



by Walter Jowers

In the early 1920s, right about the time of the Bungalow Boom, the portland-cement industry made a big effort to sell architects, home builders and home buyers on the "charm, beauty and permanence" of stucco. This campaign was quite successful; many of the houses built during this period were clad in stucco, and many older houses were remodeled with the material.

Before 1900, most stucco houses were finished with lime-based stucco, which is particularly susceptible to water damage. There are still lots of lime-based stucco houses standing, however, and in this article we'll discuss how to distinguish between the types of stucco, and how to repair each type.

Stucco Problems

Water is the cause of most stucco failures. Improper mixing of mortar, poor installation, building settlement and just plain exposure to the elements account for other stucco problems.

Water-damaged stucco usually bulges or falls away from the building, because water causes the coats of stucco to delaminate and the lath or lath fasteners to fail. (Wood lath can warp; metal lath and nails can rust.)

Cracks caused by building settlement or movement of framing members (stress cracks) usually are "clean" cracks, with no surrounding bulging or decayed stucco. If water enters a stress crack, you have both problems at once.

Stress cracks should be repaired only after you've determined what has caused them and whether the cracks are still moving. Similarly, loose or crumbling water-damaged stucco shouldn't be repaired until you've found and eliminated the offending water source.

Water damage to stucco usually comes from rain, the migration of water vapor from the interior of the building, capillary action from the ground or leaky plumbing. Water penetration can be prevented by:

- The proper use and maintenance of flashing, drip edges and drainage systems on the building exterior;
- The use of vapor barriers between the building interior and the stucco;
- The proper treatment of the stucco at ground level; and
- Repairing leaky plumbing.

The best materials for flashing are copper, lead-coated copper, terne metal (which must be painted; see last month's "Restoration Primer" column), and a relatively new and

very long-lasting material, terne-coated stainless steel (TCS). Galvanized steel is acceptable, but the other metals are better and cost only pennies more.

Aluminum, the favorite of many contractors, is questionable; it's flimsy and easily tarnished. It also takes paint poorly and won't take lead/tin solder at all, which makes it just about irreparable.

Problem Areas

Drip edges are changes in the plane of materials under horizontal projections, such as doorsills and windowsills. They interrupt capillary action, causing rainwater to drip away from the walls of the building. Some drip edges are formed out of flashing, while others are integral parts of the house trim, such as windowsills.

Drip edges often are overlooked as sources of water damage, but they can be major culprits if successive coats of paint or stucco have built up on them and rendered them useless.

Gutters must take rainwater away from the house without overflowing or leaking along the way. Rusty gutters with tar patches won't do the job; neither will gutters with broken joints nor gutters that have settled to the point where they no longer drain to the downspouts.

Flimsy aluminum gutters with caulked joints won't do anything well for long. Copper, TCS or galvanized gutters with soldered joints are best. Accept no substitutes.

The migration of water vapor through the walls of a house causes fewer problems than rainwater, but it can damage stucco (or exterior paint), especially on masonry buildings. (Frame structures normally have a layer of waterproof felt between the wood sheathing and the stucco, which prevents vapor penetration.)

The areas most susceptible to damage from water-vapor migration are chimney flues and the walls outside of kitchens and bathrooms. If there is damaged stucco near these walls that can't be blamed on stress cracking or rainwater penetration, vapor migration might be the cause.

One solution is to make interior walls relatively tighter than exterior walls by applying vapor-barrier paint on the interior walls and caulking joints along the interior window trim and baseboards. Another solution:

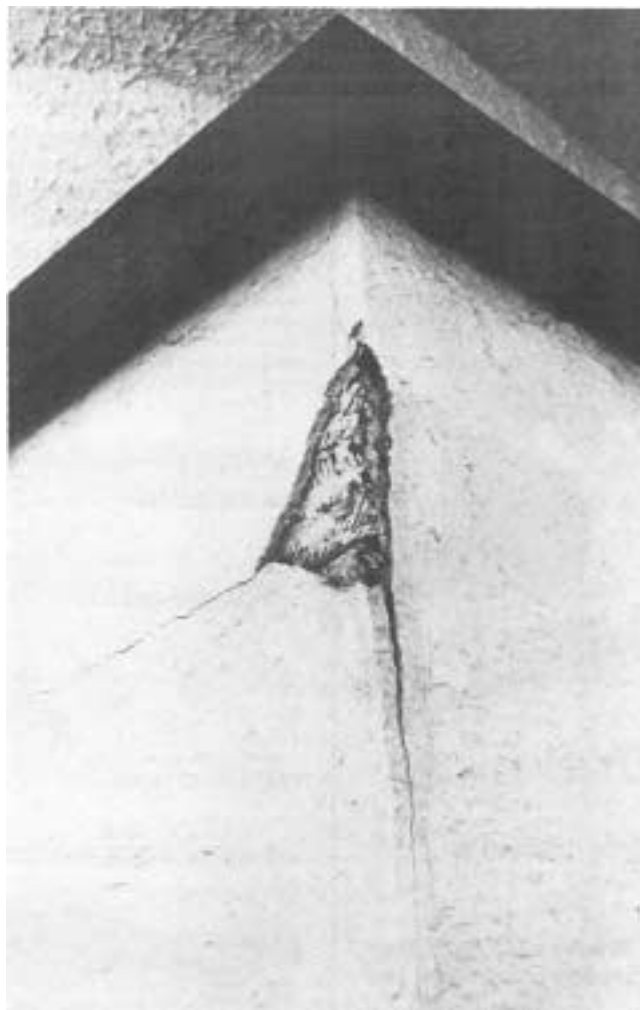
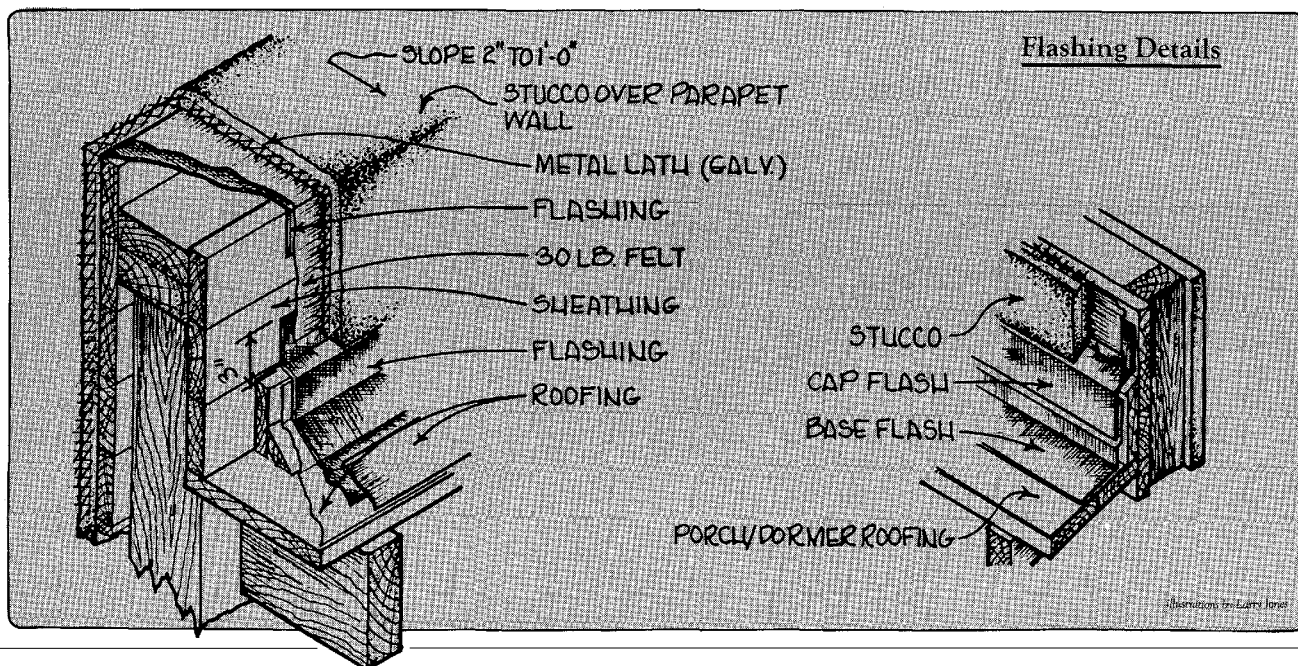


photo courtesy Illinois Historic Preservation Agency

Stucco damage at vertical corners is quite typical. In this photo, the metal lath underneath is evidence of previous attempts to correct the problem.



vent the bathrooms or kitchens with a sufficiently large exhaust fan. And if stucco on a chimney is damaged, line the flue with a nonporous liner (stainless steel is good).

The proper termination of stucco at ground level often results in water-damaged stucco. Most specifications call for stucco to terminate at least four inches from the ground, but many old houses aren't built that way—the stucco goes right *into* the ground.

