for three-coat stucco.

G. Fire Ratings

One-coat stuccos are not defined by the building codes as meeting a one-hour fire rating, so to achieve a one-hour fire rating they must be tested. For a wall to meet a one-hour fire rating, it must be built to the same standards with which the test wall was built. If the test wall was built with 5/8 inch Type X gypsum sheathing, then the building needs to be built with 5/8 inch Type X gypsum sheathing, even though the contractor has used 1/2 inch Type X gypsum sheathing on other projects. If the builder does not want a wall that meets the standards for a fire rating, then this paragraph can be ignored.

H. Texture

To achieve a consistent surface on a stucco wall, a skim coat or a texture coat of a stucco may be added. Problems occur with paints, elastomeric paints, and acrylic top coats, if the surface of the stucco wall does not have a uniform texture.

A. Paint

After a wall has been coated with stucco, the stucco needs to be beautified. Probably the cheapest coating that can be applied is a coat of paint. 50 years ago, a priest in Roma, Texas, painted brick and stucco with a mixture of green enamel paint and kerosene. The paint was thin enough so it entered the pores of the brick and stucco and has stayed there for 50 years.

A contractor tells us that one coat of latex paint will last for fifteen years; but if you use two coats, it will start peeling in five years and will have to be repainted every five years thereafter.

Paint is not the ideal coating for stucco. If you decide to paint a stucco wall, insure that you buy the best paint available that is designed for stucco and that you follow the manufacturer's directions.

B. Elastomeric Paint

The major use for elastomeric paints on stucco is the covering up of cracks. The elastomeric paint is designed to stretch. If a wall cracks, and non-elastomeric top coats are used, then the crack shows. If the wall cracks, but is top coated with elastomeric paint, no cracks show.

If a stucco wall has a pH of higher than 9.5, the paint may not stick to the stucco. Primers are available that will bond to the stucco, or one can follow the recommendations on the can of paint that usually say, "Let stucco cure for 28 days before applying." Do not mix primers and paint from two different manufacturers.

Some elastomeric paints stretch more than others. Price and elasticity usually go hand in hand. Buy the most expensive elastomeric paint that you can afford. Expect to pay \$90 to \$100 per 5-gallon pail for a top-of-the-line elastomeric paint.

Many elastomeric paints do not allow water vapor to pass through them. If the wall design needs water vapor to vent through the stucco, be careful in selecting an elastomeric paint.

Most elastomeric paints need to be applied in two coats. Failure to apply two coats may reduce the elasticity of the coating or reduce the expected life.

Since the elastomeric paints are a heavy coating, they tend to mute the texture of the stucco behind them.

Elastomeric paints are usually used in situations where cost, not aesthetics, is the major factor in choosing a top coat.

C. White and Colored Cementitious Top Coats

These are sanded cementitious stuccos that are made from components that meet rigid color standards.

The components are very accurately weigh-batched and blended in a clean blending system. They are designed to add texture and to provide a consistent color. To achieve consistent results:

- *the brown coat must be well cured,*
- *each batch must be mixed with the same amount of water,*
- *each batch must be mixed for the same length of time,*
- *each batch must be used within the same time frame,*
- *each batch must be applied in a consistent manner,*
- *temperature, sunlight, and humidity must remain constant for the entire job, and*
- *the entire job must be cured in the same manner.*

The darker the color, the more important the above requirements. Strong texture tends to add light and shadow to a wall and can camouflage some of the variation. Efflorescence, caused by an inadequately-cured brown coat, is disastrous. Fog coats are available that **help** to correct color variations.

Occasionally one sees someone trying to job-site mix a colored top coat. This is a disaster in the making. Color consistency cannot be achieved with job-site adding of pigments (even pre-weighed packets), measuring sand with a shovel, and measuring water with a garden hose.

D. Acrylic Top Coat

Several manufacturers make acrylic top coats. These are a complex mixture of acrylic polymer, non-staining sand of specific gradation, UV blocks, de-foamers, and other components. The coating is usually packaged in 5-gallon buckets and is of a consistency to use from the bucket. Acrylic top coats provide extremely sharp looking walls but they are not crack resistant. If the base coat of stucco cracks, the acrylic top coat will crack. If this coating is used, do not rush the job.

