A Rumford Fireplace, Southwestern Style

A California mason combines the adobe look of a kiva with the heating efficiency of a Rumford

by Vladimir Popovac

Photo this page: Roe A. Osborn

The city inspector said it was the first house he'd ever seen built entirely from faxes. The supervising contractor seemed to be on the phone every other minute as the owners and the architect became absorbed in the project. For the crew, frustrations occasionally outpaced pride of accomplishment. Carpenters immersed in a complex job often had to revise the previous day's work as fresh ideas poured in.

My partner, Marshall Dunn, and I were luckier. The architect and the contractor always managed to keep changes one step ahead of the masonry work. We had to change our plans several times, shift our setup lines and recalculate our numbers, but we never had to tear out any work. We were asked to build a fireplace that would fit in with the Southwestern style of the house (photo facing page). The rounded shape of the fireplace, its arched opening and its plastered finish would be reminiscent of a Native American ceremonial kiva structure.

The circular shapes found in the architecture of Native Americans reflect their belief in the cyclical characteristics of life and nature, such as the progression of the seasons. Ironically, as the fireplace itself progressed from drawing board to finished fireplace, its appearance changed dramatically. But despite the changes, we were determined to build a fireplace that would burn efficiently and cleanly.

The only fireplace design that would give us the performance we were seeking is the Rumford, an extremely efficient fireplace design developed two centuries ago (sidebar right). So I started looking into the possibility of building this little kiva fireplace with the proportions and configuration of a classic Rumford.

Start with a good foundation—Every good fireplace begins with a good foundation, and our kiva was built on top of an 8-in. thick reinforced-concrete slab that was tied in to a fully grouted (all voids filled with mortar) and reinforced 8-in. concrete-block perimeter (drawing p. 102).

We formed the slab on top of a ½-in. thick cementitious backerboard, which we left in place after the slab had cured. The space directly under the fireplace floor is sometimes left open as a place to pile up ashes that get swept through an ash drop in the firebox floor. However, with a living area below the fireplace, we opted to leave the space under the slab empty.

We set our slab about 17 in. off the subfloor, which was 2 in. lower than the finished height of the stone hearth and bench that would run in front of the kiva and along one wall. The hearth and bench sit on top of a mortar bed that is supported by backerboard on top of a short framed wall that forms the curve of the bench.

We built the firebox floor out of 1¼-in. thick firebrick pavers set into a thin layer of refractory cement. The firebox floor would then end up ¾ in. lower than the stone hearth, a margin that helps to keep the ashes in the fireplace.

Before starting the firebox floor, we built the outer walls of the fireplace with fully grouted reinforced block. We normally use 8-in. wide block for the walls, but the limited space on this job permitted only 4-in. block. Unlike 8-in. block, 4-in. block is difficult to fill in one pour after the walls are built, so we grouted the block course by course as we went up.

Adapting the Rumford to a kiva—Once the firebox floor was set, we were ready to lay out our lines for the firebox walls. Rumford fireplaces generally run from 24 in. to 48 in. wide, and manufactured parts are available from Superior Clay Corporation (Uhrichsville, OH; 800-848-6166) that fit this size range and facilitate construction. These parts consist of a one-piece throat with the distinctive rounded breast, the damper, the smoke chamber and the matching flue liners. Everything is precast, solidly built and fit together with sublime simplicity.

This kiva, which was designed by the architect, called for an opening only 16 in. wide. With the smallest manufactured parts made for a 24-in. opening, at first we figured we'd have to make our own Rumfordlike parts. Besides, the base (or footprint) of a standard Rumford firebox is trapezoidal, looking sort of like a squashed rectangle, wide in front and narrow in back. The traditional kiva firebox structure is supposed to be semicircular in keeping with basic Native American architecture.

