A Mortar-Bed Shower

Building the critical parts—the pan, the wall membrane and the mortar bed

by Michael Byrne

More and more of my clients want a fancy bathroom, and the showpiece in nearly every one that I work on is a shower done in tile. Because it's easy to clean and impervious to water, tile is an ideal finish material in the bathroom. Even more compelling is the vast array of contemporary tile colors that are available. Some tiles are small enough to conform to almost any shower configuration, so I sometimes find myself building round or oval shower stalls. But regardless of the shape of the project, the three most important components of any first-class tile shower are the pan, the wall membrane and the mortar bed to which the tiles are affixed. This article is about the materials and methods that I use to build leak-free tile showers. The photos are of several different jobs.

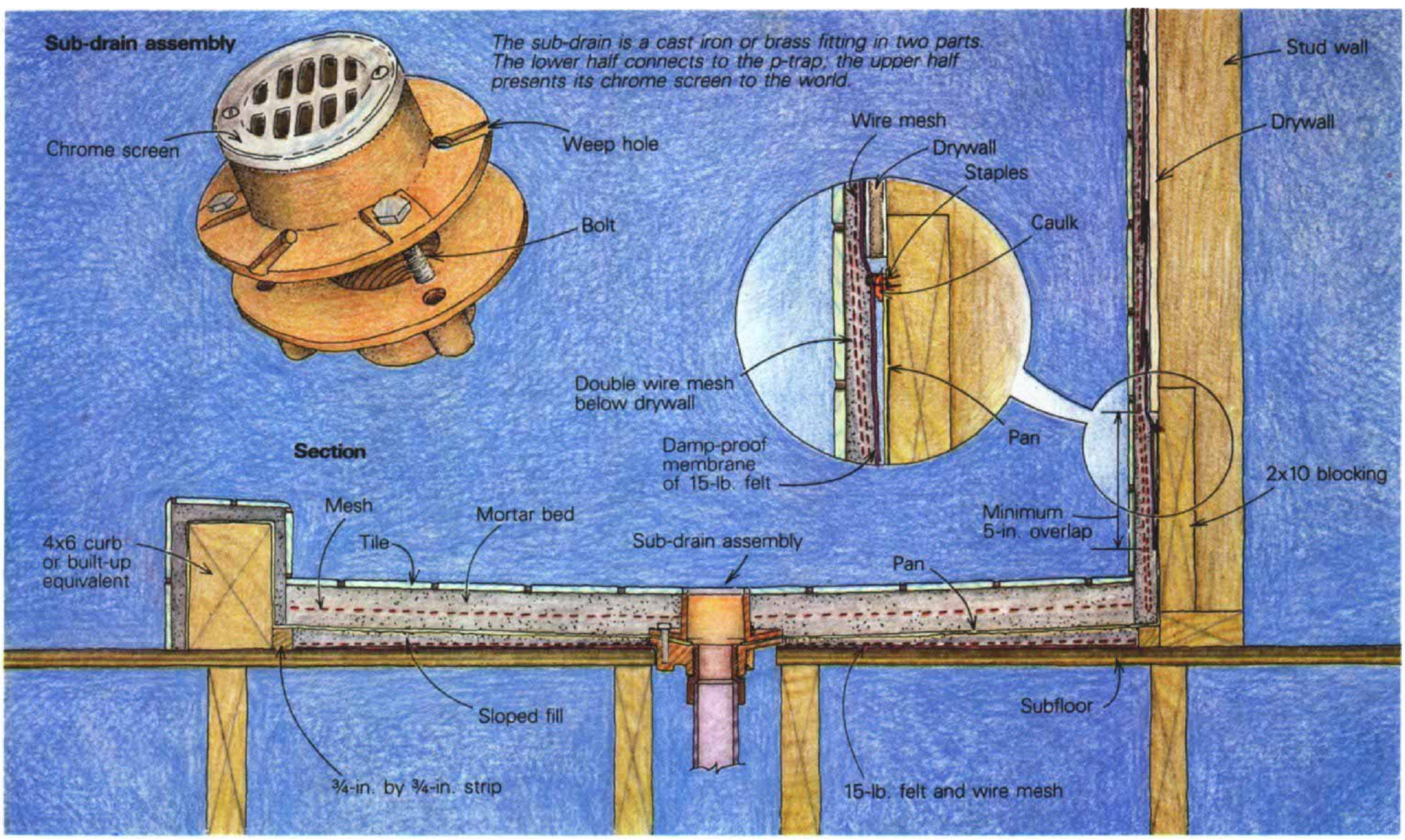
The shower pan—When the water swirls down the drain in a mortar shower, it passes through a two-piece cast-iron or brass fitting called a sub-drain (drawing, below left). The upper half of the sub-drain is a hat-shaped casting with an open top that's fitted with a chrome screen. The lower half is similar, but it has a threaded opening in its center to secure it to a nipple extending from the shower's p-trap. Around the circumference of the top half are six small holes. Three of them accommodate the bolts that clamp the drain halves together, with the pan's membrane sandwiched between. The other three are weep holes to let any moisture that gets into the mortar bed escape into the drain. If this residual moisture is trapped, it can promote the growth of fungus and bacteria in the mortar bed.