E. Elastomeric-Acrylic Coatings

A new addition to the market are acrylic coatings that are elastomeric. We anticipate these coatings making major inroads into the market during the next few years. They provide the looks of acrylic coating and the crack-covering advantages of the elastomeric paint.

All builders need standards. We will help you write standards concerning stucco and mortar, but we cannot write them for you. Standards serve several functions, including:

- *All parties know what is required,*
- *All parties have a handy reference as to what constitutes an acceptable job,*
- *A bench mark is available to judge work,*
- *Writing standards educates the builders about the various trades, and*
- *Design personnel are put on notice as to what is acceptable.*

There may be initial resistance to formal standards. After they are in place, most people interested in quality construction are glad that they are in place.

Standards on stuccoing cannot stand alone. They must be incorporated into comprehensive standards that address all aspects of the building program.

Following are a few sections that need to be addressed in stucco standards. Where suggested wording is included, we are indicating a requirement, or we are stating a position about which we have strong feelings.

A. Type of Stucco

- **Three-coat,**
- **One-coat, or**
- **EFIS.**

Indicate which systems are allowed and which are not allowed. If EFIS is not allowed and that fact is not specifically stated, a contractor may use it.

B. Type of Top Coat (select which ones are approved):

- Magna Wall Acrylic Top Coat
- Any Acrylic Top Coat
- Pre-mixed Cementitious Top Coat
- Elastomeric Paint
- Non-elastomeric Paint

C. ASTM or Other Standards:

- **ASTM C-847** (Standard Specification for Metal Lath)
- **ASTM C-897** (Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters)
- **ASTM C-926** (Standard Specification for Application of Portland Cement-Based Plaster)
- **ASTM C-1063** (Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster)
- **ASTM C-1328** (Standard Specification for Plastic (Stucco) Cement)

Listing ASTM specifications is not sufficient. ASTM C-847 lists four types of lath and a total of eight different weights. The builder may decide that 2.5 pound per square yard diamond mesh lath is the appropriate lath to list in his specifications. By standardizing on specific components and specific techniques, the superintendent's job is easier and there is less probability of errors occurring.

Someone must read the standards and decide which aspects of the standards are applicable.

D. Substrate

The framing contractor may leave the stucco contractor a flat wall, or a misaligned wall. Standards should be included under the framing section as to how straight and flat the walls must be.

E. Sheathing

The sheathing may be:

- CDX Plywood,
- Oriented Strand Board,
- Gypsum Sheathing,
- Hardie Board,
- or many other sheathing choices.

Building codes will have a strong impact on the sheathing choices made. You must specify the grade of the sheathing and the thickness. If you want 5/8 inch Type X Gypsum Sheathing and you specify Gypsum Sheathing, you will probably get 1/2 inch interior sheet rock.

F. Water Resistance

- Paper-backed lath or 15 pound felt. Lap according to code requirements.
- Flashing - Follow the code requirements. Water has a tendency to go where you do not want it to go. Design people must understand this, or problems will develop. Do not leave the flashing to the man on the job-site.
- Caulking - Most EFIS failures have been caused by design personnel and tradesmen not understanding caulking. If backer rod is not used and if the caulk is applied to three surfaces rather than two, it will fail.
- Foundation Weep Screed. Get the water away from the wall.

G. Lath and Accessories

Metal and wood expand at different rates than does stucco. Face metal (including electrical conduit) and wood with felt paper prior to applying lath, to prevent cracks in the stucco. Paint is usually an acceptable substitute.

Grade of lath:

- For exterior stucco, use 2.5 pound galvanized diamond lath.
- Specify thickness of accessories (3/8 inch, 5/8 inch, 3/4 inch).
- Specify nail size and pattern.

Lapping:

Overlap lath one inch on the ends and at least one-half inch along the sides. Where an end overlap occurs between supports, the lath must be laced with wire or wire tied every two inches with galvanized, annealed steel wire.

Expansion joints:

Expansion joints should be attached to the substrate only at stud and plate locations. Lath must not be continuous under the expansion joints.

Expansion joints shall be placed:

- *above each corner of each window,*
- *below each corner of each window,*
- *above each corner of each door,*
- *at least every 18 feet horizontally,*
- *at least every 18 feet vertically,*
- *along each floor plate.*

H. Stucco

Specify sand — ASTM C-897 sand is the appropriate sand, but not available everywhere. Before you require it, find out if it is available at a reasonable price.