We came up with a way to honor that principle by building our firebox in the shape of a half-circle while still using precast parts. We built the firebox of firebricks cut in half and installed on edge with their ends showing to achieve the required radius. The firebricks are about 9 in. long and can be cut in half with a saw, but we found it quicker and easier to break the bricks in half by tapping them with a mason's hammer.

The half-brick length of 4½ in. on each side of the 16-in. specified opening gave us an outside perimeter of 25 in. for the firebox, which was enough to accommodate the smallest precast Rumford throat with no problem (bottom photo, p. 102). We had all the precast parts on hand and set the throat piece on the lines we drew on the firebox floor to make sure it would fit before we started laying the firebrick.

Refractory cement is best for high heat—For the firebox as well as for all masonry joints that will be exposed to fire and high heat, we always use refractory cement. Refractory ce-

Rumford origins

Rumford fireplaces are named for Count Rumford, who was an American inventor and a contemporary of Ben Franklin. As a Loyalist in the Revolutionary War, Rumford was forced to flee to London, where he was confronted with a city choking on smoke and fumes from its thousands of residential fireplaces. So Rumford set about to reinvent the fireplace.

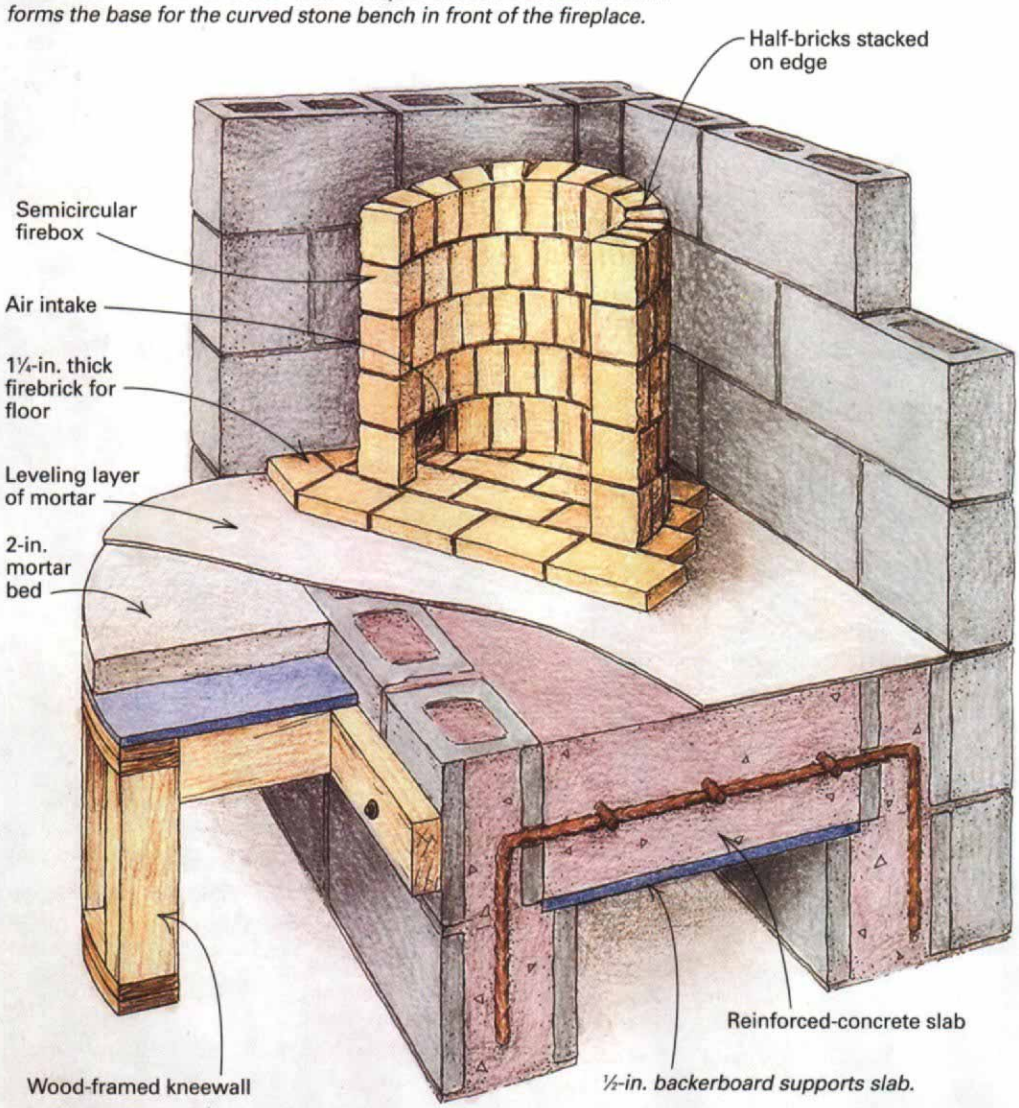
Rumford understood that the open fireplace heats a room by radiating and reflecting heat off the walls of the firebox. He correctly reasoned that if the sidewalls of the firebox were sharply slanted toward the room and that if the firebox were made shallower and higher, then more heat could be reflected back into the room.

