

Cracks in Portland Cement Plaster (Stucco)

by Mark Fowler

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Where do they come from? Why do they happen? Who is to blame? An analysis on what causes hairline cracks in Portland cement.

Every contractor who has anything to do with stucco knows the frustration of hairline cracks that are inherent with a cement stucco system. We try every new product and technique but yet still seem to find ourselves on site with the designer, owner and general contractor pointing fingers at one another for cracks in stucco. When tempers fly and no resolution seems likely, a private consultant can be hired to take core samples and ship them off to the lab for a petrographic analysis. The process is then to scrutinize the materials used, remove large sections and measure every fastener for spacing, all in the hopes to find a way to pin the problem of cracking. Depending on the consultants hired, the amount of money the plaintiff is willing to spend and what concessions the contractor is willing to make short of litigation, the problem can be costly—in time and money.

The purpose of this article is to educate and assist contractors, foremen and journeymen in a better way to handle the problem of hairline cracks in stucco. Instead of simply regurgitating the same information that has been published many times or quote established standards, I will try to provide realistic goals and information you can use.

This article will help with language for bidding cement stucco projects and; key items we should be looking at to minimizing cracking in stucco (including putting a light on some poor trade practices that can add to the cracking problem).

MYTHS

First we must dispel two common myths about stucco systems and hairline cracks. Each of the myths seem to be propagated by either contractors or designers—not surprisingly—each side seeing the controversy from only their point of view.

Myth Number 1: “A Good Stucco Job Will Not Crack!”

Some designers believe if they write perfect specifications with the best materials and proper placement of control joints, a stucco job will not crack. No one can guarantee that a cement stucco job will not crack, no matter how good the installation. Stucco is a brittle and relatively thin material applied to framing that moves. When the stress of this movement overcomes the strength of the plaster, the plaster can and will crack. This statement is true of any Portland cement-based product when subjected to enough stress.

All buildings are subjected to a variety of stresses in various forms and this stress can transfer to the plaster (stucco) membrane. Stucco is not and never was intended to be a structural material and can crack if the stresses are transferred to the membrane. This statement is not meant to condemn stucco; stucco has so many outstanding qualities that make it a cladding that's impossible to beat. Designers and building owners should be reminded of the positive benefits of a cement stucco system:

- Fire resistance
- Abuse resistance
- Cladding with the lowest life time maintenance cost (per ASTM)
- Pest resistant
- Extremely suitable for hot, cold or wet climates
- Can be formed to almost any shape
- Monolithic
- Variety of textures
- Natural components and considered a "green" building material
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These are some of the qualities that make stucco one of the most desirable claddings in the world. Educated designers appreciate the versatility and rich look of stucco. Although stucco is subject to the occasional hairline crack, it seems a small price to pay for so many benefits. It is the plastering contractors obligation to inform people of these facts and educate themselves on the best practices to minimize the cracks.

Myth Number 2: "All Stucco Jobs Crack!"

I know you must be thinking, "Wait a minute, how can both statements be myths?" While this may seem like we are trying to have it both ways, it is not. Unlike some things in life that are either black or white, right or wrong, stucco is subjective and typically falls in the realm of shades of gray. It is certainly possible for a building with stucco to have no cracks, but in all probability some hairline cracking is inevitable. The problem is that this myth or position that all stucco jobs cracks is propagated by too many plasterers trying to use this statement to explain away poor planning, a lack of knowledge, bad plaster mixes or bad practices.

While some hairline cracking should be expected, too many plasterers make statements like, "I will make a guarantee but the stucco will eventually crack." This purely negative statement is usually an attempt by the plasterer to get the customer to accept all cracks. He believes this minimizes his responsibility for due diligence to minimize the cracks as much as possible. This tactic rarely works in the short term, as owners hire consultants to investigate why the cracks have occurred and the courts rarely side with the contractors using this poor defense. In the long run, it will sway people away from selecting stucco as a cladding. Never forget they have choices in exterior claddings and not choosing stucco decreases your future work.

