Plaster Perfect

Traditional lime plaster is a good candidate for restoration, if you have the know-how.

By Rory Brennan

When people began plastering, approximately 14,000 years ago, they knew then what we know now – a successful new plaster or repair project depends on an understanding of the materials and the science behind them.

When repairing a plaster surface, it is important to first drill holes, through which conditioner and adhesive will be injected into the void between the plaster and the lath. This mural, on the ceiling of a home in Leavenworth, KS, suffered water damage from a radiator leak.

Rory Brennan uses white plaster to the fill in the cracks and injection holes. A decorative painter will restore the mural after the plaster job is complete.

Know Your Materials

Lime, as a plaster material and mortar, has its roots in the Middle East; it can be traced back 140 centuries to northern Jordan. In the United States, historic plaster denotes lime plaster from pre-Colonial times to the early 1920s. Today, most plaster is still produced as it was historically – by heating either limestone or gypsum (or a combination of the two) at high temperatures.

Above 800 deg. Celsius, limestone loses carbon dioxide to form lime, which cures slowly with atmospheric carbon dioxide. Processing must be done in a manner that reduces the particle size and increases the surface area, allowing the lime to release water slowly as it brings in air to carbonate. Once carbonated, lime plaster is highly water resistant, which makes it useful for exterior applications. Mixed with sand and hair, it makes coarse plaster, which can be used as a basecoat; combined with fine sand, it creates a finish-coat plaster that can be polished to a mirror-like sheen. Lime is also very flexible (it is capable of bending over time as the crystals slide past each other), which allows installed plaster to move with a building, thereby eliminating the need for expansion joints.

The use of gypsum, on the other hand, can be traced back to the ancient Egyptians, who used it to plaster the Great Pyramid of Giza. At 150 to 200 deg. Celsius, gypsum loses most of its hydration to form Plaster of Paris. Gypsum cures when mixed with water; on contact, it begins to dissolve and separate into its component compounds. Once it is mixed with water, gypsum sets quickly and forms a crystalline structure. As the plaster is mixed, these crystals generate more and more crystals until the wet plaster is completely set. Left alone, an open bag of gypsum will set from ambient atmospheric humidity. Once gypsum plaster sets, it will not expand nor contract as all the crystals are locked together wherever they touch; as there can be no movement between the crystals without breakage, gypsum is inherently brittle.

Knowing these properties allows lime and gypsum to be blended in different ratios to perform different tasks, from running cornice and moldings to applying different finish coats.

Why Keep Old Plaster?

The fact that lime plaster cures slowly gives it the qualities – flexibility, water resistance and longevity – that make it a viable candidate for maintenance and repair. Lime sets over an extended period of time and is still young at 100 years. Properly cared for, it can last for thousands of years. There is no other plaster that can make that claim.

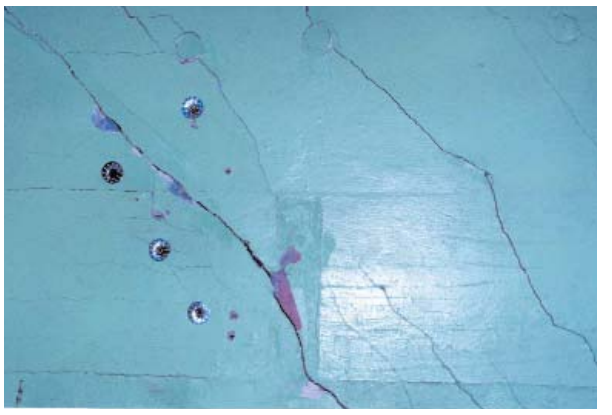
Old plaster cannot be replaced with a material as good or better, so it is generally best to salvage as much as possible. In terms of time, repairing plaster takes half the time it takes to replace it. The cost of preserving old plaster is also significantly lower than the cost of installing new plaster. With the former option, demolition costs, clean-up costs, disposal costs and landfill costs are eliminated. When time and money are considered in analyzing a plaster problem, the repair of traditional plaster is the soundest investment that can be made.

Stabilization

Repairing plaster begins with stabilization – if plaster is not stabilized, repairs will simply not last. Conversely, once plaster is stable, almost anything done to its surface will work.

In choosing a method to stabilize plaster, it is important to have an understanding of the techniques and materials used in the construction of historic buildings. A typical residence from the 18th or 19th century was built with a stone or brick foundation and a braced frame with studding to attach strips of wood lath, which were then covered with lime, cattle hair (not horse hair) and sand plaster. The one common factor in each of these building components is that they are all similarly flexible: masonry foundations expand and contract with moisture and temperature changes, while wooden-braced frames with attendant framing and laths expand and contract in concert with the foundation. Articulations where these systems meet allow movement between them.

There are two ways to stabilize plaster. The conventional approach – using washers and screws to compress plaster to laths – has a couple of issues that make it incompatible with repair. First, washers and screws often crush plaster to the lath, fracturing its structure. Second, screws and washers create a very hard, narrow point of attachment that doesn't move with the plaster or the building; when the plaster moves the washer around, it will break. The inevitable cracks that result from this method need to be bridged with a mesh to prevent them from showing. The cracks do not go away or come together; they are hidden under tape and joint compound. The mesh tape, screws and washers also need to be covered with multiple layers of joint compound and then sanded and/or sponged. Because the cracks will reopen under the mesh tape and the washers will show at some point, this type of repair is only short term.



Plaster repair begins with stabilization, but it must be done correctly to stand the test of time. In this case, the plaster wall was stabilized incorrectly – instead of using screws and washers, which often crush plaster to the lath and inhibit flexibility, the better method is to inject a flexible water-based adhesive.

The preferred method of stabilization is the injection of a specially designed water-based adhesive. The adhesive provides a dispersed area of attachment that is flexible and leaves nothing on the surface to cover. The flexibility of the adhesive allows the plaster to move as naturally as it did when it was first applied. After the adhesive sets, the injection holes and cracks are simply filled.

Repair and Restoration

When approaching a plaster-repair project, it is important to first identify the historic plaster so that it can be matched. Lime plaster can be identified by the presence of hair in the mix. If it's white with sand and hair, a little soft to the touch and seems old, it's most likely lime plaster. Different types of hair and plant fiber were used, depending on what materials were available; the hardness of old plaster depends on its age. These instructions should be followed to patch holes:

- **Patching materials:** Before applying new plaster, it is important to fix the problem that caused the