Chimneys and Moisture

by John Leeke

In past centuries chimneys were used every day for cooking and heating. The constant heat kept the chimney warm and dry, even though the top of the flue opened directly to the sky. I suspect chimney leaks were more acceptable back then, but now, owners expect their chimneys to be completely waterproof. Finding the cause of moisture problems can take as much effort as fixing them. Here's the process I went through when I fixed two chimneys with different kinds of moisture problems.

Moisture From Within

Fort Western, in Augusta, Maine, is an early military barracks and museum. The barracks have four three-story-high chimneys (see Figure 1). In 1988 weathered mortar joints on the caps above the roof had been repointed, and the contractor had installed sheet-metal lids to keep out the rain. Since the chimneys weren't being used, the lids had been tied down with wire to nails in the exterior mortar joints, effectively sealing off the tops of the chimneys.

Figure 1. *These four brick chimneys at the Fort Western Barracks museum had persistent leaks.*

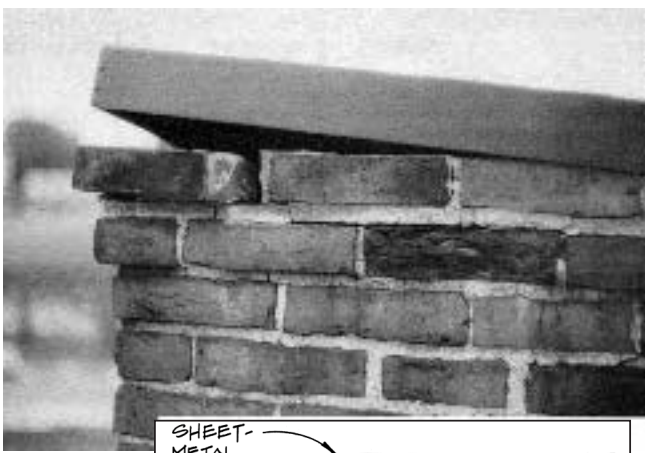

Figure 2. *To keep out the rain, a sheet-metal lid was wired to nails in the mortar joints of each masonry chimney cap (inset). Still, moisture trapped in the brick caused spalling. Also, ice formed under the sheet-metal lids and pushed them off the brick.*

Just two years later, when I arrived to look at the job, the pans were loose, mortar joints in the top three courses had cracked, and the brick was deteriorating (see Figure 2). The repair didn't last because the mason who had repointed the chimney didn't think about possible conflicts between the way the chimney had been used historically, and the way it was being used now (as museum space). The repair technique might have been appropriate for a leaking 1950s chimney, but not for historic masonry.

Originally, masonry chimneys were built to breathe and move. Although water easily penetrated the soft brick of the cap, the masonry dried out again, especially with daily fires burning below. As the masonry moved (through thermal expansion and contraction and wind), the soft lime-rich mortar moved with it. Individual bricks could shift slightly without cracking the mortar.

The modern use of the building as a museum put the fireplaces out of commission, so moisture build-up was more likely to become a problem. Although sealed against rain penetration, the chimney was not completely tight. The slow leakage of air from under the cap created a "chimney effect" that drew moist air from the damp cellar up into the chimney.

In the winter, frost and ice formed between the top brick and lid, pushing up on the lid. The wire and nails broke the mortar joints, leaving loose bricks. Also, the lip of the lid bound the perimeter of the cap, limiting the cap's natural expansion. Moisture trapped in the masonry began to cause spalling.

Clearly, roof-top repairs need to last longer than a couple of years. And if you're doing this kind of work, you need to get input from the occupants before you come up with a solution. You want to make sure the solution fits the way the building will be used and that you understand the maintenance plans.

At Fort Western, we rebuilt the top courses of the chimneys and left gaps in some vertical joints, the third course down from the top, to allow ventilation. Weights hanging inside the flues will hold the lids in place, rather than wires and nails, and allow the caps to move. The museum staff also plans to reduce moisture in the cellar.

Because they've seen that a problem in one part of the building leads to problems in other parts, the museum staff has changed its maintenance planning procedure to include the whole building and not just isolated problem areas.

Moisture From Without

The second moisture problem was in the story-and-a-half central chimney of a 19th century Cape-style home on the coast of Maine. This chimney has two fireplaces on the first floor. During short rains the interior masonry absorbed the water before it