Wall and ceiling contractors should advise owners that some cracks are possible, even likely, but that he will do all in his power to minimize the cracking as much as possible. To minimize cracks requires a working partnership with the general contractor and other trades. Cracks are a result of stress and many of these certainly come from outside sources and are beyond the plastering contractors control.

Be wary of quick-fix products or seemingly easy solutions. Cement stucco has been around a long time and many have claimed to have the magic answer. Remember, if it sounds too good to be true, it probably is. This does not mean we should close our minds to new products and procedures, just proceed with "cautious optimism"—there may be some long-term issue to consider in an attempt to avoid a short-term problem.

For example, while it may seem that using an elastomeric rubber-type coating is an easy solution, there are long-term vapor permeability issues to consider that may not be so rosy a few years down the road. Small amounts of moisture that can find its way behind the stucco will try to exit as a gas through stucco. Most elastomeric coatings do not allow a vapor to pass through the coating. This can result in bubbles or blisters in the coating.

A UNIQUE MATERIAL

It must be understood that stucco (Portland cement plaster) is unlike any other building material that we use today. While seemingly basic and simple, it can be very complex and have hundreds of variables. Think about it: Stucco is just sand, cement and lime, pretty simple, right? That is until you consider how many types of cements there are on the market, as well as lime, lime replacers and sand selection. ASTM recognized the sand dilemma and made a provision in the standards to allow any sand that has a proven track record in that specific market. All of these factors combine to make stucco in one part of the world vary from stucco in another part of the world and stucco is truly worldwide.

OWNERS' EXPECTATIONS

We have already stated that many owners' expectations are that a good stucco job will not crack. While those familiar with construction understand cement stucco is a great cladding with one possible drawback—the occasional hairline crack—building owners may not be familiar with construction and can have the perception that a hairline crack is a defect, regardless of the width or length of the crack.

Hairline cracks in cement stucco was one of the primary reasons EIFS took off so well in the '80s. Contractors discovered that EIFS is a flexible cladding and much less prone to hairline cracks than stucco. This statement is not meant to condemn or discourage the use of stucco—both claddings have pros and cons.

In fact, the plastering contractor who can do EIFS and stucco systems with equal expertise and understand the benefits of each system is formidable competition. They will be better at matching a system's characteristics to the preferences, needs and desires of the client.

Oftentimes, a contractor will try to push clients to the system he prefers. Being familiar with both systems and able to do either system with confidence provides the contractor an arsenal of choices for his clientele.

If a designer or homeowner is truly concerned about a few hairline cracks in the stucco, I recommend they consider using EIFS. Barrier or drainage, they are much less prone to cracking than stucco.

However, some designers are more interested in the natural look of stucco or they strongly prefer a traditional stucco for other reasons. In either case, it is best to let the customer decide based on fair, unbiased facts of each system.

Bidding a project specified with a particular system with the intent of switching

the system during construction is not a good idea. Several contractors have done this with mixed results. In a worst-case scenario, the contractor can be liable to replace the system at their own cost and be liable for any perceived consequences of the substituted system.

PLAN AHEAD

First and foremost, a plastering contractor should review the project specifications and elevations. While this may seem obvious and standard practice, some contractors bid projects under the impression they will do it the way they have always done stucco.

Consider the use of control or expansion joints that may or may not be specified or drawn on the elevations. I caution contractors about taking responsibility for placing or moving control or expansion joints that may vary from the plans and specifications. If a designer has placed control joints in locations not typical for the stucco industry, notify the designer the control joint lay out may not follow industry guidelines and then proceed as directed. Do not take it upon yourself to move the joints to where you think they should be placed. If no control joints are specified or desired by the owner/designer, a contractor would be wise to send the person in charge of design a letter to the following effect:

Dear Valued Customer,

Re: your project:

It has come to our attention that the above referenced project has no control or expansion joints in the stucco system and the owners/designer prefer not to have these trim accessories, as they would change the aesthetic look of the building. We appreciate the owners'/designers' concerns, considering that even with the installation of control joints, no one can guarantee the stucco system will not crack.

