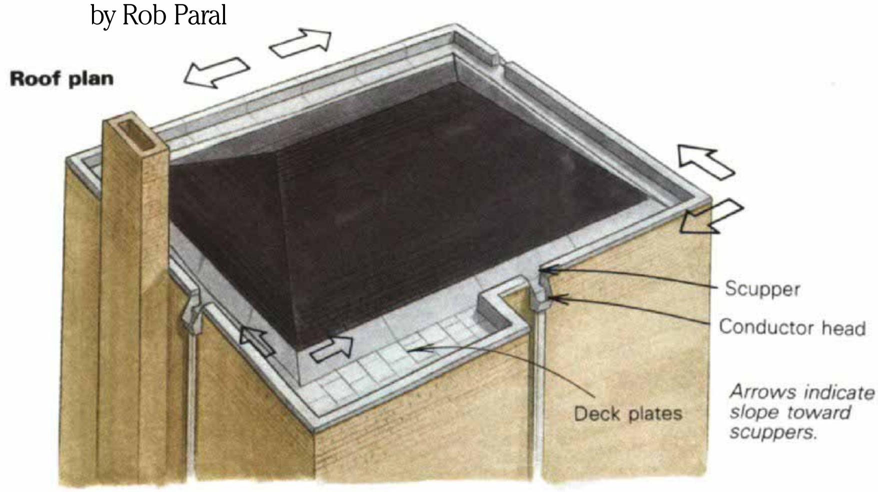
Replacing an Inlaid Gutter

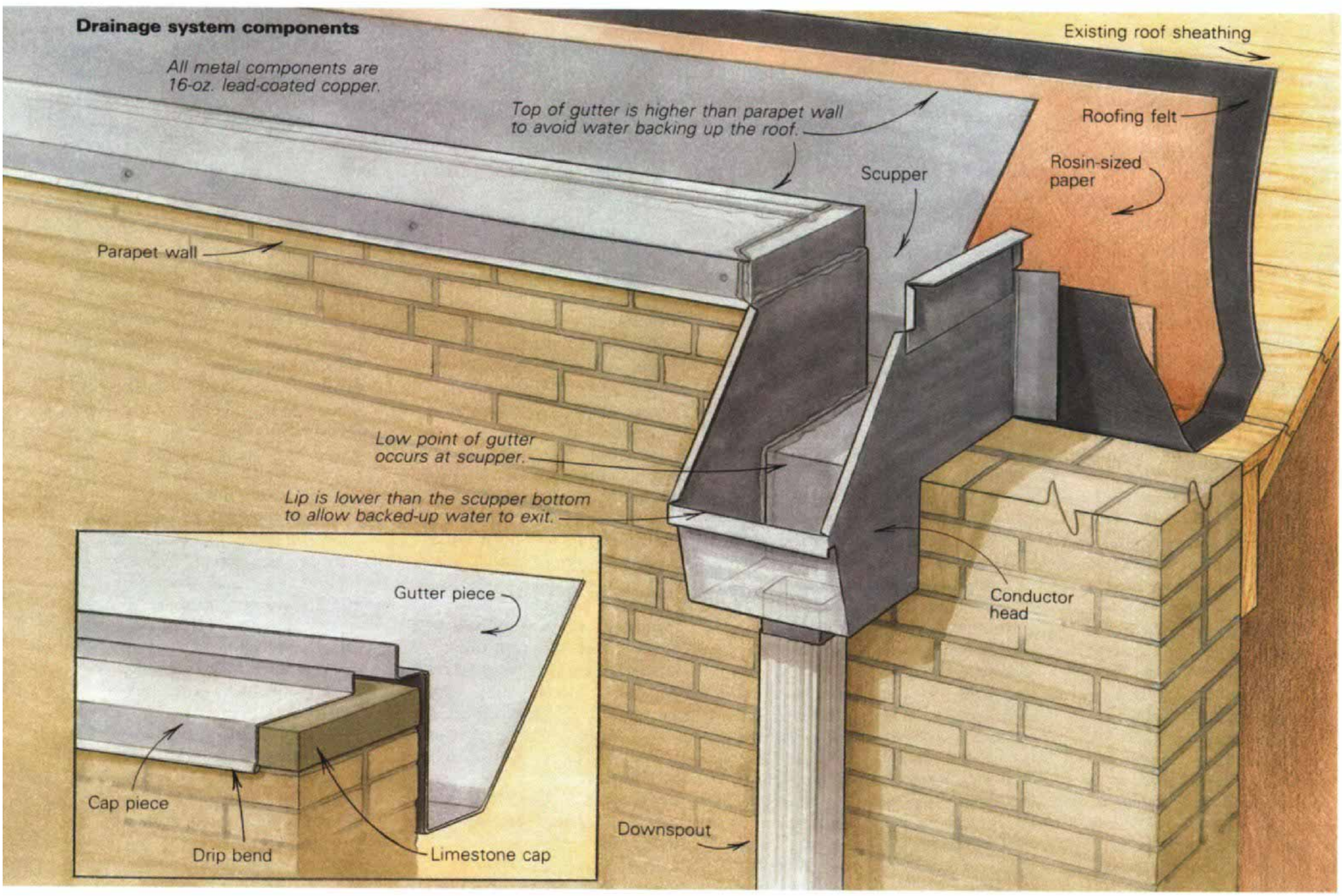
How one sheet-metal contractor fabricated and installed a lead-coated copper drainage system

