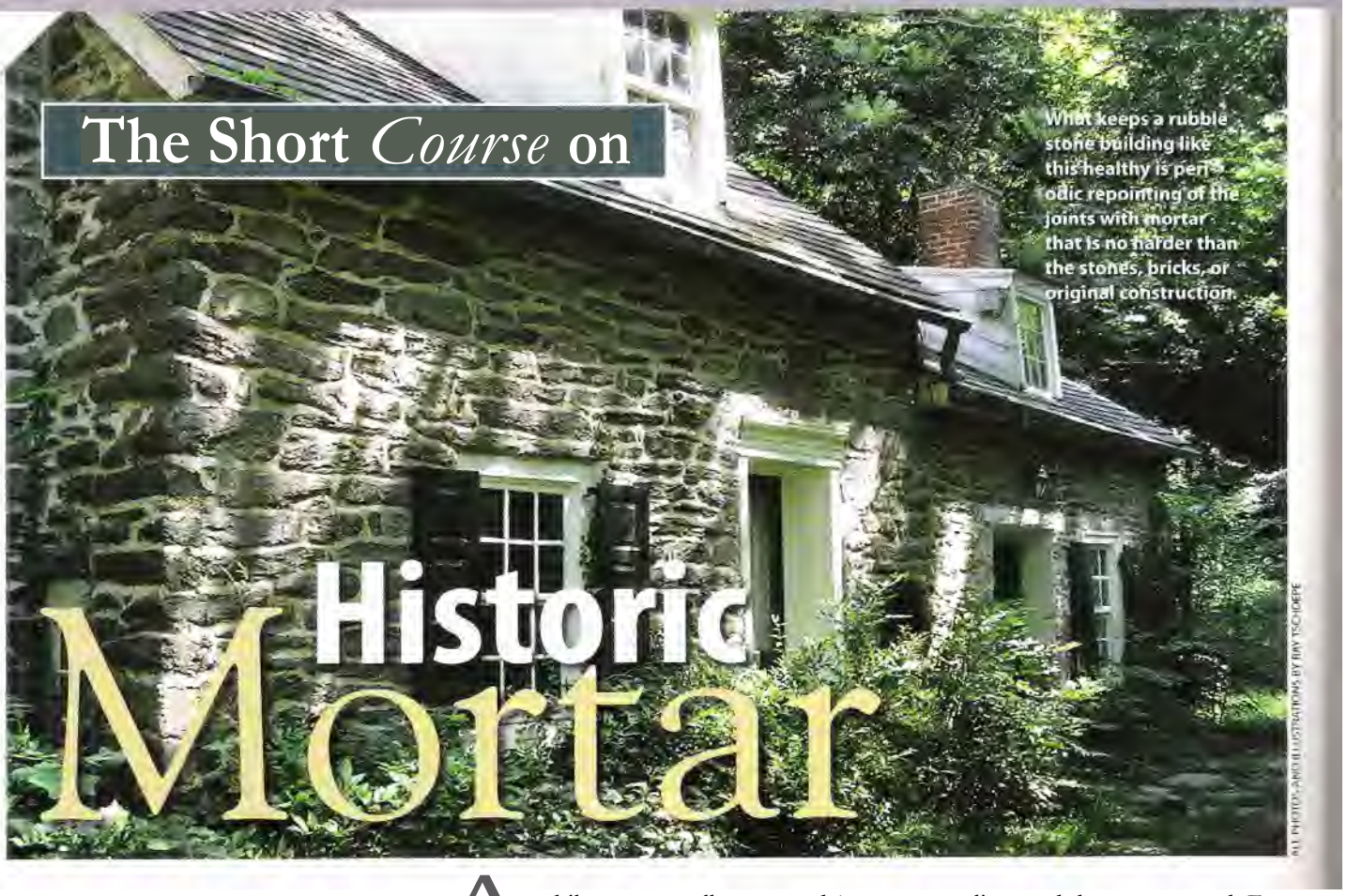


The Short *Course* on Historic Mortar

Though masonry mortars don't *look soft or* hard *to the naked eye, the difference has a big impact on the condition of old brick and stone.*

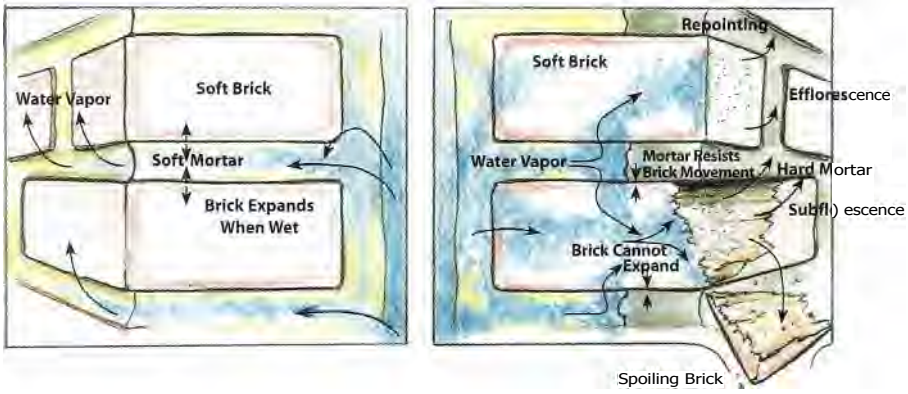
BY RAY TSCHOEPE

A **while** ago my colleagues and 1 were asked **to** repoint a stone A. -_ building whose final wing was added in the mid-19th century. Since the original construction dated to the late 18th century, it was important for us to understand the different materials and mortars the masons used before we could choose an appropriate mortar, ranging from soft to relatively hard.While the only problem associated with a soft mortar is the potential to require re-pointing often, using a mortar mix that is too hard can be quite harmful. When mortar is too hard, the bricks or stone become the sacrificial portion of the wall, particularly when movement within the masonry units exerts pressure on the mortar joints. Since this hard-soft issue is a common and confusing one in old houses, here are the basics on the subject and what you need to know to make some decisions if you face a similar project.

