RELINING Old Chimneys

by Bob Priesing

Using an inflatable form and poured cementitious liner restores old chimneys to better than new

As a sweep and masonry chimney relining contractor in eastern North Carolina, I'm constantly amazed at the misconceptions people have about older chimneys. Many people imagine that they're impervious masonry structures that don't require any maintenance and never wear out, while others are convinced that the only way to "restore" an aging chimney is to tear it down and build a new one.

Both are wrong. Chimneys definitely wear over time, but even a badly deteriorated chimney can often be completely restored by adding a poured liner. In most cases, the result will be better than new — combining the original appearance with modern standards of safety, efficiency, and structural strength.

Limitations of Older Chimneys

Chimneys built before the early 1900s seldom have tile liners, and many of the clay liners found in newer chimneys are badly broken up from the intense heat of past chimney fires (see Figure 1). In both cases, the interior brick and mortar are exposed to the residue of combustion gases, which mixes with rainwater to form acidic compounds that gradually eat away at the mortar joints. Not only does this weaken the chimney structurally, but the eroded joints also allow more heat to escape the chimney and threaten surrounding combustibles.

To make matters worse, old-time builders often left framing in direct contact with the masonry, while most current codes require a 1-inch to 2-inch clearance to combustibles. Over the years of exposure to heat, the wood dries out and its ignition temperature is lowered through a chemical process called pyrolysis. This can eventually allow the wood to ignite even under fairly normal operating conditions.

Because such points of contact between the masonry and the framing are often concealed between floors and within walls, they can be difficult to find and correct. In most cases, it's more practical to install an approved "zero clearance" liner system that allows for contact between the chimney and combustibles such as framing. The insulating value of this sort of liner also helps keep the flue itself warm, greatly improving the draft.

Figure 1. A badly damaged tile flue liner like this one — which shows the effects of repeated chimney fires — leaves the brick and mortar beneath exposed to rain and to the acidic byproducts of combustion.

Chimney Relining Systems

In general, there are two types of cast-in-place liners. In one system, a zero-slump mix is poured around an electrically powered vibrating bell, which is raised by a winch at the top of the chimney to form a smooth flue. The operator controls the position of the flue by adjusting the placement of the mix. Pouring additional mix on one side of the bell, for example, will cause it to move sideways in the other direction. The stiff flue-liner mix used with this system exerts a minimum of hydraulic pressure on the sides of the chimney, which makes it possible to gain height relatively quickly.

On the other hand, this method is labor intensive because all of the mix has to be carried to the rooftop in buckets. That's not a problem with a small single-flue chimney, but for larger multi-flue jobs — which may take 100 cubic feet of mix or more — that's just not practical.

The other approach uses tubular inflatable formers that are centered in the chimney before a more fluid flue-liner mix is pumped into place around them (Figure 2, next page). The formers are vibrated as the mix is poured, causing the mix to fill voids and gaps in the masonry. Once the mix has set up, the formers are deflated and withdrawn. The smooth-surfaced round flues that result are much more efficient than the typical square or rectangular tile-lined flue.