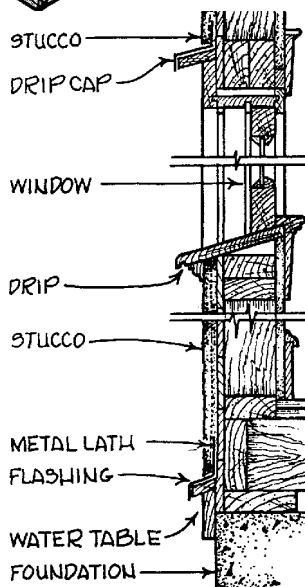
In cases such as these, do everything possible to keep the area dry: Repair and maintain gutters and drains, and make sure the ground slopes away from the stucco wall. Only then should the stucco be patched.

Stucco often fails at 90-degree joints such as those between parapet walls and roofs. Deteriorated or improperly installed flashing usually is the culprit. In such cases, you must remove enough stucco to allow you to remove the old flashing and install new material. (The accompanying drawings show some typical flashing details.) If you are faced with an extensive flashing-replacement job, it might be easier (and cheaper) to re-stucco the whole house as opposed to re-stuccoing over a lot of new flashing.

Stucco Patching

After you've found and corrected the source of damage to the walls, the next step is to determine what type of mortar was used for the stucco, as you'll want to use the same type of mortar for repairs.

Generally, 20th-century houses are stuccoed with portland cement, whereas earlier houses most likely used lime mortar. This isn't a hard-and-fast rule, however, some avant-garde masons used portland cement in the mid-19th century, and some conservative



Next, remove the damaged stucco before you start patching. There are two schools of thought on this subject: Remove the smallest amount of stucco possible to avoid extra work, or apply new material all the way to a logical break in the building surface (for instance, re-stucco a whole wall or chimney). In the second scenario, the patch will be less noticeable, and masons generally don't charge much more to re-stucco a whole wall than to make a patch. Both ideas are

sound of loose stucco (a succession of sounds similar to a tap dance). When you reach an area that doesn't move and makes only one solid sound, you've found the good stucco.

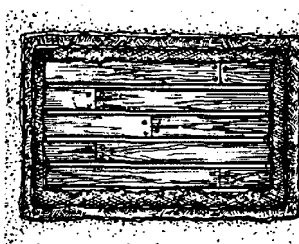
Don't try to peel off the loose stucco. If you do, you could de-stucco the whole house before you realize that you're breaking off sound portions along with the bad ones. Instead, make cuts through the stucco around the damaged area, either with a cold chisel or by drilling a series of holes with a masonry bit.

Cut to the lath, then pry off the old stucco with a broad, flat tool such as a nail puller. Cut back the coats of old mortar in square layers, as shown in the illustration.

Once the old stucco is removed, clean out all the dust, dirt and loose material with a wire brush. If there's loose wood or metal lath under the old stucco, be sure to nail it back to the sheathing tightly.

Lath Options

There is continuing debate over whether to apply stucco over old wood lath. People who are disturbed by the idea of using "inappropriate" materials in old-house repair can't bear the thought of metal lath



When removing loose stucco, cut around the damaged area down to the lath. Coats of old mortar should be cut back in square layers, as shown.

embedded in a wall that originally had wood lath. If you concur, be sure to wet the wood lath thoroughly with water containing a little photographer's wetting agent (such as Kodak Photo-Flo) before applying the new stucco.

Professional plasterers nail metal lath over old wood lath (so they *know* the stucco will stick) and get on with it. But *do not* use metal lath when patching lime stucco over a

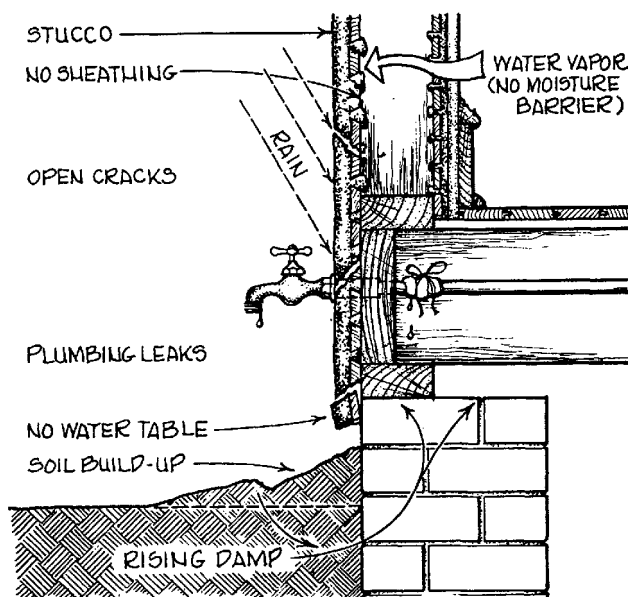
To test for mortar type, take a chip of the mortar in question, place it in a tightly sealed container of diluted muriatic acid, and shake it vigorously. If the mortar dissolves, it's lime; if it doesn't, it's portland cement.

masons used lime mortars well into the early 20th century.

