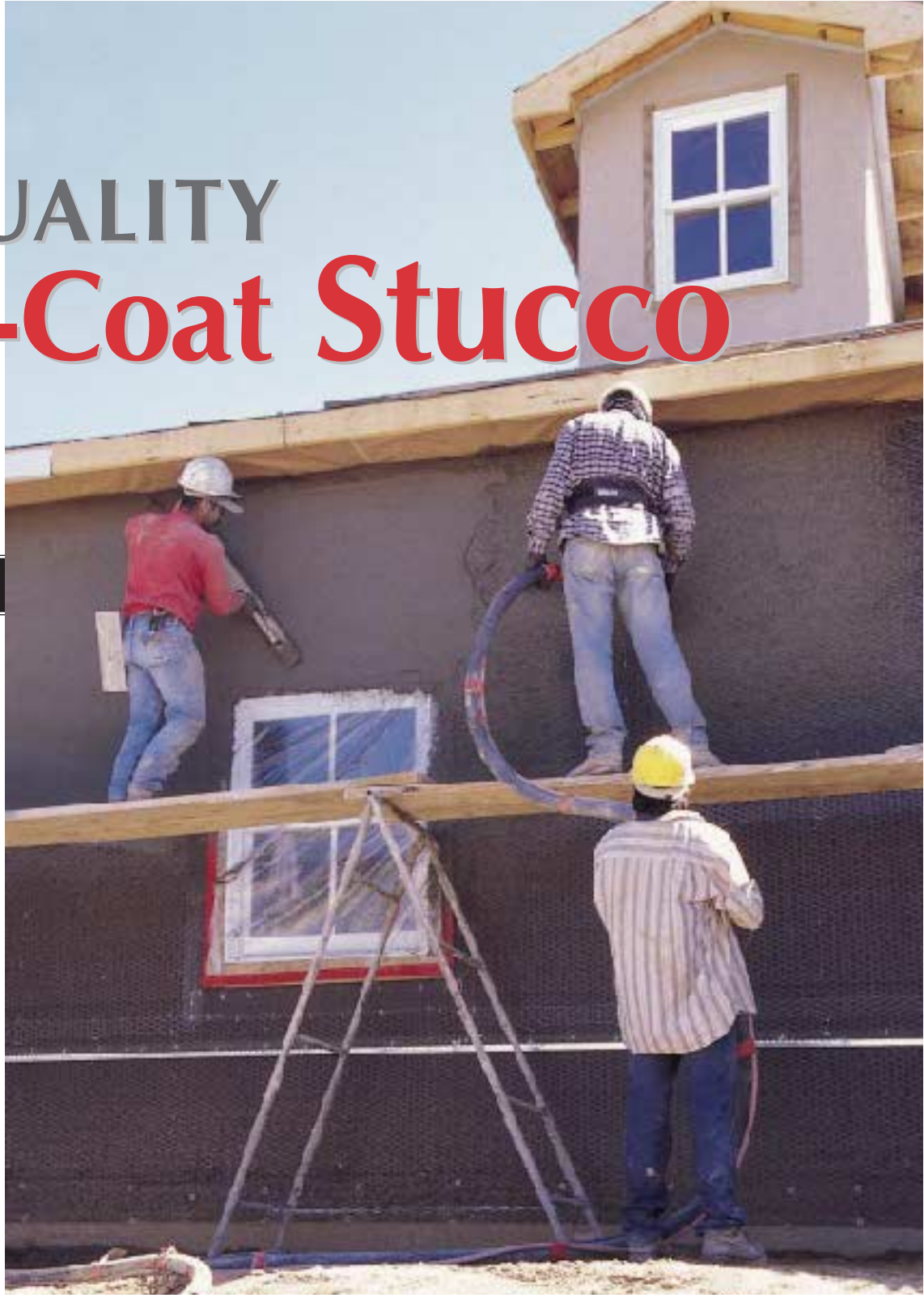
TOP QUALITY
Three-Coat Stucco



Plastering isn't the oldest profession, but it may be close to it. Coatings have been applied to the outside of structures for almost as long as people have been building shelter. Originally, plaster consisted of mud alone. As technology advanced, lime-based compounds were used. Modern-day Portland cement was invented in England in the early 1800s. It gradually gained popularity in the United States and was widely available by the 1890s.

by Ron Webber

Traditional three-coat stucco is nothing more than a Portland cement-based exterior plaster, which is a mixture of cement, sand, and water. Cement-based stucco has a long history of proven performance in a variety of climates here in the U.S., from the hot, dry Southwestern deserts to cold Northern winters and the humid Southeast.

