12 point list of methods for reducing cracking in portland cement stucco

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I plan to publish a new point every month. I may not publish points 11 and 12, secrets on how we mix our finish coat. I don't want them to fall into the wrong hands.
Plus, people are paying me money for my recipe at the moment, believe it or not.

Point one - sheathing and framing

**Stamp on plywood says space 1/8" at ends and sides.
Next to stamp is joint butted so tight you can't stick
a razor blade in it.**

A large source of cracking in stucco is the movement, warping and expansion of plywood or OSB sheathing. The American Plywood Association recommends spacing of 1/8" at ends and sides of plywood and OSB panels. "If severe moisture conditions are anticipated, increased spacing may be required." The buckling caused will crack the stucco, not necessarily at the joints, but anywhere. If this wasn't important, the plywood manufacturers wouldn't waste the money on stamping every sheet. All I can do is insist that the plywood be spaced 1/8".

The plywood is easy to space during installation by driving nails as spacers into the studs. The lack of spacing can be remedied later by cutting "kerfs", or grooves with a circular saw. The saw blade can be set to a 1/2" depth and the joints traced.

Lack of spacing is hard to detect because usually the sheathing is covered immediately with Tyvek. We don't discover this condition until we build a scaffold and tear off the Tyvek. The delays of waiting for the sheathing to be corrected or the disputes created are too

expensive, so usually we proceed with unspaced plywood. All I can do to enforce proper spacing is to insist on spacing before the plywood is installed.

We have had fewer cracks on jobs with OSB than with plywood. I like OSB a lot better. When you try to drive a nail (or roofing staple) into plywood, it bounces like a basketball. OSB has a nice solid thunk, indicating it is stronger, and more resistant to vibration, a cause of cracks.
Check out this source of information about OSB and plywood:

Choosing Between Oriented Strand board and Plywood

When plywood or OSB gets wet due to inadequate flashing or drip caps, the swelling and buckling is increased, cracking the stucco. Water infiltration is the subject of a future point on my list.

Nails are driven through plywood, indicating pressure is too high on the nail gun.

Another typical condition is the nails are driven through the plywood. The plywood is then only supported by the bottom layer of wood. Bear in mind the metal lath is attached to the sheathing, and not necessarily the studs. This creates a lot of movement which obviously cracks the stucco.
There is a lot to be said about driving nails by hand. Not only don't the nails go through the wood, but the beating and banging pull the sheathing tight to the studs. (Remember wood studs aren't straight).

A great method we have used to limit cracks (but not cheap) is to cover all the plywood sheathing with durock. We did a house

this way and a year later there were only 2 tiny hairline cracks over windows on the whole thing. The reason is that the layer of durock

In the old days, sheathing was done by applying 1x6's diagonally to the studs, leaving a space of about 1" between the 1x6's. This seems a superior method to modern plywood or OSB.

We stuccoed a three story townhouse once where the framing was so flimsy you could shake the whole wall easily with one hand. If I find this condition again, I'm leaving.

Point two - Tear off the tyvek

Tyvek is easily torn off and felt paper applied

I got an e-mail message from a third generation plasterer saying that tyvek causes awful cracks. Click here. This set off an alarm in my head. The jobs we did that had excessive cracking all had tyvek.

At the end of the day, we throw away the left over mortar by putting on an empty cement bag, piece of plastic, or whatever. This makes it easier to throw in the dumpster. I noticed when we threw away old mortar left on scrap tyvek, it was always mushy on the bottom, and never set all the way.

If you remember my Stucco Wrap test, I was trying to test what seemed like a superior product, according to their advertising. It appears that the mortar never cures properly, because water is trapped against the plastic. Tarpaper, on the other hand, is porous, allowing mortar to cure better.

The tyvek is usually on when we get to the job for protecting the wood. Tearing it off also allows us to inspect the framing and sheathing for

irregularities. Also, it comes in handy for covering sidewalks, doors, etc.

