CONSERVATION TALK

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Are "Simple Epoxy Repairs" Really That Simple?

This month's column tackles the issue of what are sometimes called "simply epoxy repairs." This technique has been advocated by some AGS members as well as several publications (for example the *Canadian Landscape of Memories: A Guide for Conserving Historic Cemeteries* and the *Michigan Historic Cemeteries Preservation Guide*) as a routine method of repairing broken gravestones. It seems to be widely used, perhaps because it represents a simple solution to a complex problem. These repairs require the purchase of only epoxy and a few simple tools. In addition, the technique is seemingly easy, requiring relatively little skill. It involves using a thin bead (or sometimes dabs are suggested) of epoxy to rejoin broken headstones.

The only warnings I have found, either on-line or in written publications, address the obvious: dry-fit the stones, use care and avoid getting the epoxy on the stone. One source provides two possibilities for failure: the stone is not dry or the weather is too cold. Neither addresses issues such as moisture insensitive epoxies or ambient surface temperature limitations.

Unfortunately, as with all simple solutions, some problems have not been well addressed. The biggest problem may be that many repairs are performed poorly, with epoxy allowed to run down the face of the stone, creating permanent disfigurement. In addition, while most structural epoxies used in stone repair are "moisture insensitive," this does not mean that they can be used when the stone is wet or there is ponding water. Many technical data sheets provide guidance, such as "[surface] may be dry or damp, but free of standing water" (Sikadur 31). Some provide no guidance (Aboweld 55-22). Technical data sheets also usually provide information on temperature limitations. For example, Sikadur 31 advises that the minimum surface or ambient temperature is 40°F.

This photo shows a broken obelisk with a "simple," but very sloppy and unprofessional epoxy repair.

Here the handyman attempted to hide the epoxy repair by using paint to cover the excess epoxy. Of course the effort failed and the stone is even more significantly disfigured.

Another critical consideration is matching the thermal expansion and contraction of the epoxy and stone. Internal stresses occur because of the differences in the thermal expansion of the substrate (the stone) and the epoxy. These stresses can degrade joint strength and cause premature failure. For example, the coefficient of thermal expansion for marble is 8-12x10-6 m/m/K. For slate, 5-12 x10-6. Most epoxies have a coefficient of thermal expansion of around 55x10-6—very different from most stones.

In addition, the components of two-part epoxies react stoichiometrically (a fancy way to say that it is a balanced chemical reaction), so maintaining proper mix ratio is essential to ensure consistent performance. This can be difficult in a field situation and may introduce yet another factor in the success of the treatment.

An epoxy glue joint creates an impervious barrier that prevents the free movement of moisture in the stone. A barrier close to the ground (as many are) may cause additional freeze-thaw damage as well as a reservoir of soluble salts that have migrated into the stone from the surrounding soil.

But more important than all of these issues is the condition of the stone itself. In most cemeteries we aren't repairing a stone just delivered from the quarry. Often the stone has been in the cemetery for decades and exhibits weathering and other deterioration. Marbles, for example, are often sugaring (granular de-cohesion associated with atmospheric weathering) and undergoing significant strength loss.

With these issues in mind, it shouldn't surprise us that so many "simple epoxy repairs" fail. Hardly a cemetery I visit does not contain one or more failures. All

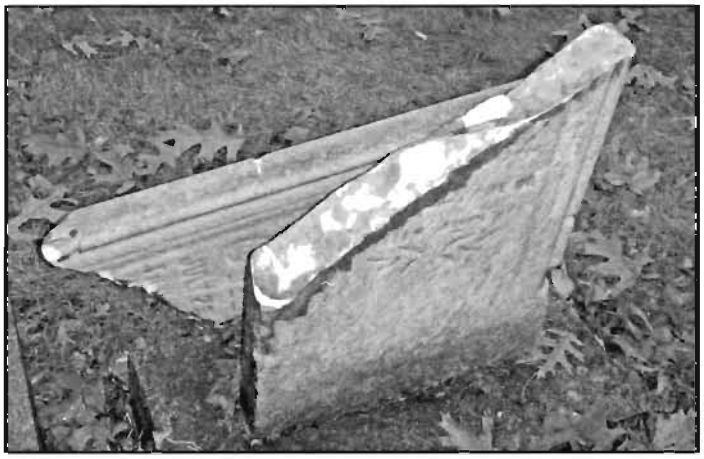
reveal that the stone (not the epoxy glue joint) failed, typically a few millimeters above or below (often both) the old repair. And some of the repairs have been documented as being less than a year old. The mechanism of the failure is pretty simple, especially for what I call ground breaks—where the stone is broken close to the soil line. The repair was unable to support the top-heavy repair.

We can hope that the failure will be slow and little or no new damage will be done to the stone as it falls, but this is often not the case. Certainly loss of fabric along the joint line makes subsequent repairs more costly because the old adhesive must be mechanically removed and additional infill used to repair the resulting "poorer" fit. Sometimes the stone suffers additional damage if it falls or damages surrounding stones. It may also present a hazard to the public.

Those interested in preserving cemeteries would probably do well to think twice before attempting their own repairs, however well meaning and regardless of the approach. The "simple epoxy repair" is particularly prone to failure (at least when used with marbles and similar stones) and probably ought to be avoided in most circumstances.

Of course, epoxy can be used successfully. For example, it tends to be widely used for the repair of slate stones (which exhibit different physical properties). Epoxy may also be used when the repair is not structural. For example, replacement of a small fragment bearing little or no weight. But these specific situations don't apply to the majority of repairs that I see.

It is important that we not use repair techniques simply because they are easy, undemanding, cheap or they are all we know how to do. When we repair a stone for future generations, our efforts, like those of a physician, must do no harm. Put simply, there is no such thing as a "simple" repair and anyone who tries to say differently is kidding you—or themselves. ♦



This is a type failed "simple epoxy repair." Notice that the break follows the original repair, except for about 2-inches of new break. Notice also the epoxy smeared on the face of the stone.

This stone with a simple epoxy repair failed within months of the repair.

Another failed "simple epoxy repair."

No matter how much epoxy is used, repairs like this are doomed to failure–and can often result in additional damage to the stone as the epoxy joint fails.