Rumford also figured that because hot gases rise straight up, the back of the firebox should be straight and plumb. The sloping back wall of the firebox in a conventional fireplace causes the hot gases from the fire to swirl and collide instead of flow smoothly upward. This turbulence draws more warm air out of the room to mix with the burning gases. Instead of heating the room, conventional fireplaces suck warm air out.

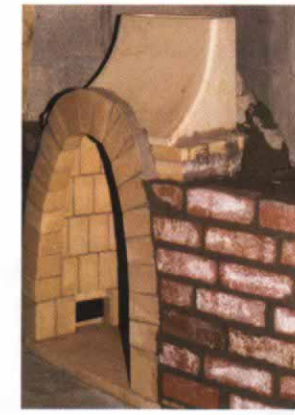
Rumford also improved efficiency by rounding off the front of the throat, a process he called "rounding the breast." He concluded that the sharp right angles of a conventional, box-shaped fireplace throat created even more turbulence in the upflowing gases and sucked more warm air out of the room. In the throat of a conventional fireplace, room air mixes with hot rising gases, cooling them, and reduces the chance for their continued or secondary combustion.

With the gently curved Rumford breast, the gases from the fire rise smoothly and do not mix with room air, which becomes layered and acts as a shield that maintains combustion heat in the firebox while allowing heat to radiate from the back of the fireplace. The result of the innovations is that a Rumford fireplace delivers more heat than a conventional fireplace. Recent tests have shown that Rumfords burn cleaner as well.—*V. P.*

The heart of a kiva Rumford. *The firebox of a kiva Rumford is semicircular in plan but built with a straight back. The foundation consists of a reinforced-concrete slab built inside fully grouted concrete block. A 2-in. mortar bed on top of a wood-framed kneewall forms the base for the curved stone bench in front of the fireplace.*



A plywood form for the arched opening. To make the rounded opening, firebricks were set in refractory cement around a form of two sheets of plywood separated by a 2x spacer.



A precast throat sits on top of the firebox. A manufactured Rumford throat with its characteristic curved front, or breast, is a key ingredient for turning this kiva fireplace into an effective, clean-burning heater.

ment comes in a container ready to spread. Unlike most cement and mortar that use water as part of a chemical reaction to turn the compound solid, refractory cement becomes solid solely through evaporation. Refractory cement, available at masonry-supply stores, is resistant to extreme changes in temperature, and the cement we used stays solid up to 2000 °F.

Refractory cement is supposed to be used thin, so we made the mortar joints no more than ⅛in. wide. Because we were stacking rectangular brick along a circular line, the joints between the firebrick filled with refractory cement widen in a wedge shape as the bricks fan out. We parged the back of the firebrick and the wedge-shaped joints with a mixture of portland cement and fire-clay mortar because we wanted to avoid fat joints of refractory cement and because that area would not be exposed to flames or high temperatures. The space between the back of the firebox wall and the outer block wall was filled with loose rubble and mortar, which gives the firebox room for expansion.