by Rob Paral

Growing up in Chicago, I've always been fascinated with the endless supply of fancy metal cornices, spires and building façades found in neighborhoods throughout that city. My curiosity about the installation of architectural sheet metal led me to visit the Wagners, who are among Chicago's premiere architectural sheet-metal contractors. Their company, Albert J. Wagner and Son, fabricates and installs architectural metal building components.

During the Great Drought of 1988, the owners of a 1940's chateau-style house in Park Ridge, Illinois, hired Wagner and Son to solve chronic seepage problems in their house's inlaid gutter system.





Drawings: Bob LaPointe

The home in Park Ridge is surmounted by a hip roof that slopes up from a 10-in. high parapet (top drawing, facing page). The inlaid gutter occurs where the sloping roof meets the parapet wall (I've heard the terms *pocket gutter* and *built-in gutter* for similar configurations, but Al Wagner prefers the term *inlaid)*. With an inlaid gutter like this one, a sheet-metal liner covers the junction between roof and wall. Water flowing down the roof enters this sheet-metal gutter to be channeled to scuppers, openings in the parapet wall that drain to conductor heads. The conductor heads discharge the water into downspouts, or leaders.

In this house, the original galvanized-steel gutter had begun to rot through, allowing water to leak directly into the building. The failure of the galvanized gutter was hastened by scuppers that proved to be too small: they clogged with debris in summer and choked with ice in the winter. Previous roofers had slathered the gutter with liberal amounts of aluminized roof sealer and asphalt, but this just made the situation worse because it sealed moisture in rather than out.

Another source of seepage was created by the lack of a through-wall flashing under the limestone cap. This allowed backed-up water and even normal precipitation to weep into the building through the stone parapet cap.

Fabricating the gutters—Each section of the new inlaid-gutter system would be composed of two pieces (the girth of the gutter was too great for a single piece). Both would be made from lead-coated copper (for more on this material, see the sidebar on p. 49). One piece forms the actual gutter and runs up the side of the parapet and partway across the limestone cap (bottom drawing, facing page). The roof flange of this gutter piece would extend higher than the parapet wall so that if water were to collect in the gutter, it would exit over the wall before it could back up to a point high enough to soak unprotected roof sheathing.

At the top of the stone cap, the gutter piece would be locked and soldered to a second piece of lead-coated copper—a coping piece—that covers the rest of the cap and extends down the outside face of the parapet, ending in a drip edge below the joint of the brick wall and the limestone cap. The cap piece would prevent seepage through the limestone. The gutter and coping pieces would be locked together and anchored to the limestone with copper clips, or cleats. All joints would be soldered.