A shower pan waterproofs the floor of a shower stall. Pans are often made of metal—usually copper, lead or galvanized sheet metal. Although metal is traditionally considered a superior pan material, my experience has taught me otherwise. I've found that a metal shower pan will usually disintegrate around the drain, a victim of electrolysis. I've seen this happen even when the metal has been given a protective coat of asphalt.

Hot-mopped pans, made of alternating layers of 15-lb. or 30-lb. felt paper and melted tar, have long been used for showers and carry the blessing of most building codes. Some localities may have air-quality control laws that prohibit open melting of tar, and some installers consider hot-mopped pans just plain dangerous to work with. Finding someone to install one may be a problem, because this is specialized work requiring experience, speed and precision.

About ten years ago, an accident that dumped about 4 gal. of hot tar onto a carpet convinced me to look for an alternative. I tried fiberglass cloth and resin pans, but quickly rejected them because they crack at the slightest movement of the framing.

Finally I discovered CPE (chlorinated polyethylene) pan membrane material. It is thick (40 mil), tough and flexible, and it carries a 50-year guar-



Drawings: Christopher Clapp

antee. In addition, companion sealers, caulks and accessory patches (preformed corner pieces) enable me to create shower pans in any shape. Chloraloy 240 (The Noble Co., 614 Monroe St., Box 332, Grand Haven, Mich. 49417) is the brand I use, with no failures on over 600 pans. A similar product is called Composeal 40 (The Compotite Corporation, PO Box 26188, Los Angeles, Calif. 90026).

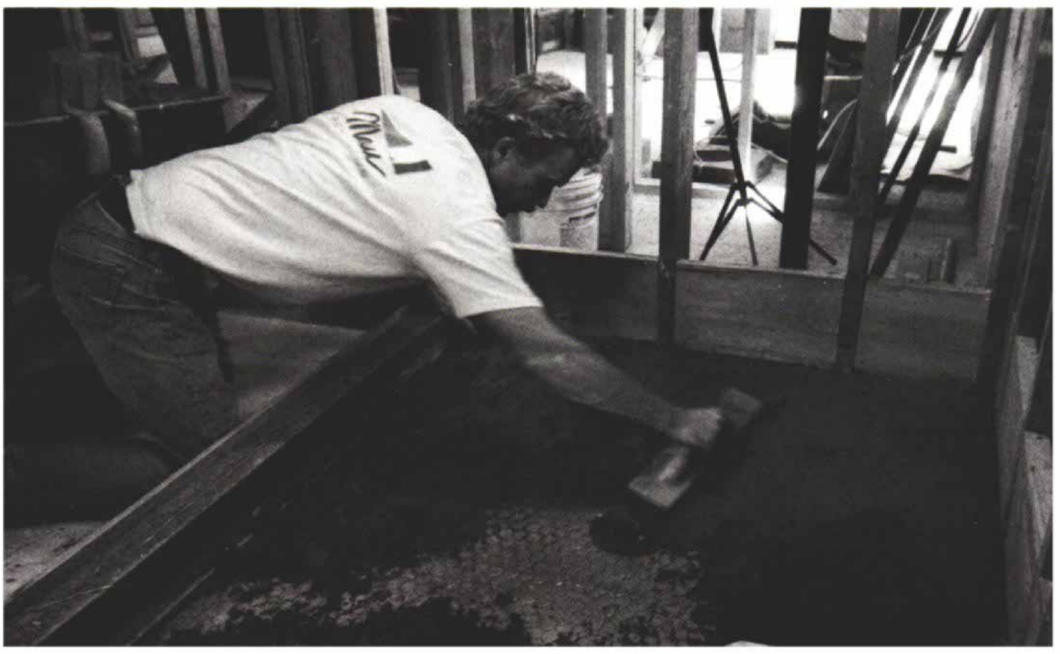
Sloping the sub-floor—To ensure that the sub-drain weep holes work properly, the shower floor must be sloped toward the drain at no less than ¼ in. to the foot (drawing, facing page, right). This involves a sloping mortar base over a level plywood subfloor.