I may not have discovered about tyvek it I didn't have this stucco communication outpost in cyber space.
Who are you going to believe, a third generation plasterer or a Tyvek advertisment?

Point three - Don't retemper the mortar

Retempering mortar, also known as "shaking up" is adding water after mortar starts to set. This weakens the mix every time. Stronger mortar means more crack resistance.

When mortar is set to the point that it is "chunky", it should be pitched. Plaster brown mortar can't be retempered, and has to be pitched. As a plasterer, we learn methods to extend the working time of plaster, such as using clean water to mix with. Dirty water makes plaster set faster, and does the same for cement mortar. It hurts me to see bricklayers wash their shovels, etc. in the same water they mix with. Their mortar has to be retempered often to maintain workability, not only weakening the mortar, but it is a complete waste of time. Time equals money, remember?

Portland cement mortar can be easily scraped off with a finger. Mortar in the stone work on this multi-million dollar house was constantly retempered

Certain rules should be followed, extending working time, to avoid retempering.

1. Use clean water

Water should be clean and clear, even drinkable. Well water usually makes mortar set faster than city water, due to the minerals.

2. Don't let the mixer run too long, or mix by hand.

The longer the mixer runs, the faster the mortar sets. The mixer should run barely long enough to mix the mortar. The mortar man should shut it off while he does other chores. Mixing with a hoe is better. The mortar can be dry mixed first, and then wet mixed, a little at a time, as it's needed.

3. Use clean sand.

Reddish sand indicates a high clay content. Clean sand should be yellow.
Sand should be sand, and not dirt.

4. Work in the shade.
Work should be planned to allow as much to be done in the shade in hot weather. The mortar box and mortar can be easily shaded by throwing a piece of plywood or cardboard over it.

5. Use clean tools
Shovels, wheelbarrows, etc. should be cleaned every day. The old mortar gobbed on tools sucks the water and the life right out of the mortar.

6. When in doubt, throw it out.
Stiff mortar should be pitched when it is too hard too work with.

Point four - Fibers

Reinforcing fibers made for concrete work for stucco, too.

Here we're using Fiberstrand made by Euclid chemicals.
These fibers do reduce the cracks, but have other benefits. Hairy mortar bonds better to successive coats. Also, flexural strength is improved.
For years, animal hair was used in plaster, as well as lime basecoats, and portland basecoats. The use of reinforcing fibers dates back to the ancient egyptians.
Up until the early fifties, hair was bought by plasterers at farmer's markets and building supplies. When farmers butchered animals such as pigs, they would shave them. They would then save up the hair and sell it when they went into town.
These days, animal hair would probably considered a hazardous material, unless it was sterilized.
These modern fibers are made from polypropylene, and are cheap. We make 6 bags of portland with a two lb. bag of fibers.
The expensive part of using the fibers is they must be dry mixed in the mortar by hand. In a mortar mixer they clump up.
The fibers do a lot of good.

Point five - Let it cure between coats.
Let your brown coat cure at least a week before applying the finish.

Probably the largest single reason for excessive cracking in stucco is not allowing the brown coat cure long enough. These cracks usually look like the cracks of a shattered mirror.
Each layer of cement forms it's own separate slab. Only a slight amount of cracking in the brown coat will shatter the finish coat. As the brown coat cures, and dries, it shrinks and cracks.
In California, the building code requires the brown coat sit for 30 days before the finish is applied.(Correct me if I am wrong). This seems like an expensive delay in hot, desert areas where 2 or 3 days may be fine. Fortunately, here in Virginia, there is no building code governing stucco, which is both good and bad. The good is I don't have the government directing me how to do my work.
Another good reason to let the mortar sit is to avoid being able to "read" green spots in the finish. You can see the size and shape of the green spot a long way away. It ususally shows as a swirly or coarse area.
The best thing to do here is do nothing- let it sit.