Any problems with stucco are more related to a lack of uniformity and skill in stucco application than to the products themselves. In the past 15 years, in response to this, manufacturers have introduced many new stucco products, including fiber-reinforced "one-coat" stuccos with acrylic polymers. These products have the perceived advantage of faster installation time and fewer shrinkage cracks as the coating cures. Despite the apparently "enhanced" performance of these products, I believe that the original recipe for stucco still best withstands the test of time.

A carefully prepared substrate and attention to application detail will ensure a durable exterior

Figure 1. A properly installed weather-resistive barrier is essential to protect the structure from moisture intrusion. Here, 60-minute Type D kraft paper is being installed.

Properly installed three-coat Portland cement stucco provides the building with a dense, monolithic, protective shell. It requires very little maintenance and can easily last over 100 years. Three-coat stucco is easy to repair or patch and resists weather, impact, fire, insects, and rot. It is also vapor-permeable, as well as watertight in its entire depth. These are clear advantages over new synthetic exterior-finish systems.

Preparing the Substrate

Stucco can be applied to just about any wall system, including wood frame, metal frame, masonry, ICF block, Rastra (a particular type of ICF with a textured surface made of 85% recycled foam plastics and Portland cement), pumicecrete, poured concrete, straw bales, or adobe. Regardless of the wall system you use, quality stucco starts with a suitably rigid structure. Good stucco will be strong enough to resist cracking as the building undergoes normal movement, but stucco is not structural. Stresses from ground movement, foundation settlement, or most commonly, framing or structural movement will crack stucco. Earthquakes may be beyond your control, but foundation settlement and framing movement are not. Most of the structural movement I see is the result of changes in the moisture content of framing and sheathing materials. Plywood can move enough to crack stucco if it is improperly spaced or

Figure 2. Lath can either be stapled — the fastest method — or nailed. Special furring nails (inset) are designed to hold the lath off the wall so that it's properly embedded in the stucco.

nailed. For every 4% change in moisture content, lumber will change 1% in size. These dimensional changes primarily occur perpendicular to the grain and can result in significant structural shifting.

The finished thickness of stucco is only 7/8-inch. Irregular or uneven framing at plate lines, along shear panels, or at bowed studs can leave the stucco too thin at these places, resulting in cracks. Keep the framing straight enough so that the stucco won't have any excessively thin areas. If I happen to see bowed out framing before starting a job, I'll recommend furring out the rest of the wall so that the stucco can achieve an even 7/8-inch thickness in that area.

Flashing and Weather Barrier

The fact that stucco is highly vapor-permeable doesn't mean that you can forget about the effects of water and water vapor on framing and sheathing. It's important to protect the framing and sheathing from any rainwater that does get behind the stucco (see Figure 1). Make sure that the backup system of flashing, weep screeds, and a weather-resistive barrier is carefully installed. I have covered this subject at length in another article (see "Stucco Flashing Details," JLC, 10/98; the article is also posted on the *JLC* website), so I won't repeat it here. But the best way to think about the backup system is to imagine that you are all done with the prep work but the stucco hasn't been applied yet. If you were to spray water on the building with a hose, it should all run off without any water getting to the framing or sheathing (Figure 2).

Lath

Some stucco-compatible surfaces — for example, porous masonry, concrete, and Rastra — will accept stucco without the use of metal lath. The surface should be clean and sufficiently damp and rough to ensure a proper bond. I'll often verify that I'm getting a good bond by doing a test patch. If I'm not satisfied, I can always attach lath or use a bonding agent. A Portland cement dash coat of one-and-a-half parts sand to one part Portland cement will also promote adhesion.

Wood sheathing, ICFs, and adobe all require metal lath. Metal lath comes in many forms, including wire fabric, commonly called "stucco netting" (which looks a lot like chicken wire but isn't); expanded, or diamond mesh; and expanded metal mesh with flat or 3/8-inch ribs. Lath must be corrosion resistant for exterior use, and must be overlapped and fastened properly (Figure 2). While pneumatic staples have become common on many sites, furring nails are a better option. The advantage of furring nails is that they put the wire in the center of the scratch coat, thus providing better reinforcement.

