Rebuilding a Chimney Top

by Mike DeBlasio

Stainless anchors and pressure-injected grout form a strong bond with the original masonry

Back in 2006, I took on an unusual chimney-repair job in Chestnut Hill, a well-to-do urban neighborhood on the outskirts of Boston. When I first met with the new owner, he called the 1929 brick home's four decoratively corbeled chimneys its "crown jewels." Certainly, viewed from the ground, they were impressive. The two largest measured 9 feet by 3 feet 6 inches in plan and towered 22 feet above the roof line. The two smaller ones were 4 feet square and stood 14 feet above the roof.

Inspection and Demolition

I was hired to inspect the chimneys for structural integrity and conduct any necessary repairs. Indoors, the fireplaces showed significant deterioration. Firebrick hadn't been used to build the fireboxes, and water had infiltrated all the way down each chimney, carrying leached salts that had crystallized and expanded within the bricks, basically breaking them apart from the inside out. In addition, the dampers had been installed too low and too far back from the tops of the fireboxes, and the smoke chambers were badly constructed. The flue paths weren't directly vertical in any chimney, and the poorly built offsets had compromised proper drafting. Sooty ceilings inside the home proved that case.

It was a good bet that conditions were no better above the roof, especially since the steep slope of the slate roof and the massive height of the chimneys made them virtually inaccessible to routine

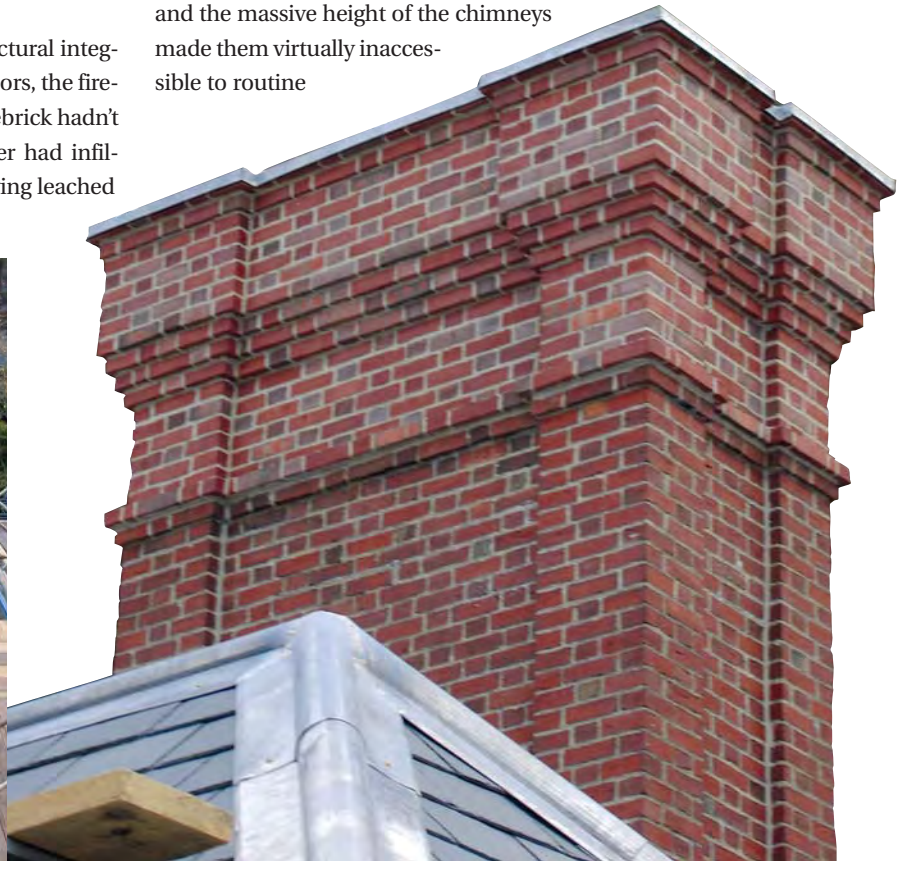

Figure 1. Vertical cracks indicate a chimney in trouble. A combination of water infiltration and unrelieved thermal expansion of the flues caused the failure (far left). The view down the flue shows cracking and water seeping in (left).

Figure 2. Plywood templates and photography will provide a visual record of the original corbeling when the chimneys are rebuilt.

inspection or maintenance. To create a safe working platform, we completely covered the roof with scaffolding — another story in itself, not covered here.