The Wagners fabricated the components of the new gutter system, including scuppers and conductor heads, in their shop on the north side of Chicago, down the street from Wrigley Field. The channels of the gutter pieces are not equal in size: each section of gutter grows narrower and deeper from one end to the other to provide positive drainage to the scuppers. For this reason, each gutter piece had to be made for a particular location on the roof. Most cap pieces were of equal size.

After cutting the gutter pieces to the proper length and width, using a power shear, the shop crew laid out the sheets of lead-coated copper on a bench and made prick marks with a hammer and punch to mark the location of bends. The marks served to guide alignment of the sheets in the power leaf brake, a floor-mounted tool that can bend sheet metal up to 10 ft. long.

Installing gutter and cap pieces—Work on site began with the removal of the old galvanized-steel inlaid gutter. Working on sections at a time, the crew used crowbars to pry up the old gutter, and then hatchets to chip off the strata of liquid roof coating that lay atop the limestone cap. It took a crew of two to four people about two weeks to complete the job from demolition to installation.

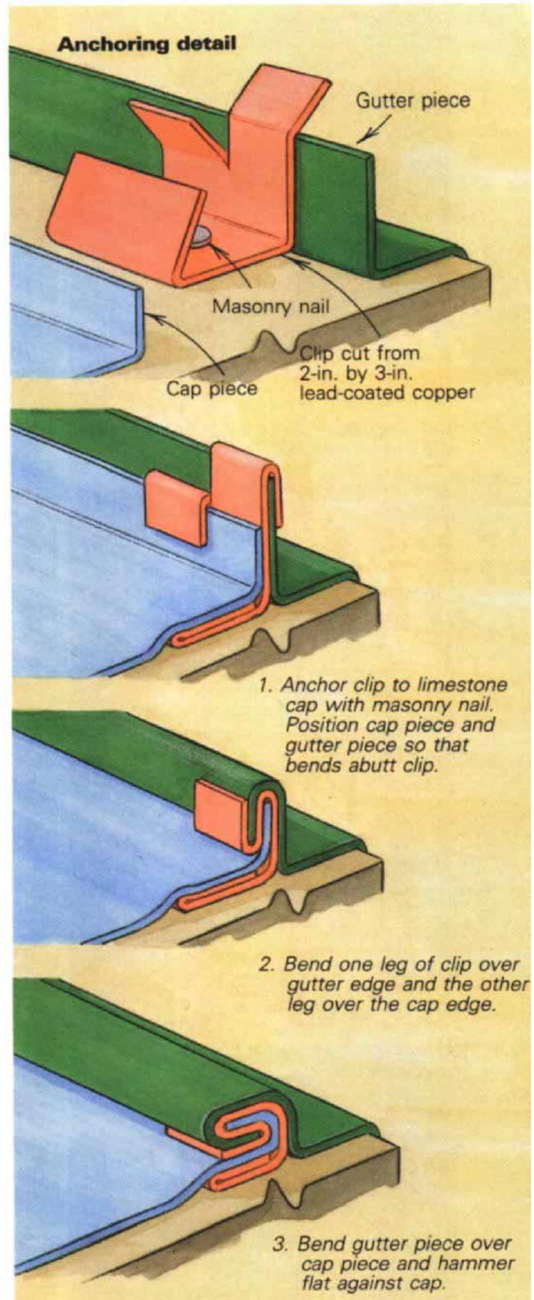
With the roof sheathing exposed, the area to be covered by the new gutter was lined with 30-lb. roofing felt that was nailed into place. The felt was extended up the parapet wall. Using copper nails, the crew attached a layer of rosin-sized paper (also called red rosin paper) on top of the felt and nailed it in place. Red rosin paper is moisture-permeable but prevents a metal gutter from bonding to asphalt-impregnated roofing felt; such a bond would inhibit normal expansion/contraction of the gutter and tear the roofing felt. It also prevents oils in the felt from contaminating the solder when heat is applied.