Note that lath must be installed with the long dimension perpendicular to the supports. Also, metal mesh must be installed with the right side up, or the stucco will slide off the building. At corners, make sure that the lath is not installed too tightly or else it will not be embedded sufficiently in the scratch coat and the normal expansion and contraction of the building due to temperature changes will pop the stucco off. To prevent this, we "pooch out" the lath at corners, pulling it away from the building so there will be room for the stucco behind it. Alternately, you can apply cornerite, an expanded metal lath designed for this purpose (Figure 3).

The Mix

Although it comprises only about 20% of the finished product, Portland cement is what makes stucco stucco. Most cements are of good quality these days, so it really doesn't matter which brand you use. Watch out for older bags of cement, because humidity can partially react with the cement over time even if the bags have never been opened.

Some cement will have plasticizers added. If you use

Figure 3. This house is ready for stucco. Special care is taken to ensure the lath is not pulled too tightly at corners. If it is, the stucco will pop off over time. A lath accessory called cornerite (left) can also be used at corners to ensure proper embedment.

a plastic cement (as I do), do not add lime or other additives. Cement is typically packaged in 94-pound sacks, which equals one cubic foot. This is helpful when you are trying to figure out proportions.

Sand. Stucco is mostly sand, so you should use clean, sharp, good-quality sand (Figure 4). Good sand is the key to dense base coats, with either traditional three-coat or the one-coat method. Ask for and get verification that your subcontractor is using sand that conforms to ASTM 897 for gradation and has a minimum SE (sand equivalent) rating of 70. (SE is a designation for the amount of fines in the sand.)

If you want to check the sand yourself, take a random sampling from various areas of the sand pile. A glass jar test will quickly tell you if the sand is clean. If it's dirty, you'll see silt or other contaminants; more than a very slight amount of contaminants is cause for concern.

Figure 4. Clean sand, dry cement, and the correct amount of water are key to a good stucco mix.

Soluble salts or excessive fines are also harmful to the stucco. Salts can result in efflorescence, while clay fines may expand when wet, absorbing extra water, and causing the stucco to be weaker when it dries.

If you have any doubts about the quality of the sand the stucco contractor is using, I suggest setting aside a bag for future evidence, just in case there are problems.

Water. Clean, potable water is the rule. It takes only 2.8 gallons of water to fully hydrate a sack of cement, but it takes about 6 gallons per sack to make a workable mix when using good-quality sand. Poor-quality sand may require more water, and you might use up to 10.5 gallons of water per sack if you have added lime to the mix.

Application

With proper substrate, preparation, and materials, you are more than halfway to a good stucco job. Now it's up to the applicators to mix the stucco and apply it correctly.

Almost all of our base coat stucco is applied with a plaster pump (Figure 5). The plastering pump is temperamental: The mix has to be blended properly — otherwise it will not slide well through the hose — and the equipment must be in good working order. Although pumped plaster is generally a slightly wetter mix, it still results in a perfectly acceptable job. Hand application with a trowel is simpler, but it actually requires more skill. Given the proper mix, an experienced plasterer with a trowel can provide a stronger, denser, more carefully applied job, but this is not always the case.

The Scratch Coat

The scratch coat is the first coat of stucco, and it serves as the foundation for the next two coats. It should be harder than the brown coat, which we achieve by using a richer mix — about one part cement to two to four parts sand, or 21 to 24 shovels of sand per sack of cement. After the scratch coat is applied, the plasterer scores the surface with a special scarifier rake or a scratching trowel. This creates extra surface area and a better bond for the brown coat. In the first few hours after the scratch coat is installed, the cement is very fragile and should not be disturbed while it slowly gains strength. Because the scratch coat is thin, the moisture evaporates quickly. If it dries out too quickly, it will be weak as a result of incomplete hydration. To prevent this, you'll need to mist the surface with water.

Verify the hardness of the scratch coat before applying the brown coat. To test for hardness, we drag a nail over the wall. If the nail does not dig in but leaves a white line, the stucco should be hard enough. If the nail does dig in, then the scratch coat is not hard enough and should be wetted so the cement can hydrate more thoroughly.