This is the method we use, because it's the best option for the large, multi-

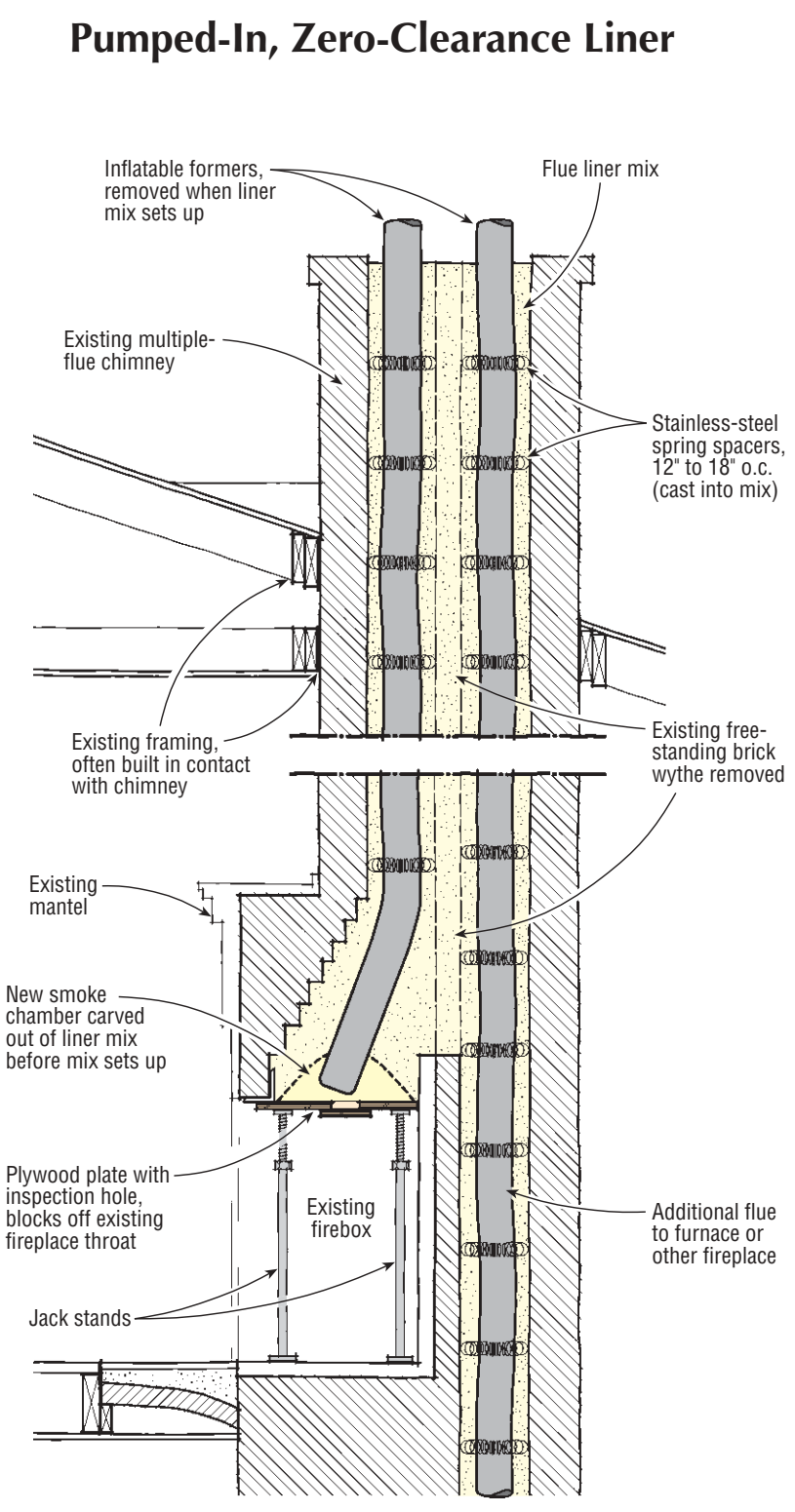

Figure 2. Relining a chimney with inflatable formers and pumped liner mix is a cost-effective way to provide safe, properly sized flues for existing fireplaces, wood- or coal-burning stoves, and oil or gas appliances. The poured liners are rated for direct contact with combustibles, eliminating the need for costly framing modifications.

flue chimneys common in our area. The system I use is called Golden Flue, which is based in Rutherford, Va. (800/446-5354, www.chimneys.com/goldenflue). I like this system because the company is based relatively close to my area, which simplifies getting technical and logistical support, and because I feel that the mix-pumping system is better than others I have looked at.