First, I position the lower half of the sub-drain on the plywood subfloor. I cut a circular hole in the plywood that is about ½ in. smaller in diameter than the drain flange. This gives the flange ¼ in. of solid bearing, which prevents the drain casting from punching through the pan when someone steps on it. I check both halves of the casting for burrs, and if I find any, I file them off. With the lower drain half bearing on the plywood, its flange stands proud by about ¼ in.

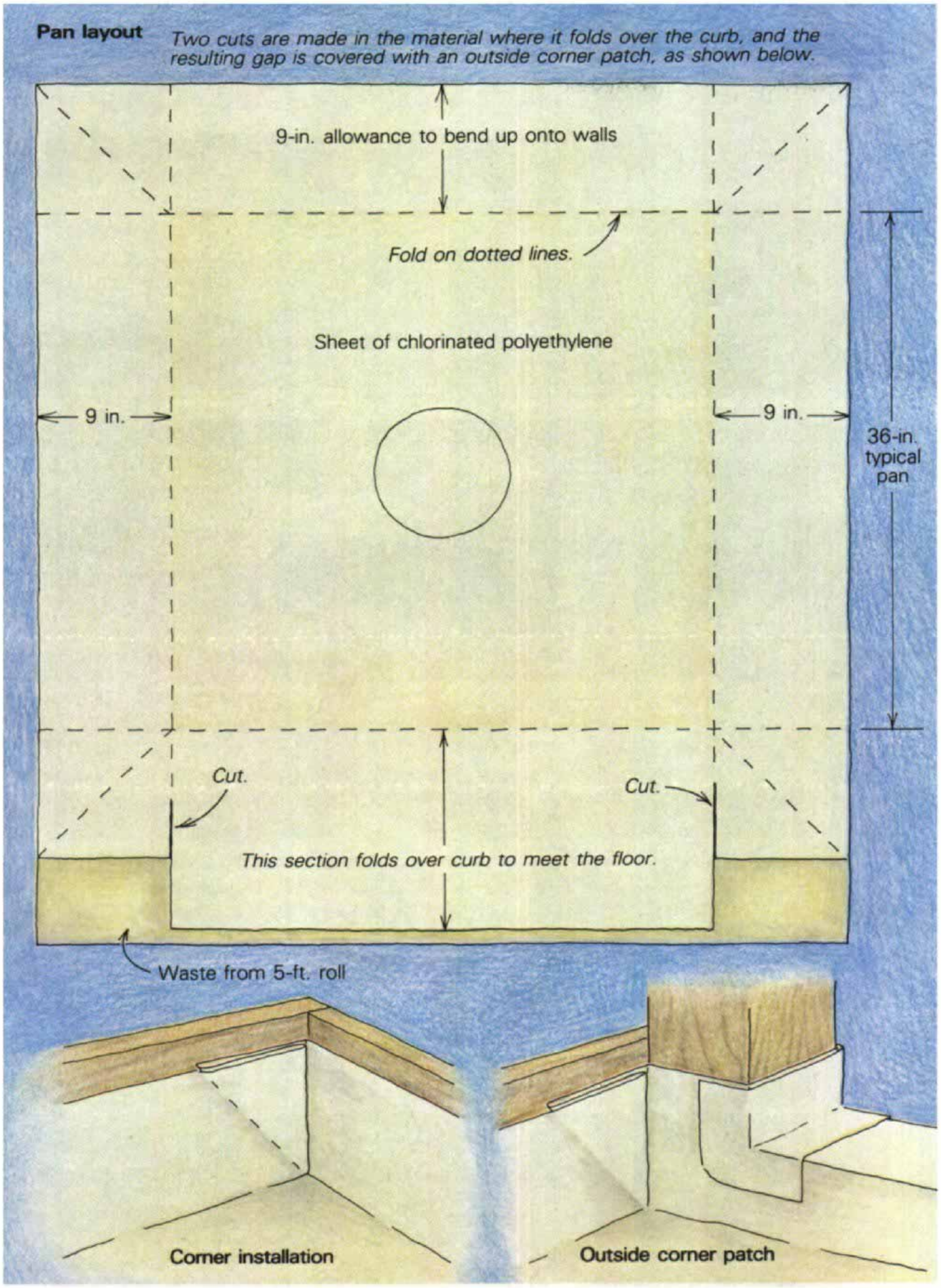
To get the proper slope, I first lay ¾-in. by ¾-in. strips around the perimeter of the 3-ft. square shower and nail them to the subfloor next to the plate. If the floor is larger than 3 ft. square, I use thicker wood strips to maintain the slope. My calculations are made from the point on the floor farthest from the drain. Then I cover the plywood with a layer of 15-lb. felt and 20-ga. 1-in. wire mesh, stapled in place. Next I mix up a batch of mortar using Laticrete 3701 (a latex admix made by Laticrete International, 1 Laticrete Park North, Bethany, Conn. 06525) instead of water. This "deck mud" is on the crumbly, dry side of mortar mixes (for more on mixing mortars, see *FHB* #25, p. 35). I pack the deck mud over the paper and wire, and float away the excess using the wood strips and drain flange as guides (photo bottom right). I let the mortar harden overnight before I fabricate the pan.