Specify the components — Examples —

- Magna Wall Scratch and Brown Mix, or
- 1 part portland and 0.5 parts Type S hydrated lime.

Specify additives — No liquid detergent, Kelcrete, Gilco, or other air-entraining agent, mortar fat, or other modifier shall be added to the stucco mix unless authorized by _____ on a case-by-case basis.

Specify mixing — Mix the stucco at least 3 minutes after all components are added to the mixer to insure that all components are evenly mixed. Do not mix stucco more than 5 minutes; otherwise, excessive air may be entrained into the mix.

Pigments — Do not job-site add pigments to a stucco mix.

I. Application

Temperature — Do not apply stucco at temperatures below 40 degrees F or when the stucco might freeze within the first 24 hours. If freezing temperatures are anticipated, protect the fresh stucco with plastic sheeting and heat.

Temperature — Apply stucco in summer in such a manner that drying winds and direct sun do not hit fresh stucco.

Re-tempering — In the summer, stucco may be re-tempered for up to two hours. In cool weather, stucco may be re-tempered for up to two and one-half hours.

Curing — Fog or mist stucco walls for the first 48 hours, so the stucco does not dry out.

Skim coat — If the brown coat is not evenly smooth, apply a skim coat to smooth the wall prior to top coating.

Pattern — Each plasterer puts a slightly different pattern into the finish coat. Take this into consideration when finishing a wall so the apparent pattern on each wall is similar.

Breaks — Do not stop plastering in the middle of a stucco panel.

Timing of top coat — Do not top coat stucco until the following conditions are met:

Acrylic top coat 28 days

(If the wall is moist cured for 48 hours, the pH has dropped to 9.5 or less, and the wall is dry to the touch, the acrylic top coat may be applied after 14 days.)

Colored cement top coat 7 days

Elastomeric paint 28 days

The time frame can be shortened if a primer is used to neutralize the calcium hydroxide efflorescence (white in color) on the base coat. If a primer is used, use only primers manufactured for that specific brand of elastomeric paint, and follow the manufacturer's instructions to the letter.

J. Problems

If a problem develops, stop until it is solved. We do not produce substandard buildings. Ask for help.

Truisms are statements that are usually true. In formulating stucco mixes, everything is a compromise. By understanding what the compromises are, when a problem develops it is easier to solve the problem.

USE OF LIME

The higher the absorption of a wall, the greater the need for lime to maintain a high water retention.

The higher the lime, the greater the workability.

The higher the lime, the less the bleed water.

The higher the lime, the more open time for working the mix and the longer before the next coat can be applied.

The higher the lime, the lower the ultimate strength.

The higher the lime, the higher the carrying capacity for sand.

USE OF CEMENT

The higher the portland cement, the greater the initial strength.

The higher the portland cement, the greater the final strength.

The higher the portland cement, the greater the likelihood of plastic shrinkage cracks.

The higher the portland cement, the sooner the second coat can be applied.

USE OF SAND

The lower the sand, the greater the strength.

The lower the sand, the greater the cost per cubic yard of prepared stucco.

The higher the sand, the less the likelihood of plastic shrinkage cracks.

The lower the sand, the greater the workability.

The coarser the sand, the less the likelihood of plastic shrinkage cracks.

The coarser the sand, the less the workability.

NON-FORMULATION TRUISMS

Always install tile roofs before installing sheet rock.

Always install sheet rock before installing stucco.

Never use a hammer on anything connected to a wall if the stucco is less than three days old.

Rapid construction is usually poor construction.

It takes years to become adept at troubleshooting problems with buildings. The following guide is meant only as a guide, and hopefully it will help solve problems before they develop into big problems. Not all stucco problems are stucco problems.

Inadequate caulking or flashing of a window can show up as blistered paint on a stucco wall. A shifting foundation can show up as a crack in an otherwise good stucco wall. If you have a problem, call in an expert to help identify the problem. Do not accept the common statement that all stucco cracks. Rather find out why the stucco cracked and then determine whether there is a problem. Not all stucco cracks.