We found serious problems with all the chimneys, all due to faulty construction (**see Figure 1**). The corbeled tops required complete rebuilding. Vertical cracks had opened between the corner "pilasters" and recessed faces on the biggest chimneys; similar vertical cracks ran the full height of the two smaller chimneys. Set back 1½ inches, the recessed faces had not been properly bonded in interlocking sequence with the corners. Instead, the builders made continuous vertical joints, creating serious weaknesses. Furthermore, the space that should have existed between the clay flue liners and the brick was solidly filled, eliminating the conventional allowance for flue expansion.

We ran a small video inspection camera down the flues and found them crazed with stress cracks. The mortar had eroded out of the abutting joints, a fire hazard for sure. We even found flue tiles with corners broken due to rough handling during construction, the gaps crudely patched with mortar. Those tiles should never have been used. Making matters worse, the flues were all undersized: Some were as much as 30 percent smaller than necessary for proper drafting.

In short, the chimney tops had to be rebuilt and the flue tile replaced; the vertical cracks had to be repaired and reinforced; and the fireboxes needed rebuilding. Quite a list of urgently needed repairs — and none of them simple.

To begin we tore out the crumbling fireboxes, controlling the clouds of demolition dust with a powerful

Figure 3. Reinforcing anchors presoak before installation in the masonry. The anchors — hollow, perforated stainless steel tubes in a fabric sock — come in a variety of sizes; the ones shown are 1/2 inch in diameter and 22 inches long.

exhaust fan at the top of the chimney. Next we tackled the chimneys — but not before tracing the corbels' profiles onto pieces of plywood and taking photos, so that later we could rebuild them according to their original design (**Figure 2, page 2**). Then we tore down the top 4-plus feet of each stack, using small rotary hammers to remove the brick below the corbeling.

At this level, the quality of the original construction was sufficient to rebuild upon — but not without reinforcement to ensure strong structural chimney corners.

Retrofit Anchors

We relied on a proprietary system called the Cintec Anchor (Cintec, 800/363-6066, www.cintec.com). The anchor is a perforated stainless-steel tube encased in a fabric sock (**Figure 3**); it comes in various lengths and diameters depending on the application. When inserted into a cored hole in the masonry and pressure-injected with a fluid grout, it creates an extremely strong mechanical bond across the bricks. The sock prevents the grout from entering any deep fissures that intersect the coring. The anchors we used were 1/2 inch in diameter and 22 inches long, and cost $7 apiece.

Diamond Coring

To guide the 3/4-inch-diameter coring bit at the chimney corners, I devised a jig of threaded steel pipe fittings and lumber (**Figure 4**). After bottoming out with a short bit, we removed the jig and let the hole itself guide a longer bit, coring to a finished depth of

Figure 4. A short 3/4-inch diamond coring bit, guided by a site-made jig, makes the initial hole for the anchors (top). A long-shank coring bit (above) completes the 26-inch-deep holes, providing sufficient depth for the anchors and a finishing masonry core plug.

Figure 5. The anchor, fitted with its proprietary mastic injection nozzle, is gently inserted into the cored hole. Grout is pressure-injected until the "grout milk" stops flowing from the site (top). The grout is delivered from a conventional pressure pot at a relatively low psi (above left). The author saved coring plugs to protect and disguise the anchor holes after grouting (above right).

26 inches. We cored holes across the pilaster corners at 3 feet on-center vertically, offsetting them 8 inches from adjacent sides. In preparation for the anchors, we blew each hole clean with pressurized air.

Grouting

Cintec grout comes in 56-pound bags and is added to about 1¼ gallons of clean cold water. After it's mixed thoroughly with an electric paddle, you let it stand for about five minutes, while it thickens a bit. Then you mix in just enough water to bring it to a smooth, creamy texture, ready for the pressure pot and injection. The pressure pot is identical to that used for airless spraying, except that the outlet must be modified to accept a ½-inch hose adapter and up to 12 feet of reinforced hose equipped with a quarter-turn ball valve. A special mastic nozzle is provided, which you trim to fit the anchor's injection tube.

With the grout in the pot and the pot pressurized to about 30 psi, we checked the flow for continuity and sufficient pressure. To install an anchor, you fit the nozzle on the anchor, insert it in the bore hole — taking care not to tear the sock — and pump in the grout until the "grout milk" stops flowing out of the hole. Rotating the anchor during filling ensures that it's centered in the bore. We recessed the anchors about 4 inches from the surface and plugged the bore holes with a length of the cored material (**Figure 5**).