Installing a pan—In my area, the code requires the pan to extend at least 9 in. up the walls, and it must have a solid backing. Also, the lower edge of the drywall usually ends up about 9 in. above the floor, and it too must have a solid backing. Both of these needs are filled by nailing 2x10 blocking above the plate and between the studs (drawing, facing page, right).

Square shower pans are the easiest to make. First I measure the dimensions of the floor, and then add 9 in. for each wall and about 14 in. for the curb to determine the size of the CPE. The curb must be covered completely, inside face, top and outer face. The CPE will be cut to lap over the curb once the pan is in position. CPE



A tile shower can add a dazzling touch to any home (above right), but before the tiles can be applied, a careful sequence of work must be followed to prevent water damage. One way to get the necessary drainage to the center of the shower pan is to slope mortar fill over a flat subfloor (right). The thickness of the mortar is controlled by wooden strips placed around the perimeter of the pan. They needn't be removed.



comes in 5-ft. wide rolls, so I cut off a piece that best matches one of my total dimensions. At $8 to $10 a linear foot, I don't want many scraps hanging around.

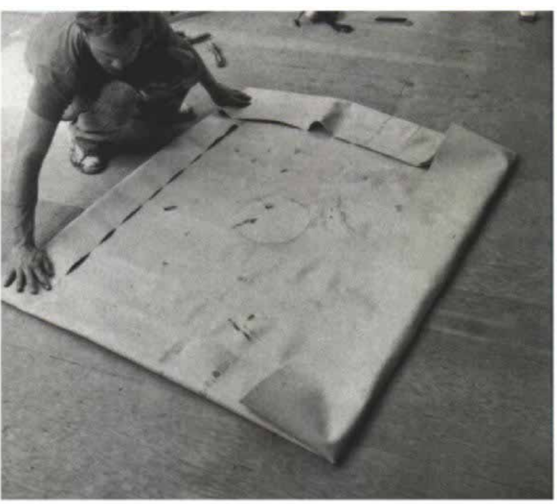
I draw the layout onto the CPE with a felt-tip marker or a pencil as shown in the drawing at left. The dotted lines show where the material laps up the walls, and how the corners are creased. At this point I glue a circle of pan material to the area that will end up between the drain halves. This makes a thicker gasket for the drain to grip at this potential point of abrasion.