Point six- Don't pile heavy materials against the wall, and no excessive beating and banging

This is largely out of control of the plasterer, but it should be insisted on.
There is nothing worse than seeing a big stack of sheet rock stacked against

the wall, where the the stucco was recently finished on the other side.
If a sheet rock delivery is made, it can stacked against a partition wall, that doesn't affect the stucco. You can't tell me that a stack of sheet rock that weighs 3000+ lb. leaning against the wall won't bow the studs enough to seriously crack the stucco. Since there is no guarantee against cracks, I reserve the right to say nyah nyah nyah, however one person's action changes the quality of the product for everyone. So I must insist and insist.

The outer walls on the inside are usually the most inviting places for material deliveries, such as paneling, plywood, etc.

Once we had a stucco wall that cracked severely a few months after we finished when a contractor bolted a heavy bay window assembly to the wall, which should have been installed before the stucco.
I took some prospective customers by to show the house as an example of our work, and to show the great impregnated color. I had been by a few weeks earlier and there wasn't even a small hairline crack, making it a great example(put your best foot forward, right?) I could see the disappointment in their faces when they saw the big nasty cracks radiating out from the bay window.
I was embarrassed.
When they called me to tell me they had decided to put on a different material on their house, I knew the real reason.

Electical openings, plumbing rough outs, exhaust ducts, etc. should always be made before the lath is applied. I have seen neglected pipe openings knocked in later with a sledge hammer. In this event, the holes should be carefully made with a diamond or carbide blade.

Windows and doors should be checked before the lath is applied also, for alignment, proper opening, etc. Prying a window jamb or beating it out will crack the stucco every time.

All I can can do on all these cases is insist that these things be observed, but none are my fault.

On masonry:
Patches and blocks extendinding walls should always be toothed in, and not just butted tight. There will always be a nasty crack if blocks aren't toothed in.

Blocks extended on this multi-million dollar are loose enough to shake. I took a picture to show that when a nasty crack appears, it was due to an inadequate substrate.

Last but not least, is to insist that heavy roofs, such as slate or spanish barrel tile, be put on before the lath is applied. Several tons of roofing will bow the framing and crack the stucco. The disadvantage of doing this is that chimneys and dormers should stuccoed first, to avoid walking on the roof and breaking it up.
When I was in Southern California, I noticed a lot of times, the barrel tiles were loaded on the roof before they were installed. This allowed the stucco to proceed without loading the roof later and cracking the stucco.

Point seven - Gradation of sand in the finish coat

Another secret shared by Don Miles- using several grades of sand in the finish coat. This not only dramatically increases strength in the mortar, but adds crack resistent properties.
One large reason for excessive cracking in the finish coat is the sand is too fine. Your western style stucco finishes are sold in a variation of two grits, such as 40-60, or 16-20, for example. These means the ratio of coarse sand to fine sand. Even though these finishes look nice, they are on the right track. But they still aren't good enough.
I met someone in Seattle that used to plaster boats. The formula they used for boats was 7 bags of 7 grits of sand, for 2 bags of portland.
He had to guarantee the boats would withstand 8,000 psi, which is incredibly strong. Samples were taken to break them in a concrete tester. Sometimes the samples would break at 12,000 psi or more.
To put this into perspective, the footers under your house are probably required tp withstand 2,500 psi.
Sand sold here in Northern Virginia for stucco finish, comes from West Virginia. It is crushed quartz, graded into 3 grades, no.1, no. 2, and no. 3, number three being the coarsest. A grade finer than number one is available from the factory, and is called silica powder.