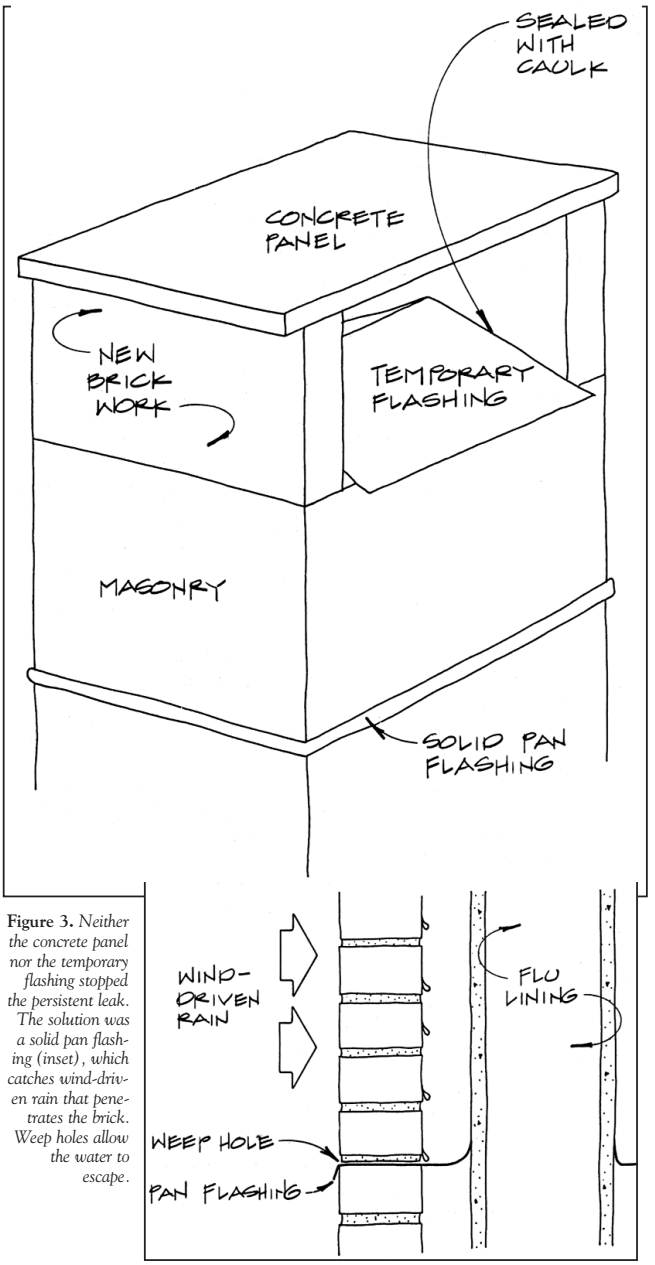

Figure 3. *Neither the concrete panel nor the temporary flashing stopped the persistent leak. The solution was a solid pan flashing (inset), which catches wind-driven rain that penetrates the brick. Weep holes allow the water to escape.*

reached the fireplaces below. But during prolonged rain, leaks developed in the chimney, and rain fell into the fireplaces.

Tired of the perpetual drip, the owners called in a mason who added a concrete panel supported by new brick above the cap and coated the chimney flashing with tar. The fireplaces still leaked. The mason came back and repointed the cap with cement mortar, but the fireplace stubbornly continued to have a single annoying drip.

A couple of years ago, when I began to consider how to really fix the chimney, I thought the most likely source of water was rain blowing in under the panel and down the open flue. Another possible location was the roof flashing, but I couldn't spot the leak because the flashing was so gooped up with tar.

Since the owner wasn't using the chimney, I added a temporary sheet-metal flashing to keep rain out of the flue. Based on what I had already learned from the Fort Western project, I knew I should allow for ventilation so I mounted the temporary flashing on 1-inch-wide brackets to allow air movement. But the leak persisted, especially during long wind-driven rains. In my mind the only possible source was the tarred flashing. But flashing leaks would most likely show up as drips in the attic, not inside the fireplace.

I called in Nick Whatley, of Morningstar Masonry, in Bodenham, Maine, to take a look. He explained that once a brick wall is saturated, even low-velocity winds will drive water right through the wall of a brick cap, causing leaks within the chimney. Also, water can penetrate through the fine hairline cracks in the rigid cement repointing mortar. The structure of the chimney was still flexible, but the repointing mortar wasn't. As the chimney moved slightly in the wind, most of the mortar had broken its bond with the brick.

We put our heads together to come up with a solution. While exterior masonry sealers would help prevent water penetration, they would have required regular reapplication. Nick said the only sure way to solve the problem was to install a solid sheet-metal pan flashing just above the roof line to bring the water that gets in back out again (see Figure 3).

The pan covers the whole area of the cap and is turned down at the outer edges. Where flues penetrate the pan, the edges are turned up. Weep holes in mortar joints just above the pan guide water that drips down within the wall of the cap back out to the exterior (Figure 3, inset).

Installing the pan requires tearing down the chimney to just below the roof line and rebuilding it. Since the owners plan to put the chimney back into service, they'll have to add a flue liner anyway. The additional $1,500 to rebuild the chimney and its cap is the price the owner will have to pay to bring the performance of this early chimney up to the modern standards of a chimney without any leaks. ■

John Leeke, of Sanford, Maine, restores and maintains historic buildings. He also consults with contractors, architects, and owners working on older buildings. If you have questions on restoration topics, you can contact him c/o JLC, *1233 Shelburne Road, Suite C1, South Burlington, VT 05403.*