Setting Up

Safety is a key consideration in our chimney restoration projects. We've learned that taking a little extra time during setup to provide solid scaffolding and good access allows us to work in a more relaxed manner, helping us to concentrate on the tasks at hand. During the restoration process, a lot of effort goes into gaining safe access to roofs and chimney tops. We try not to nail anything into the roof itself; instead, we hang the majority of our scaffolding from ridges and peaks using systems like the Ultimate Ridge Hooks (Deer Hill Enterprises, 800/588-9660) and Vanguard Chimney Brackets (Lynn Ladder & Scaffolding, 800/225-2510). If necessary, we will build up beams to span valleys, anchor them to lumber or ladders hung from ridge hooks, and bolt our scaffolding to the beams (Figure 3, next page).

Dust control. Most of our projects take place in occupied houses, so we also take care to protect both the house and its contents with well-placed runners and drop cloths. To control dust, we screen off our work areas with poly Zip Walls (800/718-2255, www.zipwall.com) and use powerful dust-collection vacuums while doing demolition or other dusty work. We've had very good results with the August West Sootsweeper II (available from Copperfield Chimney Supply, 800/247-3305, www.copperfield.com), which is a high-powered vacuum manufactured for chimney sweeps. Although it isn't listed as a HEPA system, the manufacturer claims that it will filter out particles as small as .5

Figure 3. Solid, well-thought-out scaffolding provides a sense of security as well as a safe place to work. The chimney has been wrapped with plastic stretch wrap to help it resist the pressure of the fluid mortar that will be pumped around the inflatable formers.

Figure 4. Tyvek coveralls and full-face respirators protect workers from potentially carcinogenic dust.

microns and move 350 cfm. We use it by putting the hose inside the fireplace so it sucks up the dust laden air before it has a chance to spread. To reduce indoor noise, as well as to prevent any dust particles that may make it past the filter from being exhausted in the house, we keep the vacuum itself outdoors whenever possible, running a 3-inch or larger flexible hose to the work area. To protect ourselves during chimney sweeping and demolition, we wear full-face respirators and disposable coveralls (Figure 4).

Demolition and Temporary Reinforcing

Many of the older, unlined chimneys in our area were built in the early 1900s and are separated into multiple flues with freestanding brick wythes that aren't keyed into the chimney walls in any way. Weathering and erosion of the mortar leave them very unstable. Homeowners often realize they have a problem when they start finding loose bricks from a collapsing wythe in their fireplaces. These deteriorated wythes must be removed before any liners can be installed.

Take it from the top. We remove as much of the wythes as we can from above. This is easy at first, because the topmost courses can be reached by hand. Once we get beyond arm's length, we use a variety of hand tools that can be mounted on bull-float handles. We also use the Chamber Chipper tool from Golden Manufacturing (800/446-5354, www.chimneys.com/goldenflue), which is an inline air hammer mounted on a shaft of 3/4-inch galvanized pipe. The piston is lowered into the chimney, and the control stays at the top (see photo, page 83). The chipper can be extended as long as 40 feet, although we find it difficult to control when it's asked to reach beyond 20 feet or so.

The deteriorated bricks that are chipped loose simply fall to the bottom of the chimney into the fireplace firebox, which is padded with plywood, temporarily closed at the front, and fitted with a vacuum hose to control dust (Figure 5, next page).

In a two- or three-story house, it can be difficult to get all the way from the roof to the ground floor. If the firebox in an upstairs chimney is deteriorated, we'll often remove it and work our way down through the fireplace opening. When the demolition phase is done, we build a solid new firebox.

Ho, ho, ho. If the chimney is large

Figure 5. A plywood covering over the front of the fireplace contains broken masonry that falls from the chimney during demolition, and an efficient vacuum filters out dust before it can infiltrate the living space (above). The accumulated brick and mortar fragments are removed once the demo phase is complete (right).

Figure 6. If the size of the chimney permits, a worker can climb into it from above to dislodge deteriorated wythes, providing the space needed for the new poured liner (above). A metal fire escape ladder fastened to the rooftop scaffolding provides safe and convenient access (left). Openings in the chimney wall, like the unused stovepipe thimble visible in the photo at left, must be bricked up before the liner is poured, or a disastrous blowout can result.

enough, it's often easiest to climb into the chimney from the rooftop by extending the scaffolding out over the chimney and then hanging a steel fire escape ladder from it (Figure 6). Workers entering the chimney wear respirators, hard hats, and safety harnesses. A vacuum in the fireplace below pulls fresh air down the chimney around the worker and removes dust to allow better visibility.