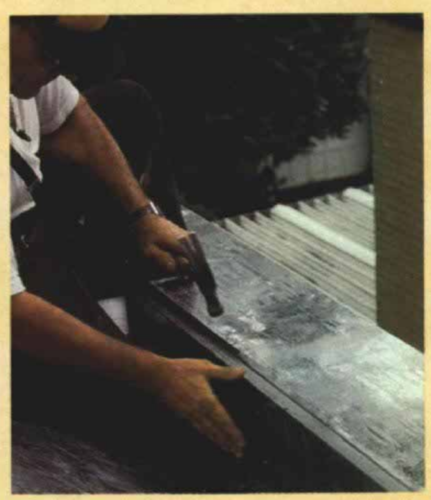
Next, the metal cap piece was placed over the limestone cap and positions of the anchor cleats were marked at 16 in. o. c. (Wagner had determined that the runs of gutter were too short to require expansion joints, but the cleats would provide for a small amount of movement of the metal.) The cap piece was then removed to allow the cleats to be secured. These cleats are easily made on a job site. A 2-in. by 3-in. piece of lead-coated copper is first bent in the middle across its width (drawing at right). One of the resulting halves is then snipped lengthwise down the middle, creating two flaps. One flap is bent to grip the cap piece, and the other flap will grab the gutter piece. The bent cleats are anchored to the capstone.

Once all the cleats were fastened to the limestone cap, the metal cap piece was again laid in place and a corresponding gutter piece was also positioned. The clip flaps were bent over the bent edges that had been formed into the gutter and cap pieces, the longer gutter edge was bent over the cap flange and the whole seam was bent over and hammered flat against the cap (photo right). At the building's corners, cap and gutter pieces were mitered using the same bendover seam. This method of "blind" fastening assured that the clips would not be visible once the seam was completely formed.

The drip edge of the metal cap piece was then secured to the outside face of the limestone cap with lead anchors placed on 16-in. centers. The upper edge of the gutter pieces was secured to the roof sheathing with copper nails.

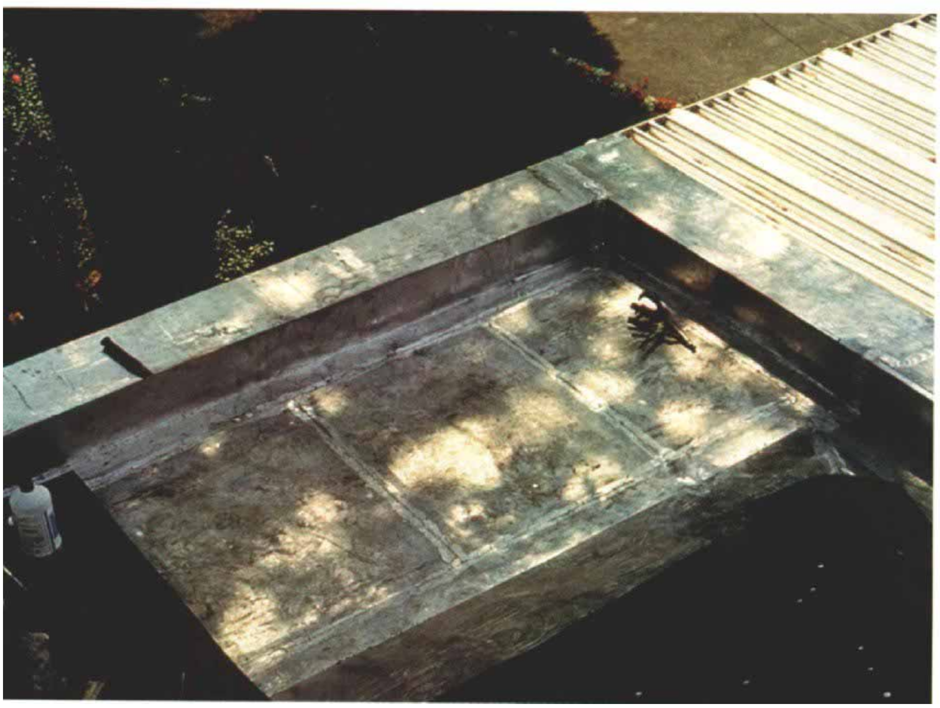
Chimney flashing and deck plates—The parapet was interrupted on one wall by a brick chimney stack. New lead-coated copper flash-





Chimney flashing is held fast in a reglet cut into mortar joints and clipped to the gutter liner at the bottom (photo above).