At the top level — the point to which we'd demolished the chimney — there was no practical way to introduce anchors close to the surface. Instead, we cored down vertically, about 6 inches, at every corner (**Figure 6, page 5**) and grouted in custom-bent stainless-steel straps to create a strong mechanical connection between the corners and the inset face brick.

Rebuilding the Chimney Tops

Following the profiles of the plywood templates we'd made before demolition, we rebuilt the chimney corbels. This time, we took care to use an interlocking layup at all corners (**Figure 7, page 6**). We used concrete partition block to build the chimney core. Corrugated stainless brick ties inserted at each course provided mechanical reinforcement between the core and the brick facing. No ties had been used in the original work, another reason for its failure.

To prevent future erosion, we installed custom-

formed lead-coated copper over the new concrete caps.

It's also worth noting that the Stiles and Hart Brick Co. (800/320-8700, www.stilesandhart.com) in Bridgewater, Mass., took great pains in working with us to custom-make new bricks that matched the originals. These were oversized and without frogs (indentations on one side). The result was a seamless union between the old and new work. Custom bricks may sound like an expensive option, but in fact the difference was only 20 cents per brick — about $1 each for the custom variety compared with 80 cents apiece for stock.

Flues and Fireboxes

Before rebuilding the fireboxes, we had to reline the flues. This part of the job requires specialized equipment and materials, so we subbed it out to a contractor — Bergquist Masonry of Temple, N.H. — certified in the Ahrens two-part flue relining system (Ahrens Chimney Technique, www.ahrenschimney.com).

Figure 6. At the top of the completed tear-down level, the author cores down vertically to install stainless-steel reinforcing straps. A wet vacuum prevents the slurry from staining the roof slates below (top left). The straps are site-bent, with 4-inch drop legs, to suit each location (top right). The strap holes are grouted in, while the straps themselves are embedded in the following course of mortar and brick (above).

Basically, the method involves breaking out the existing ceramic flue tile from the inside by smashing it with a heavy steel plate spinning at the end of an extendable drill shaft. Smashing is effective as long as there's a gap between the flue and the brick; solidly

bonded tile is chipped away with an air hammer fitted with a chisel on a long shaft. The work is done from the top down. To remove the tile in flue offsets, side openings are created.

Once the old tile is out of the way, relining begins. First, a self-centering, cylindrical "bell" is drawn up the chimney's interior through a proprietary masonry mix introduced from above (**Figure 8**). The bell forces the mix against the surrounding brick, forming a round (or oval) flue while filling and sealing all voids and fissures along the way. The mix's recognized insulating value is equal to 5 inches of brick per 1½ inches of mix. Insulation minimizes creosote condensation and flue expansion and contraction, and allows zero-clearance contact between the chimney and combustible framing. (In older construction, the framing is often found to be hard up against the bricks.)

Figure 7. The author uses stainless-steel corrugated wall-ties (about $1 each) and a layup that ensures staggered bonding between bricks. The original work omitted both of these reinforcing precautions.

Figure 8. The Ahrens chimney relining process involves drawing a bell-shaped flue-forming device up through a masonry mix that's added by the bucketful-from above. An offset wheel, visible at the end of the 2-inch-pipe, keeps the bell centered in the chase.

Next, a thin lining coat is applied to seal the surface against moisture and the acid produced by combustion gases. The final result is a properly sized crack-free flue with good flow and sufficient insulating qualities to control expansion stresses.

Smooth Smoke Chamber

The smoke chamber is that transitional area between the firebox and the flue, typically formed by corbeled masonry. When damaged or improperly built, it can be a major source of house fires.

The smoke chamber must be properly sized and its inner surface parged smooth with insulating refractory mortar. (It's rare to find any parging of the smoke chamber in older work.) With the forward-sloping back walls of the fireboxes and the dampers removed, we could stand inside the chambers and take care of this critical job. We used another Ahrens product, Chamber-Tech (www.ahrenfire.com), a lining mix that sticks to just about anything. We made a ball of it in our hands, slapped it on the brick, and troweled it dead-smooth, rounding the corners and tapering the chamber to transition to the new flue liner above.

To complete the work, we rebuilt the fireboxes and installed new dampers. Although the flues and chambers were now properly sized, the owner wanted a fail-safe system. So at the top of each chimney we installed Exhausto fans (800/255-2923, www.chimneyfans.com), which cost about $1,000 each, draw 3 to 4 amps in operation, and ensure perfect drafting.

With repair costs in the low six figures, these chimneys aren't called the crown jewels for nothing. Nonetheless, they're now better than new and will last a long, long time.

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