To fold the pan, crease the material along the four lines that represent the perimeter of the pan. Then fold the diagonal corner creases away from the center of the pan (photo bottom left), so the triangular tabs end up between the pan and the blocking (detail drawing, far left).

During installation, this type of pan droops away from the wall, which slows down the job. To counter this tendency, I coat the blocking and the floor with asphalt roofing cement. I spread it around evenly with a ⅛-in. notched trowel. Roofing cement can be a fire hazard, so make sure the room is well ventilated and wear a mask with a charcoal filter for protection against the fumes. I also wear rubber gloves to keep the black goop off my hands.

Once I've spread the roofing cement, I screw the three bolts into the lower half of the sub-drain. This lets me feel where the bolt heads are so I know where to cut the pan for the bolts. For added insurance against leaks, I run two beads of butyl caulk around the lower drain half—one bead inside and one bead outside the bolt circle. I use either Bostik 2000 (Bostik Div., Emhart Corp., Boston St., Middleton, Mass. 01949) or Noblebond 150 (The Noble Co., address above).

Next, I roll the prefolded pan into a bundle and position it over the shower floor. Starting at the drain, I smooth the air bubbles out toward the wall and press the material into the corners, leaving no voids under or behind the pan. To flatten the folds in the corners, I drizzle some Nobleweld 100 liquid glue (also made by The Noble Co.) into the fold and hold it in place a few seconds until it sets. When I'm satisfied the pan is snug, I staple it to the blocking along the top (photo below right). Then I cover the staples



Installing the shower pan. **The pan is made of a piece of chlorinated polyethylene (CPE) sheet. After the folds in the pan (dotted lines in the drawing, above left) have been laid out, the piece is spread out flat to make the necessary folds at the corners. In the photo at far left, a circle of CPE has been glued in place at the center of the pan to thicken it where it will be sandwiched by the halves of the sub-drain. The corners of the pan are folded so that the triangular-shaped tab ends up next to the blocking. Once the pan has been positioned on the sloped mortar base, it can be stapled to the blocking along the top inch of the material (left). These staples are then covered with a layer of compatible caulking compound.**

with a glob of caulk. No staples should be located below the finished height of the curb, which is usually 6 in. At the threshold, the pan is cut and folded over the curb. The resulting gap in the pan is covered with a corner patch (detail drawing, facing page, right). These corners can be purchased from your tile supplier or made from scrap. They are glued in place with the recommended adhesive.

To put the drain halves together, feel around for the bolts, and press the CPE down over the head of each bolt with one hand. With the other hand, use a utility knife to cut out a ¼-in. dia. circle of pan material, using the bolt head as a cutting board. When all three holes are made, stretch the CPE over each bolt. Then unscrew the bolts, position the top half of the drain over its mate, reinsert the bolts and tighten them evenly with a socket wrench. Finally, remove the drain screen and cut away the disc of CPE locked in the drain.