We notched an opening for an air intake into the second course of brick on the firebox walls. The air intake that we used was roughly the same size as a brick, about 2 in. high, 4 in. wide and 9 in. long. It works like a drawer that pulls out to allow fresh outside air into the firebox at the level of the firebox floor. We recessed the air intake in the firebox wall so that when closed, it is barely visible.

On the backside of the firebox, we covered the mechanism for the air intake with a curved piece of sheet metal to keep rubble and mortar away from it. We also threaded some long bolts into the end of the intake to anchor it securely in the rubble. An opening was left at the proper location in the outer fireplace wall for a 2-in. pipe to the outside, which was screened to keep out small animals and large insects.

The precast throat gets its corners rounded off—After completing the firebox walls, we bedded the precast throat in place with refrac-

Drawings: Christopher Clapp

Curve meets trapezoid. As you look down the trapezoidal precast throat, the top of the curved firebox is visible. Cut firebrick set in refractory cement smoothed out this transition.

A damper covers the top of the throat. A manufactured damper is made to go over the opening of the throat. The floor of the smoke chamber surrounding the damper is finished in refractory cement.

tory cement (bottom photo, facing page). Cast to fit the standard Rumford shape, the bottom of the throat is a trapezoid. The inside corners of the throat installed on top of the semicircular kiva firebox left triangular spaces on top of the flat firebox wall (photo top left) that had to be filled in to maintain the smooth interior surface important to the Rumford design. We filled these spaces with scraps of firebrick that were cut and set in refractory cement to achieve a uniform transition between the firebox and the throat.

Next, we built the arch for the firebox opening. We made a half-oval form the same height as the firebox out of two plywood scraps separated by a spacer and then stacked firebrick around it (top photo, facing page). Where the backside of the arch met the firebox at a 90° angle, we cut scraps of firebrick and set them in refractory cement to soften the comers. We also rounded the front edge of the bricks in the arch with an electric grinder (photo right).

Kiva shape has a brick foundation—Next, we scribed lines on the walls and the floor on both sides of the fireplace to form the kiva shape that the architect was seeking. The lines had been altered two or three times during the previous week. But once contours of the kiva were laid out, we started building with confidence. We stacked bricks in a bellied curve that joined the sides of the fireplace arch to the lines on the walls. On one wall the line was stepped to make way for three tapered shelves that would each be topped with stone to match the bench. Each brick on each course was eyeballed in place. Because they would be covered with two coats of plaster, they just had to be close, not perfect.

We filled the spaces between the brick front, the firebox and the outer walls with rubble and mortar as we went up. When we reached the top of the precast throat, we brought the whole assembly up level and flat. The next step was positioning the damper (photo top right) and the precast smoke chamber.