The disadvantage of this sand is the sand tends to be shaped in round balls, instead of sharp jagged grains. The sharper and more jagged grains are better for retaining water in the mix through setting and curing. Also, the sand is graded as no. 3 is number 3 only-nothing finer and nothing coarser. Seven grits is superior.
What do we use ? No. 2 sandblasting sand. No. 2 sandblasting sand has a coarse sand, like no. 3 quartz, but is graded differently. No. 2 is coarse and everything below, providing a uniform mixture of everything from coarse down to powder. Also, Sandblasting sand,which is also crushed quartz, has a nice jagged grain, which looks like Southern California desert sand.
Believe it or not, this fact is one of the largest improvements we have made to crack resistence. In other uses of portland cement mortar such as mud base floors or laying block, the **strength of the mortar can be more than doubled, simply by using various grits of sand.**

Point eight - Mortar applied too thin-less than 3/4"

Saving the boss man's money is no excuse. Hurry up construction scedules aren't a valid excuse either. On block walls usually cracks appear at every block joint when the basecoat mortar is too thin. If one wanted to see evry block joint, why put stucco on in the first place. This quick method may gain short term approval, and short term profits that are quickly spent, but good work is what gets the next job. I say be the turtle here- doing good work will always bring more work.

The standard thickness of cement stucco is 3/4"-7/8". True, there are places tha the mortar thickness is more or less, to make up for irregularities in the framing. 3/4" should be still considered a nominal thickness.
Thickness equals strength. Thin mortar equals weakness.
Don't get gypped. Check the thickness while it's going on before it's too late.

Point nine - Protecting the work after it's finished.

Badly cracked up and loose stucco caused by leaking roof cap

An ounce of prevention is worth 3,000 lbs. of cure. Whole wall is stripped down to block. This assures a nice job. Patches almost always show.

The culprit was this roof cap. Water runs right down the cove in the cap and gets behind the stucco.

Bottom cap is removed and pushed under the upper cap. The overlap prevents water infiltration. This would have been prevented if the bottom piece was put on first, 30 years ago.

Protecting the work after it's finished is out of the control of the plasterer. All I can do is insist that things like roof caps are done, but I don't put them on.
The material we work with lasts pretty much forever, as long as water doesn't run behind the wall.
This example of a block wall is bad enough. Wood framed walls require more attention. If the wall isn't capped immediately after the stucco is finished, water infiltration can cause warping of the framing lumber, cracking the stucco.

Badly spalled block and stucco wall will have a new roof cap when we replace the stucco.

Stucco news home

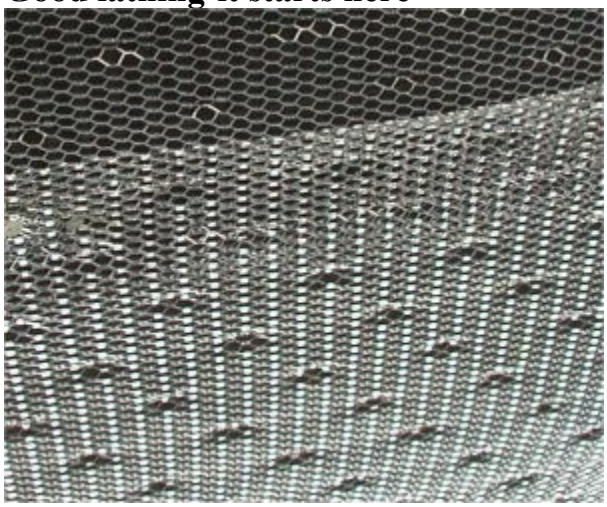
We put on a kick out flashing to divert water into the gutter. Not beautiful, but it keeps water from running behind the wall.

All horizontal members on tudor style stucco should be flashed , like over windows, before the metal lath goes on.

Why wait until it looks like this?

Point ten - Good lathing

Good lathing-it starts here



Self furring lath

Deep cracks and loose areas caused by bad lathing are
impossible to repair, without the repair coming back to haunt.
The reasons for metal lath are:
1. Support (to hold the mortar up)
2. Reinforcement -increased tension strength
Self furring lath has punches 1/4" deep, or "furs" to hold the lath away
from the wall. This allows mortar to penetrate well behind the lath
for good support and good embedding of the lath for reinforcement.
I see flat lath used sometimes for stucco. Although the mortar
will hang on enough to hold it on, it is still an inadequate method.