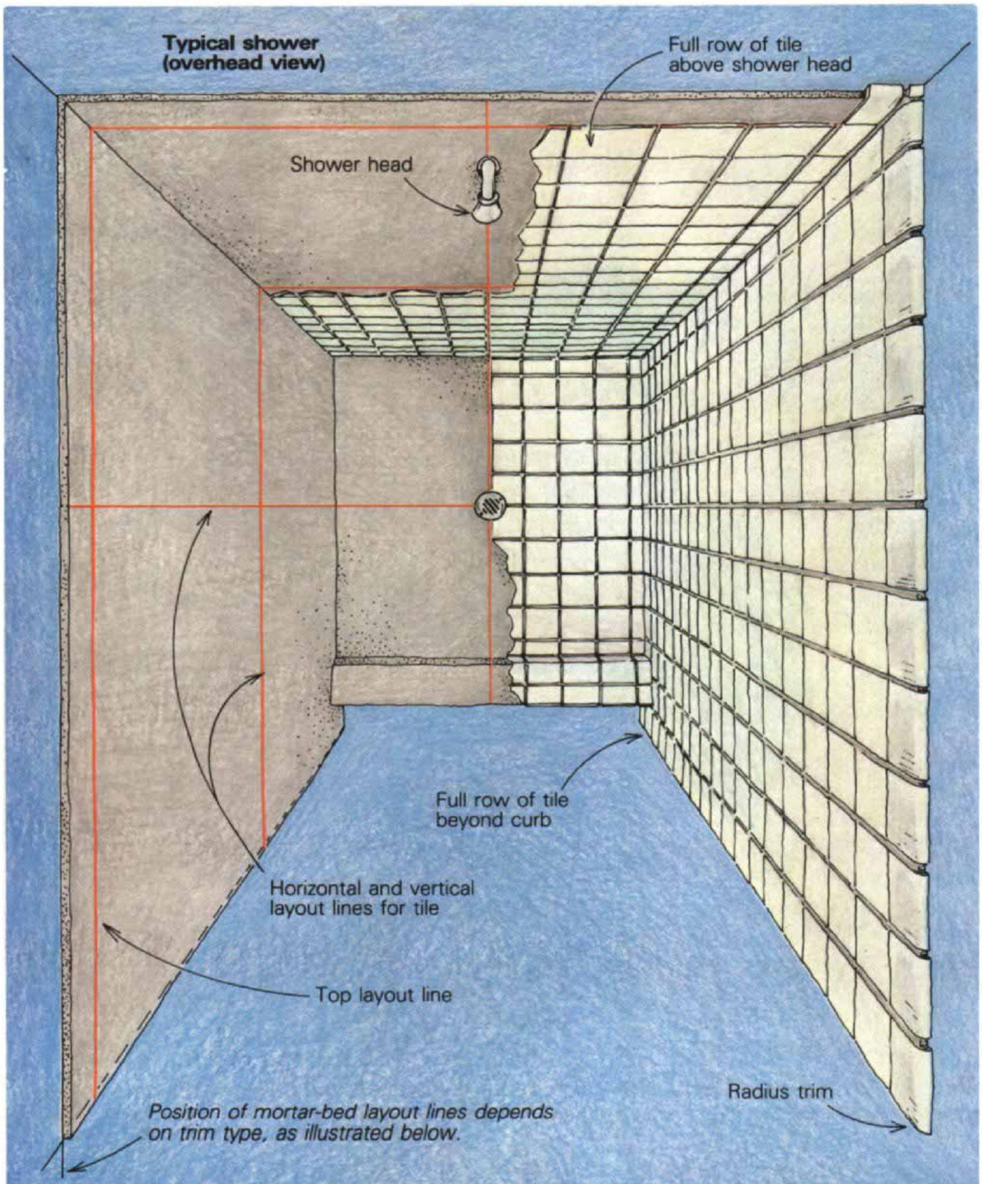
Typical mortar-bed layout—Most showers are 3 ft. square, and the wall tiles extend one row above the shower head. The flanged elbow that accepts the shower-head gooseneck is usually 72 in. above the plywood subfloor. Another full row of wall tile extends beyond the curb on the bathroom side of the shower. The layout line marks the edge of the mortar bed, and it begins next to this row of tile (drawing, top right). Its placement depends on the trim you use. The drawing at bottom right shows two trim styles, and their relationship to the bed.