We are willing to install the stucco system with the minimal or no control joints as desired and directed, with the understanding some hairline cracks are likely to develop at certain locations (i.e., windows, doors, floor lines and changes in directional framing members).

Our plastering company will use the best trade practices available to us to minimize the cracking with or without control joints. It is our intention to give the owner the desired look they want for their building with minimal cracking in the cement stucco.

Respectfully,

Your Name and Company

The use of this letter is primarily intended for single-family homes that would not look right with control joints. For example, an Italian-style villa or English tudor country home would not look right with control joints at every corner of every window. However, a few hairline cracks would be suitable and are certainly common on these European-type homes.

It should be cautioned that ASTM C 1063, "Standard for the Installation of Lathing for Portland Cement Plaster," has a requirement for control joints. If the specifications reference ASTM C 1063, further clarification should be sought.

A TIP FOR NO CONTROL JOINTS AROUND WINDOWS AND DOORS

If no control joints are specified or desired around doors and windows, a tip that can help reduce the cracks that typically radiate from the corners of windows and doors is to use furring nails: It is common to nail the lath very flat and tight around the perimeters of doors and windows. This is an effort to prevent the lath from protruding above the finished plane of the plaster. Unfortunately, this pushes the lath completely flat and can negate furring.

When a concrete driveway is poured with a wire mesh, the mesh is typically on blocks. Over-stapling the lath around doors and windows is similar to pushing the wire mesh down into the sand on the concrete driveway. Without the use of control joints at corner of windows and doors, the likelihood of a "re-entrant" crack developing is higher, especially if the lath is nailed very flat to the sheathing or framing. The corner of the openings is where stresses tend to concentrate.

A method that has proven to work is the use of a furring nail at these locations. A furring nail has a paper wad that holds the lath off the framing members about 1/2 inch, similar to the blocks placed under the wire mesh used in concrete driveways. The furring wads, similar to the blocks, allow the cement to fully encase the lath or mesh. It should be noted that the use of furring nails is not a normal trade practice and a slight cost increase would not be unwarranted.

Multi-story buildings should be more of a concern considering the additional stresses on these buildings particularly at the floor lines. Most commercial buildings will reference the ASTM C 1063, this ASTM requires control joints spaced no further than 144 square feet. The reason for this number is the 12-

foot-by-12-foot pattern works out perfectly to 144 square feet and it was an agreeable and conservative approach to control joint layout.

Some projects work out to a relatively square pattern that may exceed the 144 square feet, it is doubtful that by simply exceeding this 144 square foot standard it will greatly increase the likelihood of cracking. It should be noted that there has never been any conclusive testing to prove that staying within the 144 square foot rule will eliminate or minimize cracking. Consider that this section of the ASTM standard was written prior to the common practice of using chopped fibers in the cement basecoat which has been independently tested to reduce shrinkage cracks in stucco, yet no adjustment was made by ASTM to allow for the use of fibers in cement basecoats.

Some experts believe that setting an exact number, such as 144 square feet, is unrealistic in the real world and particularly with today's complex building designs. The Northwest Wall & Ceiling Bureau has published the "Stucco Resource Guide" that is referenced in many specifications and the ASTM for exterior clad buildings. The guidelines in this resource state control joints should not exceed 160 to 180 square feet. It should be noted that many experts in the stucco industry tend to agree with the position of the NWCB.

If a contractor notices that ASTM C-1063 is specified and the "Stucco Resource Guide" is not, it may be wise to ask or notify the designer of your intent to follow this established and recognized standard to give the designer more latitude on control joint placement and protect himself from possible future litigation.

While many wall and ceiling contractors get treated unfairly by having unqualified consultants who examine stucco cracking (another issue), there are some poor trade practices that may not create cracks but certainly do not help to minimize them.

The following items (practices) have been found to help minimize hairline cracks in stucco. Note that some items are in the control of the plastering contractor and others are in the control of the general contractor. To minimize cracking in cement stucco is a team effort.