During this part of the job, we also keep an eye out for hidden openings in the chimney. Occasionally, for example, we'll find an old stovepipe thimble that was never bricked up but got covered with wallpaper. Such problem areas have to be repaired before the liner mix is poured, or it will blow out into wall cavities or living spaces.

Strapping and wrapping. During the

Figure 7. The freshly poured liner mix exerts considerable pressure on the surrounding brick, so tender old masonry is compressively reinforced with plywood and ratcheting cargo straps. Plywood and straps will be removed once the new poured liner has set up.

pour, the chimney is subject to a great deal of hydraulic pressure from the wet liner mix. Unless that's taken into account, the result can be a disastrous blowout. Because the upper portion of a chimney is exposed to the weather, it's often much weaker than the lower portion. We frequently tear deteriorated old chimneys down to the roofline and rebuild them in the original style. Where weakened sections are accessible from inside the house, we reinforce them with sheets of plywood cut to the dimensions of the chimney and secured with ratcheting cargo straps (Figure 7).

Another method we often use is to wrap the chimney with several layers of stretch-wrap film — the same material used for securing material to shipping pallets. We buy this from a safety products supplier in 18-inch-wide rolls. When tightly wound

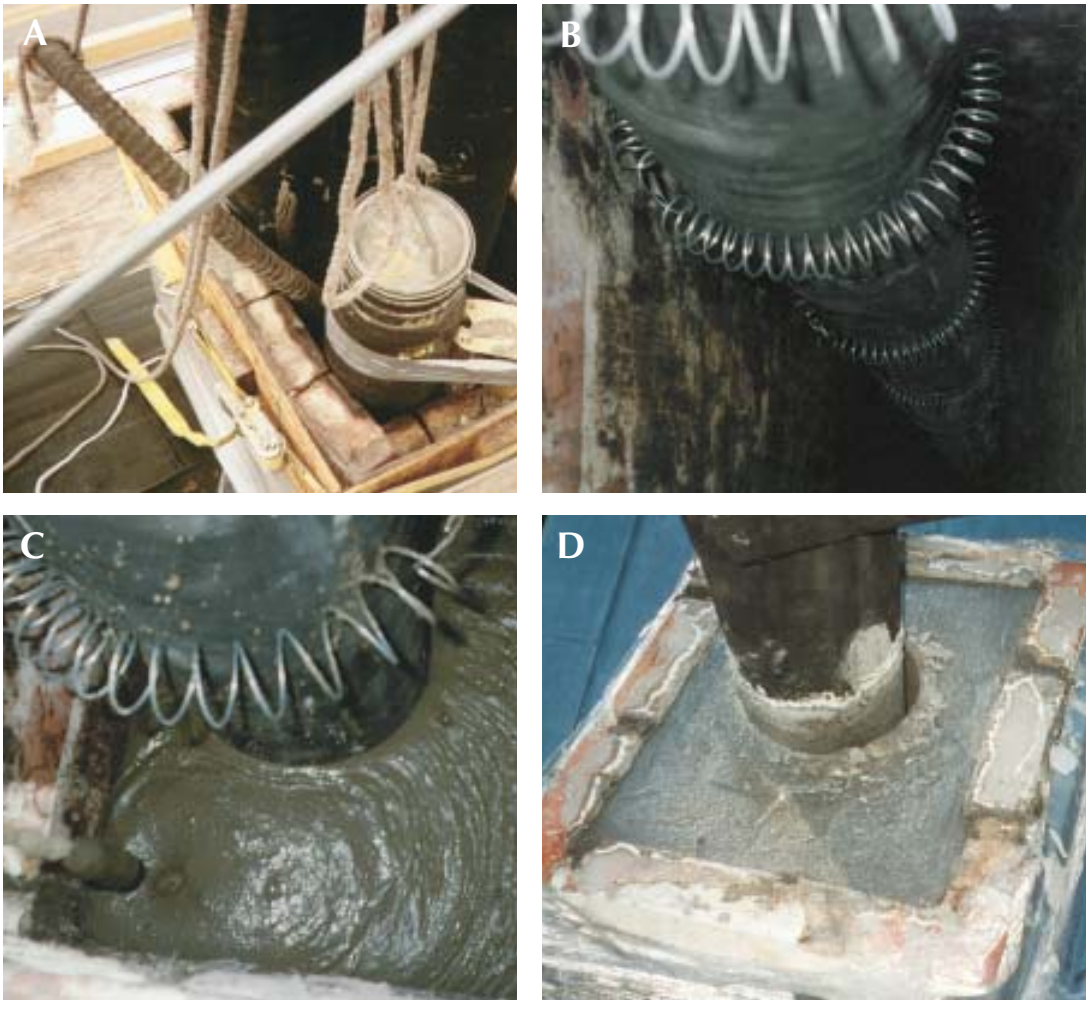

Figure 8. Once the inflatable flue formers have been inserted and properly positioned, liner mix will be carefully pumped into the chimney through the corrugated hose visible at right (A). Stainless-steel spring spacers wrapped around the flue formers prevent the formers from shifting as the flue mix is pumped between and around them (B and C). After the mix has set up overnight, the formers are deflated and withdrawn, leaving one or more smooth new flues (D).

around the chimney, it provides enough compression to resist the outward pressure of the wet liner mix.

Placing the Formers