The scratch coat should be no thinner than the brown coat, and firm enough to resist pressure from your hand when you lean against it. At least 95% of the lath should be covered by this coat. If there are any "dropouts," they should patched or filled that same day.

The Brown Coat

This is a leveling coat that provides the flat surface for the finished wall. The brown coat also adds strength and thickness, and is in large part what determines the quality of the finish. It's a little sandier, at one part cement to three to five parts sand,

or about 25 to 30 shovels of sand per sack of cement. The increased sand helps reduce the number of shrinkage cracks.

The application of the brown coat also reintroduces water into the scratch coat; because of the additional coverage, moisture will be better retained in the base coat, resulting in even more thorough hydration and a good, dense base.

You should not apply the brown coat until the scratch coat is hard. Floating the brown coat makes for a denser product — we use hard rubber floats. Wood floats will provide a straighter surface, but they are rarely used nowadays.

Figure 5. The author's crews pump brown and scratch coats (left). Finish coats (below) are hand-troweled.

The Finish Coat

This is what provides the final texture and color. Premixed finish coat material usually works fine, except I would avoid dark colors, especially reds. Because stucco colors are mineral pigments, dark colors are prone to spottiness and, if not well blended, will not match the color sample.

The only limits on the texture and appearance of the finish are the imagination and skill of the applicator. If you are new to using stucco and are planning to hire a sub, visit his previous jobs. Watch for uneven textures and appearance, discoloration, poor color matching, and irregular thickness.

Weather and Curing

Curing is an important part of a top-quality stucco job, and weather has a lot to do with curing. Weather conditions with high humidity, such as drizzly rain or heavy fog, are favorable to proper hydration of cement. If weather conditions are drier, you may need to gently spray the wall with a hose to ensure enough moisture for complete hydration and to avoid cracking. Stucco must be moist-cured for at least 48 hours, unless weather conditions are favorable (above roughly 80% RH, you don't need to moist-cure).

According to code, there should be at least 48 hours of curing time after the first coat is applied, and seven days after the second coat is applied if there is to be a third coat. The critical consideration is that the scratch coat must be hard.

As the first coat of stucco dries, it will lighten in color (Figure 6). This will be especially visible on the sunny side of the house first. When this happens you must fog or mist the stucco with water. Once it

Figure 6. As the scratch coat dries it will change color. It is important to make sure there is enough moisture available for complete hydration of the cement by misting the wall with water.

Figure 7. Finish protection is absolutely essential. Make sure you understand who is responsible for this before the job begins.

hardens (the next day), you don't have to be as careful — you can squirt water on the wall.

You should also protect stucco from freezing for at least 24 hours after it has set; you also must not use frozen materials or apply materials to a frozen base. The bottom line is this: If the weather isn't right for stucco, you should wait until it is.

Site Protection

During application, part of the stucco will end up somewhere besides on the wall — you can count on it. The responsibility for finish protection and cleanup should be carefully described in the scope of work. Make sure you know who is responsible for cleaning up the site and hauling away excess material and waste. Site protection, including cleanout areas, should be addressed before you start the job. Protection of glass, doors, window and door tracks, gutters, and landscaping from stucco slag is imperative (Figure 7) because, if left in place, finished surfaces can be irreparably damaged. For example, stucco can permanently etch glass in a matter of days. You'll want to clean up right away — it's always easier to clean up the cement droppings before they're hardened.

Cracks

Small shrinkage cracks in stucco should be anticipated; what is acceptable depends on customer expectations. Following proper curing practices and using good mixes with the right amount of water will reduce cracking.

Cracks in the scratch coat get filled by the brown coat. If you see larger cracks in the brown coat, however, it's best to fill them before proceeding with the color coat.

Hairline cracks (anything smaller than 1/16 inch) in the color coat do not allow water intrusion, so it really serves no useful purpose to patch them. The patch will inevitably be a different color and will only detract from the beauty of the stucco.

Structural cracks — cracks that go all the way to the back plane of the plaster — are another story. Although the weather-resistive paper should prevent water from getting to the framing, it's best to patch any crack that goes all the way through the scratch coat. As mentioned earlier, the best cure for these cracks is prevention: Make sure the foundation doesn't settle and use dry, straight framing materials.

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