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reasonable.

To determine the extent of damage, check for spongy areas by pushing against the stucco with your hand. Any areas that move back and forth while making a squishy sound will have to go. Then tap the stucco with a hammer handle, and listen for the



Sources of Water Damage

masonry base. Metal here causes more problems than it solves.

The old lime mortars, when deteriorated, simply fall off the building, exposing the masonry underneath. These bricks or stones can withstand weather reasonably well, and the wall can be patched whenever weather permits. But if you patch the wall with new mortar over metal lath, you've created two new problems: damage caused by the nails used to fasten the lath, and further deterioration of the masonry wall if water penetration recurs, because the patch will cling tightly enough to hold in the water.

Applying the Mortar

Application methods are similar for lime or portland-cement mortar. The following instructions apply to all stucco work:

- Keep the curing mortar out of the hot sun and away from harsh winds, as either of these conditions can cause new mortar to fail. If you must apply mortar on a very sunny or windy day, set up a lean-to or tarpaulin to provide some shelter for the mortar.

- Don't expose curing mortar to freezing temperatures.

- Crosshatch the scratch (first) coat of mortar to provide a good base (key) for the leveling (second) coat. Finish the leveling coat with a wood float that has a small nail driven through it (only the nail tip protrudes) to provide keys for the finish coat.

- Don't make more mortar than you (or your crew) can use in about one hour.

- Throw away partially set mortar. Do not try to apply partially set mortar to the wall.

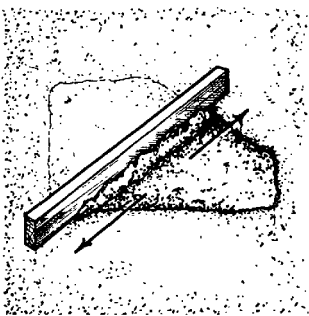
Trowel on the scratch coat of new mortar to the same depth as the scratch coat of old mortar. Use a screed (strip of wood) to straighten the mortar, and then crosshatch it. Keep the mortar damp (not wet) by misting it, and apply the second coat 18 to 24 hours later.

If your repair is three-coat work, you must repeat the above process for the leveling coat. When the base coats have cured, trowel on the finish coat and level it with a screed that rides on the old finish coat (as in the illustration).

If the stucco has a textured or colored finish or an exposed aggregate, consult your state historic-preservation office about matching the finish.

Mortar Formulas

Eye of newt, tongue of frog...lime, cement, sand and water. The recipes for mortar are as arcane as those for witches' brew, and it



Level the new finish coat with a screed that rides on the old finish coat.

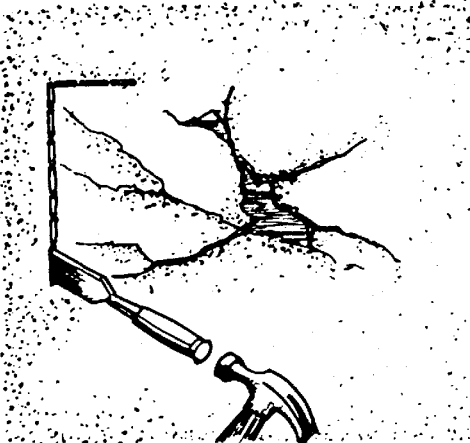
seems that every mason has a "secret" formula. The older the mortar, the more opinions there are on how to duplicate it.

The following mortar formulas can be used as starting points for duplicating typical stucco mortar, however:

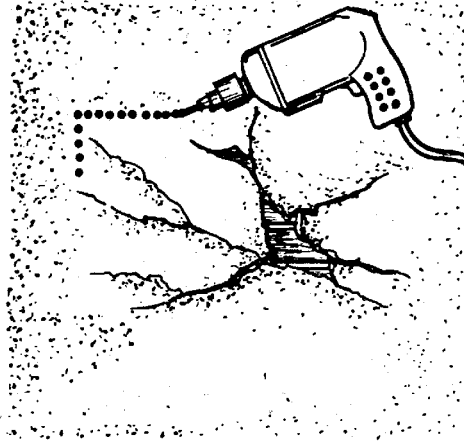
High-Lime Mortar:

- 1 bag of hydrated lime
- 1 shovelful of white portland cement
- 3 cubic feet of sand (matched to original)
- Coarse aggregate matched to original (not to exceed 15 percent of total volume of hydrated lime)