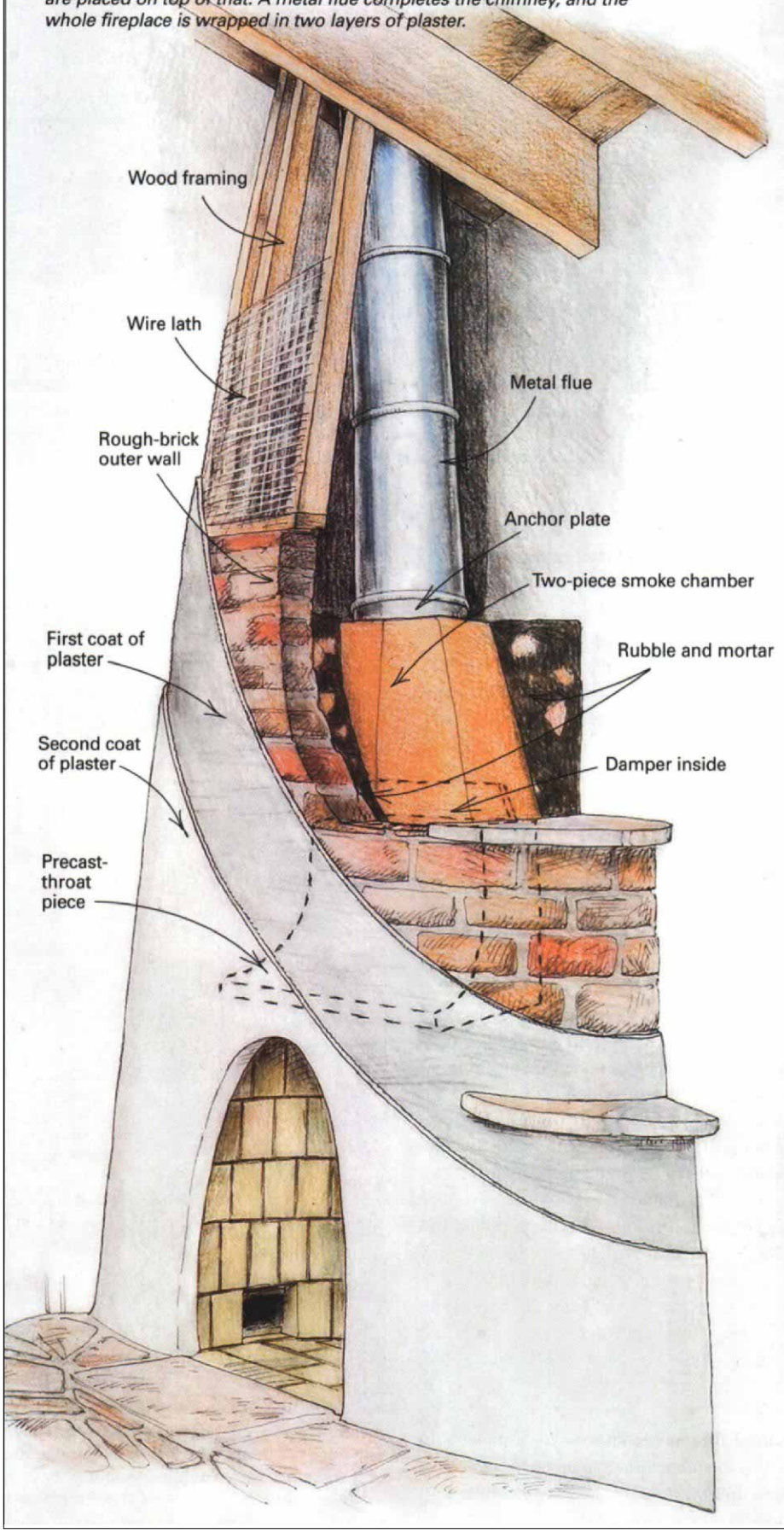
The smoke chamber is cut down to size—Normally, the damper is just mortared snug and centered on top of the precast throat. Then the two-piece smoke chamber is set around it, centered and plumb. But for this fireplace, space was at a premium, so we had to set the smoke chamber slightly askew, slanting toward the corner of the room. We also narrowed the width of the smoke chamber to make it fit.

We calculated that the smoke chamber could be narrowed by 1½ in. and still have plenty room for the damper, so we ripped that amount off the centerline of one side of the smoke chamber front and back. Like the rest of the precast parts, the smoke chamber is made of high-fired red clay that resembles terra-cotta. It is easily cut with a diamond blade mounted on a circular saw. A dry fit of the damper and the slimmed-down smoke chamber let us know that the damper could operate without interference. Then we mortared everything in place, again using refractory mortar for all joints that would be exposed to direct heat (bottom photo, p. 104).

A metal flue saves space—We went back to stacking the brick front and filling the space between it and the block wall with rubble and mortar. This time, we left a recessed area to form

Arched opening is rounded for plaster. The edges of the firebrick around the opening of the firebox were rounded with a grinder to make a softer corner when the fireplace is eventually plastered.