What Is Mortar?

In general, masonry mortars can be lime-based or Portland cement-based and, to confuse matters, some mortars may be combinations of the two. For centuries, masons relied on lime mortar derived from limestone in a mixture of approximately one part lime and three parts sand. For thousands of years, mortars also have been formulated from materials known as natural cements. These are limestone deposits containing certain clays and other "impurities" that allow them to harden underwater. Much of ancient Rome was built with these natural cements or Pozzolans (volcanic ash).

In 1756 Joseph Smeaton produced what was probably the first factory-made hydraulic lime by adding materials such as clays and ash during the lime-burning process to mimic natural cement. 1824 Joseph Aspdin patented a process for manufacturing a very hard hydraulic cement designed to answer the needs of the ever-growing building industry_ He called it Portland cement (after the source of a hard stone), and because this cement sets up much quicker and harder than straight lime mortar, to this day- it remains the staple of the building industry worldwide. Though lime mortar is slow **to** set, has only a fraction of the compressive strength of Portland cement, and require months to fully cure, this "softh-- often works in its favor, particularly used with historic brick and soft Masonry mortar must possess several _



When mortar is softer than bricks (left), water vapor will always take the path of least resistance and escape through the mortar joint. However, when mortar is harder than bricks (right) it can force water vapor to exit through the bricks or soft stones. Condensing water sometimes carries dry salts from the mortar that form a fluffy surface residue (efflorescence). If this rest due forms within the bricks (subflorescence), the pressure can spall the brick surface.

ties. Initially, it should aid in the laying up of a masonry wall by lubricating the final setting and leveling of each element. After curing or hardening, the mortar first needs to spread the weight of the building brick or stone over a wide area that is, not concentrate it on an irregularity or a high spot, but rather distribute it over the entire surface of the stone or brick below.

The results of too-hard mortar can be spalling of soft, pre-1860s brick (top) and some soft stones such as rubble fieldstones (bottom).

Mortar Mixes

Brick	Sand	Mix E.ime	Portland
Soft	3 10	1 3	0 (white)
Mid 19th Century (pressed)	9		1
Modern	6	1	1

Basic mortar mixes vary **the proportions of** lime to Portland cement based on **brick** age. When in doubt, err on the side of softness.

Second, it must make the building weather tight so wind-driven rain cannot invade the interior wall spaces. Third, it should readily pass water vapor, particularly from interior spaces, so that it is not forced into the brick or the stone. Fourth, it should be softer than the individual bricks or stones and should very slowly flex in response to settling or the expansion and contraction of porous building materials.

What to Use

How do you determine the best mortar for a building? A little preliminary investigation can go a long way toward answering a number of essential questions. Your primary concern should be to formulate a mortar that is compatible with the building material and achieves the visual appearance of the original.

First, try to determine the age of your building particularly if it is brick. Until the mid-19th century, bricks were produced by hand-packing molds sprinkled with sand or water, depending on the desired finish. When combined with small-scale firing, where bricks at the rear of the kiln often received insufficient heat to initiate the sintering process, this process tended to produce bricks that were quite soft. By the late 19th century, however, extruded, wire-cut bricks were replacing even the machine-packed and kiln-fired brick that dominated mid-19th-century construction. To be safe, it is reasonable to assume that if your house was constructed after 1890, it is very likely to have been built with relatively hard brick. If construction was completed before the 1860s, the brick is very likely a soft brick. Paralleling this period of brick production was the availability of hard Portland cement. First produced in the Lehigh Valley of Pennsylvania in 1871, Portland cement quickly began to supplement and later supplant lime mortars. From about 1880 to World War II, mortars were likely to contain both lime and Portland cement. By the second half of the 20th century, most bagged masonry cements contained Portland cement and sand with little or no lime.

Since stone is not manufactured but naturally occurring, it is far more difficult to judge whether a soft or hard mortar is appropriate. Generally, hard mortars are quite appropriate with hard stones such as granite. If you are unsure, however, its always best to err on the side of softer mortar. If you have a stone house, it's best to use the mortar that was either contemporary to the earliest construction phase, or sample the mortar for hardness. Rubble-wall houses laid up with a variety of stones should opt for a softer mortar since there are undoubtedly many soft stones among the field. If your house has been re-pointed several times over its lifetime, try to locate some of the original mortar. We find that this usually can be located in places that are difficult to access with a hammer and chisel, which past re-pointing efforts usually avoided. Look just under eaves or under the lower edge of rake boards or behind porch elements (porches were often added later). This holds true with bricks to an even greater degree. When in doubt, always use a softer mix (see the box "Mortar Mixes" at left).

If you are hiring a mason, ask him questions about the mix he is going to use and, more importantly, ask him why. Have him point a small area (perhaps a couple square feet) so you can evaluate the color match. With the information you have collected about your house, you should be in a good position to discuss the most appropriate formulation. Don't be afraid to insist on a softer mortar.

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