- Hair or fiber (for scratch coat) matched



Alternate methods for removing bad stucco: Cut through the stucco around the damaged portions with a chisel and hammer, or drill a series of holes with a masonry bit. In either case, strive for straight, clean cuts.



to original if possible; about one pound of hair per 100-pound bag of hydrated lime. (Hair should be clean and free from extraneous materials; cow hair is best and is available from the Brooklyn Animal Hair Manufacturing Co., 175-185 Beard St.,

Relatively more lime makes the mixture more "plastic," but it also will be more likely to crack because of shrinkage. Relatively more sand or aggregate makes the mixture harder to trowel smooth and weakens the mortar. Each grain of cement should be in

Relatively more lime makes the mixture more 'plastic,' but it also will be more likely to crack because of shrinkage. Relatively more sand or aggregate makes the mixture harder to trowel smooth and weakens the mortar. Each grain of cement should be in contact with a grain of sand.

Brooklyn, N.Y. 11231; phone 718/852-3592.)

Lime/Portland-Cement Mortar:

- 1 to 1½ bags of hydrated lime
- 1 bag of portland cement
- 5 to 6½ cubic feet of sand
- Coarse aggregate, hair and fiber as above.

The second mix is a good mortar to use in highly exposed areas such as parapet walls. This mortar may well have been used during the transitional period between soft lime and hard portland mortars.

contact with a grain of sand.

If the mortar was a 20th-century mortar high in portland cement, start with this formula:

- 1 bag of portland cement
- ½ bag of hydrated lime
- 6 cubic feet of sand
- Coarse aggregate, hair and fiber as above.

It is impossible to duplicate some old mortars precisely; some materials used in the past just aren't available today. (Just try to find unpolluted river sand, for example.) The

Portland Cement Association provides a service (for a fee) in which it will specify modern materials that will match an old mortar in color and density. For information, contact the Portland Cement Association, 5420 Old Orchard Rd., Skokie, Ill. 60077; phone 312/966-6200.

Mixing the Mortar

The process for hand-mixing all three mortars is essentially the same: Place half the sand required for one bag of cement in one end of the mortar box, spread the cement (portland or lime) over the sand, then lay the balance of the sand over the cement. Place the amount of coarse aggregate or hair required for a bag of cement over the top of the sand. Repeat as necessary until all the required material is in the box.

Next, with a hoe (a mortar hoe with two holes in the blade is best), start at one end of the box and pull the hoe toward you in short, choppy strokes until you've thoroughly mixed all the material.

Now pour the water into the box and pull the dry material into the water with short, choppy strokes. Make sure the hoe cuts to the bottom of the box. Continue to add water, but only as needed to bring the mix to a soft, plastic mass. Keep chopping with the hoe, moving further and further through the wet material.

Make your strokes progressively longer until all the dry material has been wetted and pulled to the end of the box. Then, to ensure



Points where roofs and walls meet are common problem spots. Cracks here may be one of the first signs of stucco damage to come.

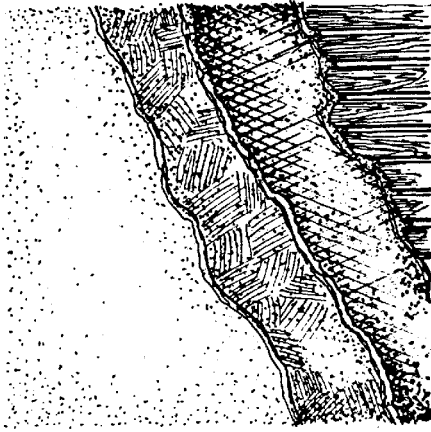
Mix the mortar with progressively longer strokes. When the materials have been thoroughly combined, the mortar color will be uniform.

a thorough mixing, change direction and pull the mortar to the opposite end of the box. When the materials have been thoroughly combined, the mortar color will be uniform. Don't overmix—this just hastens the set of the mortar.

Materials Specifications

The following specifications are taken from the *Preservation Brief 2* of the National Park Service:

- Lime should conform to ASTM C 207, Type S, hydrated lime for masonry purposes, or to federal specification SS-L-351B.
- Portland cement should conform to ASTM C 150, Type I or II, or to federal specification SS-C-192G(3).



Reading from left to right (that is, from the surface down): finish coat, leveling coat, scratch coat, wood lath.

- Sand should conform to ASTM C 144, or to federal specification SS-A-281B(1), paragraph 3.1.
- Water should be clean and free of deleterious amounts of acids, alkalies or organic materials. ■

Walter Jowers is a contributing editor to The Old-House Journal.