Precast components stack up for efficiency. *A manufactured throat with its characteristic rounded front is placed on top of the firebox. A damper and a two-piece precast smoke chamber are placed on top of that. A metal flue completes the chimney, and the whole fireplace is wrapped in two layers of plaster.*



Wood framing tops the masonry. The masonry was stopped short of the ceiling so that the contractor could insert the metal flue for the chimney. The wood frame was wire-lathed and then plastered with the rest of the fireplace.

Anchoring the anchor plate. Wire that has been twisted through the corners of the metal-flue anchor plate extends into the rubble and mortar around the smoke chamber to hold the plate in place.

Refractory cement for high-heat areas. For areas of the fireplace that will be exposed to high heat, such as the joint between the two halves of the smoke chamber pictured here, refractory cement that comes premixed in a container holds up better than ordinary mortar.

a decorative niche centered over the fireplace opening. When we reached the top of the smoke chamber, we positioned an anchor plate for attaching an 8-in. inside dia. Metalbestos flue (Selkirk Metalbestos, Dallas, TX; 800-848-2149) (center photo, facing page). A metal flue had been specified instead of a masonry chimney to reduce weight and to accommodate the slant and the configuration of the chimney. Outside the house, the chimney was to be wood-framed, wire-lathed and stuccoed.

I figured that this fireplace, with its smooth Rumford lines, would have drawn well with a 6-in. flue, but we used the standard formula that the cross-sectional area of the flue should be one-eighth of the area of the fireplace opening. The height from the top of the firebox to the top of the chimney was just under 14 ft.

We set the anchor plate in mortar and secured it by twisting six strands of tie wire into each of four screw holes in its base plate. The wire was buried deep in the surrounding rubble mortar. We softened the comers of the smoke chamber with pieces of firebrick and refractory cement for a smooth transition to the anchor plate and flue. We continued our masonry to within a couple of feet of the ceiling to give the contractor room to set the flue and to frame the top of the kiva (top photo, facing page).