All seamed and overlapping joints of the gutter are soldered with 50/50 tin/lead solder. The charcoal-heated firebox shown above heats a soldering copper in its upper chamber. The lower container holds a jar of flux, a bar of sal ammoniac and bars of solder.



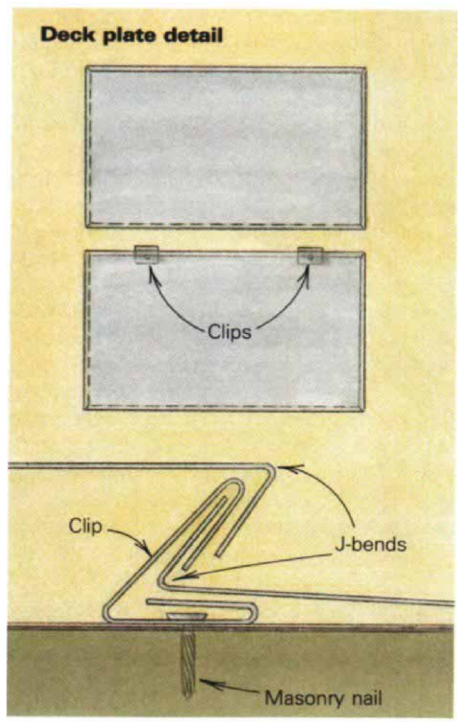
Two-ft. by 3-ft. lead-coated copper deck plates waterproof the flat-roofed wing of the house.

ing was run up the chimney to a point higher than the top of the parapet wall, ensuring that any water backing up in the gutter would exit over the parapet and not lap against the bricks. The bottom edge of the chimney flashing was attached to the gutter with the clip system described earlier (top photo, left). At its upper edge, the flashing was bent to terminate in a reglet cut into a mortar joint with a chisel. The flashing was further secured to the chimney by lead masonry anchors.

A complication of the drainage system was the presence of a small wing protruding from one side of the building. Wagner and Son covered the 3-ft. by 16-ft. flat surface of this wing with deck plates fabricated from 2-ft. by 3-ft. sheets of 16-oz. lead-coated copper (bottom photo, left). The plates were formed by bending a half-inch J-bend onto two contiguous edges of each side of a plate (drawing below).

To connect one plate to another, the edge of one plate was fastened to a pair of cleats secured with copper nails to the flat roof sheathing. The J-bend of the edge of the plate protruded up to snag the J-bend of the next sheet and the joint was flattened with hammer blows and soldered. This same joining technique connects the plates to the cap pieces on the parapet of the wing, which are extended onto the flat roof area rather than ended on the limestone cap as on the rest of the roof. Where the roof slope meets the flat area, each metal sheet on the sloped roof ends on its downhill side in a J-bend that connects to the deck plates.

Soldering joints—After cap and gutter pieces were mechanically attached to each other and deck plates were installed, all seams and over-



laps (the sides of the gutter sections overlapped each other by 1 in., as did cap sections) were soldered with 50/50 tin/lead solder. Each crew member heated his own soldering metals and tools in an individual fire pot. Each fire pot consisted of a rectangular base and a stainless-steel pipe stack in which charcoal was burned. A "copper" was set to heat in an opening in the side of the pipe (middle photo, facing page). A copper is a wood-handled soldering iron with a 1-in. by 1-in. by 3-in. long block of copper attached to a steel rod.

To solder a joint, a roofer would take a heated copper and draw it along a joint in contact with the bar of solder held in the other hand. Then he'd return it to the fire pot for reheating. The heated joint, first cleaned with liquid flux (muriatic acid cut with zinc chloride), attracts the molten solder. When the copper becomes oxidized, it won't heat up evenly and the oxide will reject solder, so the roofer draws the copper across a bar of sal ammoniac to clean it off. (Wagner has since stopped cleaning with sal ammoniac because of its toxic fumes and now draws the copper across a muriatic acid "film.") The crew then "tins" the soldering coppers on only one of the copper's four sides by applying a small amount of solder to the copper. This way, solder will only "follow" the tinned, hottest side of the copper, allowing for greater control of the flow of hot solder.