Our cast-liner system uses inflatable formers, which are inserted into the top of the chimney and inflated (Figure 8, page 6). To maintain the necessary spacing between adjacent flue formers and the chimney brick, stainless-steel spring spacers are wrapped around the formers every 12 to 18 inches. These springs come in a variety of diameters; the diameter of the spring determines how thick the walls of the liner will be.

After the mix has been pumped in and has hardened around them, the formers are deflated and withdrawn, leaving the flues behind. The springs are cast into the mix and become a permanent part of the relined chimney. This system is designed and listed for zero clearance to combustibles around the chimney with a 1-inch-thick liner.

When forming a fireplace flue, the bottom of the chimney in the fireplace opening is blocked off with a plywood plate (Figure 9). A small inspection hole in this block-off plate is covered by a smaller scrap of plywood, which is screwed into place. At this point, we're ready for the mix.

Pumping the Flue Mix

Our pump equipment is set up in an enclosed trailer equipped with a drop-down tailgate ramp. The outer end of the ramp is supported by jack stands to create a level platform for a small mortar mixer. The pump sits on the ground in front of the platform, making it easy to pour the wet mix directly into the attached hopper (Figure 10). The pump, which is powered by a gasoline engine, is strong enough to pump the mix through 180 feet of hose and up several stories.

We like to have three people on site while pouring. One runs the mixer and pump, while another tends the hose at the chimney. The third — usually me — moves around the house watching for leaks and other problems. Throughout the pour, the three of us stay in communication with walkie-talkies. This is a crucial part of the job, and I always warn the customer that I won't be able to talk with them while it's going on.

One bag of mix yields 2 cubic feet of material, and our jobs vary from less than 10 bags to as many as 90 bags. We take our time during the pour, sometimes pumping as little as one 60-pound bag of mix before stopping for a while to allow it to partially set up. According to Golden Flue, the initial pressure on the chimney diminishes by