A. Cracking

Map cracking

Usually caused by:

- inadequate sand in the mix,
- inappropriate gradation of the sand,
- excess water in the mix,
- inappropriate formula,
- lack of lath, or
- failure to gap plywood or OSB board.

Angle cracking above doors and windows

- Usually an indication of movement of the walls, the roof, or the slab.

Vertical cracks every 16 inches or 24 inches

- May be an indication that the entire wall system is flexing. Check to see if cracks are along the studs.

Vertical cracks, especially 24 inches long or shorter

- May be an indication that the ends of the lath are not tied together or adequately nailed down.

Vertical cracks every 96 inches

- Failure to gap plywood or OSB board.

Periodic vertical cracks - some above electrical outlets

- Usually indicate inadequate bond breaks in front of wood or metal objects.

Horizontal cracks at specific levels

- May be an indication that the entire wall system is flexing. Check to see if cracks are along horizontal braces.

Horizontal cracks every 27 inches

- Inadequate lapping of lath.

Horizontal cracks every 48 inches

- Failure to gap plywood or OSB board.

B. Sandy, Powdery, Discolored, or Soft Surface

Sandy or Soft Surface of scratch or brown coat

Usually caused by:

- over-sanding of mix,
- excessive water in the mix,
- improper gradation of the sand,
- inadequate amount of cement, or
- inadequate cure.

Powdering of stucco

- Inadequate cure.

Light colored blotches or staining on cementitious stucco

This is usually efflorescence. If it can be brushed off, it is an alkali efflorescence. If it cannot be brushed off, it is probably an alkaline earth efflorescence. Alkali efflorescence will weather-off or can be brushed off. Alkaline earth efflorescence must be taken off with acid washing. Get assistance with this.

Alkaline earth efflorescence is usually caused by finishing a stucco system before the base is adequately cured.

Fading of cementitious stucco

Usually caused by efflorescence. See above.

If cementitious stucco was job-site mixed, it may contain non-permanent pigments.

Dark staining of cementitious stucco

Look for a source of water. Usually the problem is related to inadequate flashing of the roof, windows, dormers, etc.

Wet areas on stucco

Usually caused by roof leaks, inadequate flashing, or someone driving a nail or screw through a water pipe. If one side of the wall system is impervious, water can build up from condensation.

Blistering of paint

This is an indication that water is trying to come out of the wall.

Peeling of paint

Water may be trying to come out of the wall.

A bond did not develop between the paint and the substrate. This can be caused by a dirty substrate, alkali efflorescence on the substrate, a damp substrate, or a soft and crumbly substrate.

Powdering of paint

If you assume that

- the paint the subcontractor bought at the flea market is a good quality paint,
 - the paint has not been on the wall over five years,
 - the paint was not watered down, and
 - the paint did not flash set,
- ...then the problem is usually related to a chemical imbalance between the paint and the coating beneath it.

Peeling of acrylic stucco

Inadequate bond is the base cause of the problem.

It can be caused by the wall being damp when the stucco was applied, by the wall becoming damp before the acrylic stucco dried, by the acrylic stucco bonding to something besides the cementitious stucco (such as dirt or efflorescence).

Light colored blotches on acrylic stucco

If the blotches brush off, the cause is alkali efflorescence.

If the blotches will not brush off, the cause is alkaline earth efflorescence.

Appearance of sagging of acrylic stucco

Generally related to poor workmanship on applying the acrylic stucco. Usually caused by stopping the application in mid-panel and then starting up the application at a later date, or failure to adequately trowel acrylic stucco onto the wall.

Staining of acrylic stucco

If the stains tend to be dark, look for water hitting the wall due to poor roof design, clogged gutters, or inadequate flashing. If the staining is light in color, it is probably efflorescence.

Apparent fading of acrylic stucco

There is a very slight chance that acrylic stucco will fade. Usually it is a very fine layer of alkaline earth efflorescence on the stucco.

Texture change in acrylic stucco, usually areas of reduced texture

If the brown coat is not evenly smooth when a texture top coat is applied to it, the larger particles of sand work into holes in the brown coat. Without as much sand being exposed on the top coat, the top coat has a reduced texture. After it has happened, there is little that can be done about this problem.

If the top coat is to be applied with a trowel, and if the texture of the brown coat is not even over the entire structure, a skim coat should be added to produce an even texture.



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