- Deflection criteria: The minimum deflection criteria is recommended to be $L/360$. Code allows $L/240$ for brittle finishes like stucco. The stiffer wall will resist stresses better.
- Wood-based sheathing is recommended to be gapped a minimum $1/8$ inch on all sides and edges. Wood swells when damp, the scratch coat will create a damp condition and this gap gives the wood panels a little expansion room.
- Wood framing is recommended to have a moisture content of less than 19 percent. Wet wood warps and can cause green cement plaster to fracture.
- Lath shall be attached along framing members (not to sheathing alone) and

well lapped. Do not over nail/staple.

- It is recommended that interior gypsum panels be nailed off prior to plastering. Pounding on the walls will crack "green" plaster.
- The building should be carrying 90 percent of its dead load prior to plastering. Be wary of heavy tiles and late stocking of gypsum wallboard.
- Control/expansion joints installed per industry recommendations.
- Plaster basecoat should have chopped fibers added to the mix.
- Use clean washed and well-graded sand. Dirty sand has clay and clay shrinks.
- Avoid cement "rich" mixes. Stay within ASTM ratios. Remember cement shrinks.
- "Hard" float the brown coat to densify the membrane. Do not use green sponge type floats on the brown coat.
- Damp cure the basecoat in warm, dry weather. Do not soak the walls. Light misting in the morning and evening is typically more than adequate.
- Allow the basecoat to cure prior to applying finish coat (14 days is recommended).
- Avoid pounding, drilling or vibrations to the plaster membrane during the first 28 days. This includes heavy equipment typically used for grading.

The term "green" plaster refers to a cement stucco that is set and hard but has not achieved substantial strength to resist stresses imposed upon it. Cement plaster is considered "green" for the first 10 to 14 days. Full strength is considered at 28 days.

COMMERCIAL CONSTRUCTION CAVEAT

One item that is not mentioned on the list is the use of a deflection track. In commercial construction, it is common to have concrete floor slabs with cold-formed steel framing in-fill panels. Designers will often use a slotted deflection track or deep lag track to allow for the anticipated horizontal movement at the floors; designers then detail an expansion joint at this location.

One common problem is that the lather is installing a weather-resistive barrier and trim item over sheathing and rarely has any knowledge of the deep leg deflection or slotted track. The lather then unknowingly attaches lath and/or trim accessories through the deflection track and binds the track together. The result can and often is the deflection that should have taken place within the track is now putting axial rotation on the studs. This creates stress upon the cement stucco and it cracks to relieve the pressure.

If you encounter a steel-framed project with a deflection track and an expansion

joint, review the detail carefully and clarify that the attachment of the casing, trim and lath will not bind the deflection track. This will often require the architect to provide revised details and/or marking “no attachment” zones on the weather-resistive barrier.

LESSONS LEARNED

Educate, advise and be honest with your client about cement stucco. Learn the industry practices, codes and standards for your trade. Advise and then document any discrepancies with standards or best practices. Many contractors are certain that these letters will mean no future work from the recipient. I ask wall and ceiling contractors to consider this: Do you really want to continue to work with a general contractor who refuses to protect himself and you? The tone of the letter on a variation from the standards should vary depending on the condition.

A general contractor who wants you to clearly violate the minimum standards of the building code and puts public safety at risk is someone who should receive the letter that needs to be signed for. Contractors with this type of personality have a short memory and are the first to throw you under the bus.

Most conditions require a “request for clarification” type letter. Basically it is pointing out that the condition may cause additional cracking beyond what is considered hairline or does not meet typical industry recommendations. What would you like us to do?

Most general contractors will often appreciate the concern when you point out “it will protect you and me.” The owner will sue the general contractor and then the general sues you. These letters are to protect the both of you.

Next time, we’ll discuss how to investigate a stucco-clad building with cracks, how to repair it, how dangerous are hairline cracks and some common mistakes that contractors make.

Mark Fowler

Mark Fowler has over 30 years experience in the stucco industry from union plasterer to contractor, and worked with stucco in many roles, from an architect to code consultant. He is Executive Vice President for the Western Wall and Ceiling Contractors Association in California (www.wvcca.org).