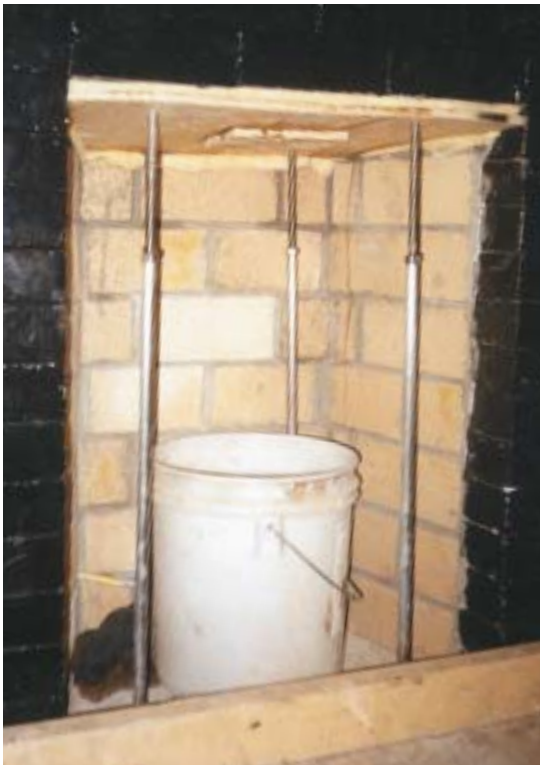

Figure 9. During the pour, the fireplace throat is blocked with a fitted plywood plate. Minor gaps between plywood and masonry are sealed with expanding urethane foam. The simple jack stands used to secure the block-off plate are fashioned from 5/8-inch conduit, threaded rod, and heavy machine nuts.

Figure 10. The proprietary flue mix is poured from a small mortar mixer into the hopper of the engine-powered pump that forces it to the rooftop. Workers on the roof and indoors remain in contact with the pump operator by walkie-talkie; if necessary, the pump can be reversed to suction the mix back into the hopper.

Figure 11. Once the temporary throat plate has been removed, the partially cured mass of material above the firebox is carefully carved away to expose the lower end of the flue former, creating a smooth, tapered smoke chamber.

half in the 20 minutes after the pour.

It's important to know the level of the mortar throughout the pour. We can move fairly quickly if we know we're pumping into a section of the chimney that's been strongly reinforced, but we slow down in weaker areas. Unlike some other relining systems, Golden Flue uses a reversible pump, which allows you to suction the mix back into the hopper at any sign of trouble.

Carving the Smoke Chamber

Three hours after the pour has begun, we unscrew the inspection-hole cover in the fireplace block-off plate and check the consistency of the mix. If it's firm enough to work with, we remove the jack stands and plywood plate and carefully begin carving a new smoke chamber into the mass of solidified mortar above. (In a small chimney, the pumping may be complete at this point, but in a larger one — especially a tender old chimney that has to be filled slowly and carefully — the rest of the crew may still be pumping flue mix into the upper part of the chimney while this step is going on.)

The objective is to create a smooth, tapered smoke chamber that will add to the performance and efficiency of the chimney. Using a small shovel and an assortment of trowels, we carve the solidified flue mix into an upside-down funnel shape. When the end of the inflatable former becomes exposed, we work carefully around it so the new flue will exit from the center of the "funnel" (Figure 11). For best performance, the smoke chamber walls should slope upward at no more than 45 degrees and the overall height of the completed smoke chamber should be no greater than the width of the fireplace.

Finishing Up

Once the entire chimney is filled, the mix is allowed to set up overnight. After deflating and removing the formers, we install one or more Lock-Top top-mounted dampers (Safe at Home Products, 800/334-2154, www.locktopdampers.com) to prevent indoor air from flowing up the new flues (Figure 12). These provide a much better seal than traditional throat-mounted fireplace dampers, and because they're operated by a cable routed through the flue to a handle in the fireplace, they're also easier to use. We usually cover the exposed top surface of the liner with a surface-bonding cement to provide a waterproof surface; in some cases, we also pour a complete new concrete crown.

When we are done, the fireplace is suitable for wood, coal, or gas. Although the flue is smaller than the original, it provides a better draft because it stays warmer than the original and has a smoother surface.

Figure 12. Each flue in the rebuilt chimney top has its own cable-operated damper, which is more efficient and easier to use than a traditional throat-mounted fireplace damper.

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