Out west they use self-furring stucco mesh. Some brands have
the punches painted with a dot of yellow or red paint, for easier alignment
to the studs. In California they call the diamond mesh lath we use here,

"K-lath".

An old lath nail was made for "hanging" welded wire lath. The nails were never driven tight, allowing mortar to key behind the wire.

Doing restuccos, we find different techniques used by our forefathers for furring lath.

One method was driving U shaped nails in the wall about 12" apart. When the lath was put on it was the nails were placed directly over the first nails, allowing the first nails to hold the lath away from the wall.

Another method was nailing small wood blocks, such as wood lath strips cut into 2 inch pieces to the wall and nailing the lath to the blocks.

I saw another method that worked, but was so strange, I am not going to write about it.

Furring strips don't work

This wall was furred with furring strips, and failed over the years. Mortar doesn't key behind the strips, forming a long weak area that is liable to crack. These strips here weren't strong enough

to permanently support the stucco.This wall had failed and had been patched several times over the years.
Furring strips do work with self-furring lath.

Tying "laps"

Where no sheathing is used, such as this interior plaster installation, The "laps", or where the lath overlaps in between the studs, should be tied with tie wire at least two ties between the studs. Failure to do this will lead to nasty cracks. Mortar must key into both pieces of lath to prevent separation.

3 inch over laps.

The standard for the minimum overlap for metal lath is one inch, but I say, why be cheap?, go 3 inches. Note how the inside and outside corners are reinforced with strips. There is a pre-made material for this called cornerite, which is pre-bent strips of lath. Crack resistant work begins with good lathing

Point eleven - The big one. Acrylic additives

This is the big one The greatest crack preventing discovery
we have made is the use of acrylic additives in the finish coat.

There are several types and brands available. The major use
of acrylic admixtures has been in swimming pools, as a method of bonding portland cement mortar to concrete. Acrylics have been also used for bonding cement plaster to cast in place concrete, and other substrates that are normally too slick, too porous, or not porous enough for a permanent bond.

I started using acrylics in the finish coat in searching for a method to retain the color in mix. Pre-mixed color stucco finishes from California have a small quantity
of plastic chemical to retain the color in the mix.

Using acrylics with color not only improved color retention, but I discovered
our jobs had no cracks, or at least very few. There also were no check cracks or imperfections from shrinkage, because of the slower final set of the mortar.

Other benefits of acrylics: Increased bonding strength (of course, they are bonding admixtures)
Improved compression strength.
Few to no cracks due to flexibility.
No need to wet the wall before applying the finish coat, which causes loss of
color.
Reduced porousness, reducing water infiltration, and spalling.
Reduced likelihood of efflorescence.

The increased material cost is about 50 cents a square foot, but the the overall quality of the finish product is vastly superior, so I have no problem
charging more for my jobs.

Point 12-Work must be done by experienced people.

This should say enough. If you are a DIY it means that you should be ready to accept the consequences, including bad work, or the fact your time is only worth $3.00 per hour. I understand the frustration of homeowners or contractors when people don't show up or do what they are supposed to do. Also, there is a severe shortage of qualified plasterers, but still it is worth the wait for quality.

Other reasons for excessive cracking:

Finish coat cracking:
Too much lime in the finish coat, mortar too rich in the finish, sand too fine.
Most cracks only occur in the finish coat. These superficial cracks may not be a danger of water infiltration, they can be avoided.

Lack of bond:

This is a source of larger deeper cracks, and loose areas.
Frequent causes:
Finish coat doesn't bond when resurfacing.
Brown coat too slick.
Bonding agent failure.
Inexperience.

Sand in the brown coat too dirty or too fine.
Sand should be a yellow color and not too fine.
A red or brown color indicates too much red clay or dirt in the sand.