An occasional hammer blow keeps the tip of the copper flat, making a blunt shape that allows the most contact between the copper and the flat sheet material being soldered. The crew would also occasionally bend the shaft of their coppers in order to hold them at a more comfortable working angle.

Scuppers and conductor heads—The last major task on this job site was the installation of the new through-wall scuppers and the exterior conductor heads they lead into. To prevent future blockage of the scuppers, a mason cut through the limestone cap and masonry that had spanned the top of each scupper opening, leaving a U-shape cut into the parapet wall. This eliminated the drainage bottleneck and allowed the entire height of the parapet wall to be used for drainage (bottom drawing, p. 46).

Wagner and Son lined the walls of the newly enlarged scupper openings with lead-coated copper and soldered it to the already installed gutter and cap. The conductor heads were fabricated so that the outside edge of each one lies below the scupper channel. This is done so that in the event of downspout blockage, water will run over the outside edge of the conductor head and drip to the ground rather than back up onto the roof. From the bottom of the conductor head, a 5-in. long drainage tube that was soldered to the conductor drains into the original, sound downspouts, the last links in the above-ground drainage system (photo at right).

For information about publications and standards for sheet-metal work, contact the Sheet Metal & Air-Conditioning Contractors' National Association (SMACNA) at P. O. Box 70, Merrifield, Va. 22116; (703) 790-9890. Among SMACNA's publications is the *Architectural Sheet Metal Manual,* a set of recommended details for the design and installation of metal gutters, flashing, roofs, louvers, cornices, spires, as well as other architectural sheet-metal work (the fourth edition, published in 1987, costs $75). A fascinating source of historic architectural sheet-metal details is SMACNA's reprint of a 1929 manual on sheet-metal work. It includes elaborate cornices, spires, domes, balusters, and gargoyles, as well as standard details for roofing, flashing and ductwork. □

Rob Paral now works in Washington, D. C. Photos by the author.

The parapet wall was opened wide to provide a substantial scupper. The photo above shows the completed parapet cap, scupper, and conductor head attached to the existing downspout.

Selecting lead-coated copper

Al Wagner decided that 16-oz. lead-coated copper was the material of choice for the new gutter system. Lead-coated copper is as malleable as copper but even more corrosion-resistant. The lead coating would prevent the copper-oxide stains that uncoated copper leaves on any wall below it and would also prevent galvanic reaction between the new work and the galvanized-steel downspouts, which were to remain.

Lead-coated copper is manufactured by copper mills and sold by sheet-metal distributors. It consists of cold-rolled copper that is hot dipped in lead. Cold-rolled copper is rolled from huge copper ingots into thin sheets; hot-rolled copper is rolled at a much higher temperature, making it very ductile and useful where the copper doesn't need to hold a shape. Cold-rolled copper, which is less pliable than hot-rolled, holds a shape yet is still malleable enough to form by hand, and it's the standard for most architectural sheet-metal work. Lead is extremely workable, so a lead-coated copper sheet is just as malleable as plain copper. (Lead-coated copper sheets do, however, stick together, so they are slightly more difficult to work with than copper.) A lead-coated copper gutter system could last from 60 to 80 years with a minimum of maintenance (a fall cleaning of the gutters).

Lead-coated copper sheets are sold according to the weight per square foot of the copper; there is an additional charge for the lead coating. The typical lead-coated copper purchased for residential architectural applications is 16-oz. copper. The copper core is approximately .0216-in. thick and the lead coating is about .002-in. thick. Heavier types of lead-coated copper, such as 20 oz. or 24 oz., are occasionally required for gutters and flashing.

Lead-coated copper is typically sold in 8-ft. or 10-ft. long sheets that are 2 ft. or 3 ft. wide. The approximate cost of a 3-ft. by 8-ft. sheet of 16-oz. lead-coated copper (January 1990) is between $55 and $70, depending on the total weight ordered. Prices of lead and copper are subject to market fluctuations. —*R. P.*