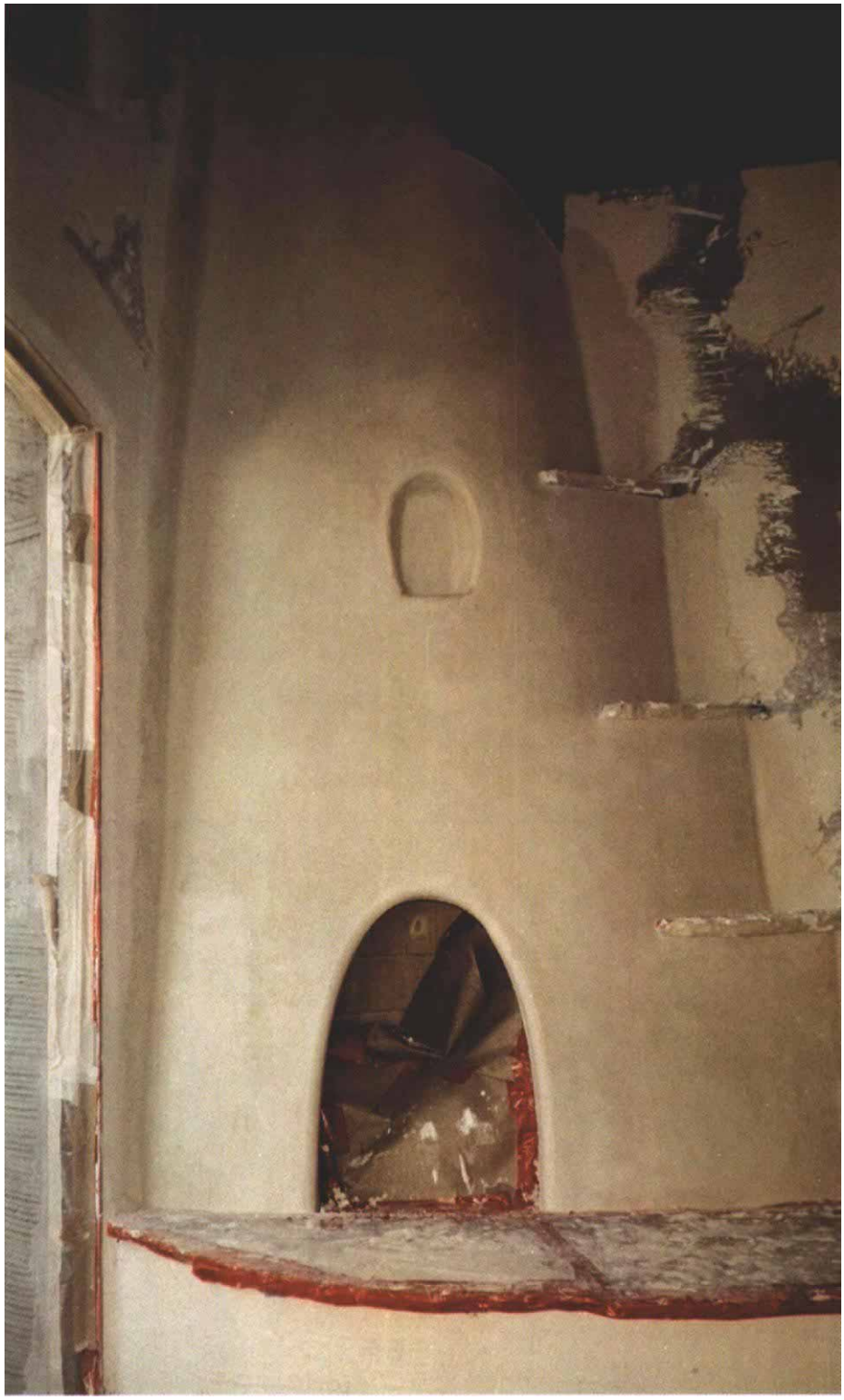
Stone benches are installed before plastering—With the contractor responsible for finishing the chimney, we turned our attention to the hearth and bench. The stone that the owners chose for these details came from the Middle East. The distributor called it "biblical stone." Each piece sported a shiny diamond-shaped gold label proclaiming that it was at least 300 years old. I'm sure that the stone, which looked to me like partially metamorphosed limestone, is actually over 3 million years old. I suppose the label meant that the stone had been part of some edifice that was at least 300 years old.

We mortared in the stone for the bench and for the shelves before the plastering commenced so that the plaster would wrap over the top of the stone where the two meet. The plasterers who did all the plastering and stucco work inside the house (Sunset Plastering, San Francisco, CA; 415-731-9049) did the kiva as well.

Before applying plaster, our plasterers brushed on a coat of Weld-Crete (Larsen Products, Jessup, MD; 800-633-6668) to ensure a solid bond. They followed the Weld-Crete with two coats of gypsum plaster. The finish has a slightly irregular, hand-tooled look (photo right).

The purity of the plastered kiva almost persuaded the owners not to use any color on the fireplace, but the work of painters Vicki Beggs and Suzy Papanikolas of San Francisco proved irresistible. Once the owners saw their work in other parts of the house, the kiva had to be painted as well.

These talented women were equipped with an array of vessels, cans, jars, tubes of colors, powders, tints, brushes, sponges and rags, but the main ingredient they used was their experience. The fireplace is finished with an umber-tinted base topped by an ochre wash. The colors are so subtly applied and blended that they glow even without the benefit of firelight. ☐



Rumford gets plastered. Two coats of plaster finish off the outside of the fireplace and create the distinctive kiva look. The stone shelves and benches were installed beforehand and masked off so that the plaster would wrap over the stone.

Vladimir Popovac, a mason, works with his partner, Marshall Dunn, in Senora, California. Photos by the author, except where noted.