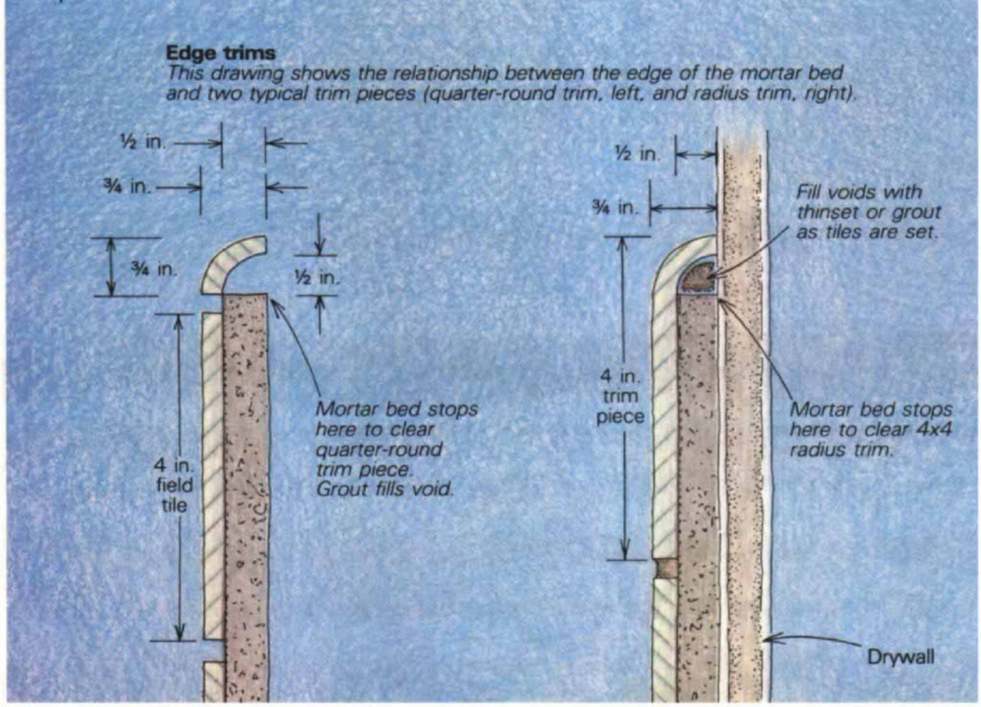
Wall membrane and wire mesh—The wall membrane is made of horizontal bands of 15-lb. felt, which are bedded in asphalt roofing cement, shingle fashion, over a substrate of water-resistant drywall. You can hang the drywall either before or after installing the pan, but be sure to protect the pan if you do the latter.

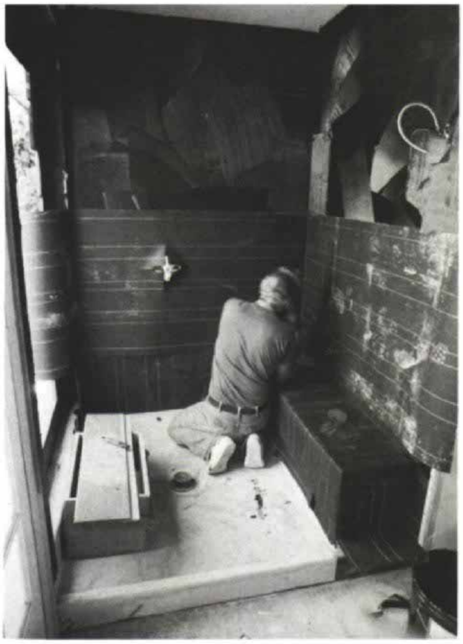
Because felt paper puckers slightly between staples when mortar is floated over it, some areas may be difficult to screed. My solution to this problem is to spread roofing cement with my ⅛-in. V-notched trowel over all the drywall, and bed the paper just like the pan (top photo, next page).

Laminating the paper to the drywall takes about 10 min. and costs about $12 to $15 for a 3-ft. by 3-ft. shower. But it's worth it. The only staple holes needed are those on the edge that laps the pan. The paper lies absolutely flat, and the roofing cement seals the paper where it usually frays and cracks in the corners—where most leaks start. The thin layer of asphalt seals around each staple as it enters the wall and is a bit of insurance against any breaks in the membrane that may go unnoticed. This step is well worth the time and effort.

The first wrapping of paper overlaps the pan by at least 5 in. (drawing, p. 46, right). After it is fastened with ½-in. staples 6 in. o. c. to the drywall, the portion overlapping the pan should be pressed into the bead of caulk, and stapled to the blocking through the caulk and the top edge of the pan. To get the felt snug in the corners and to eliminate any little coves, use a straightedge. The paper should be flat against



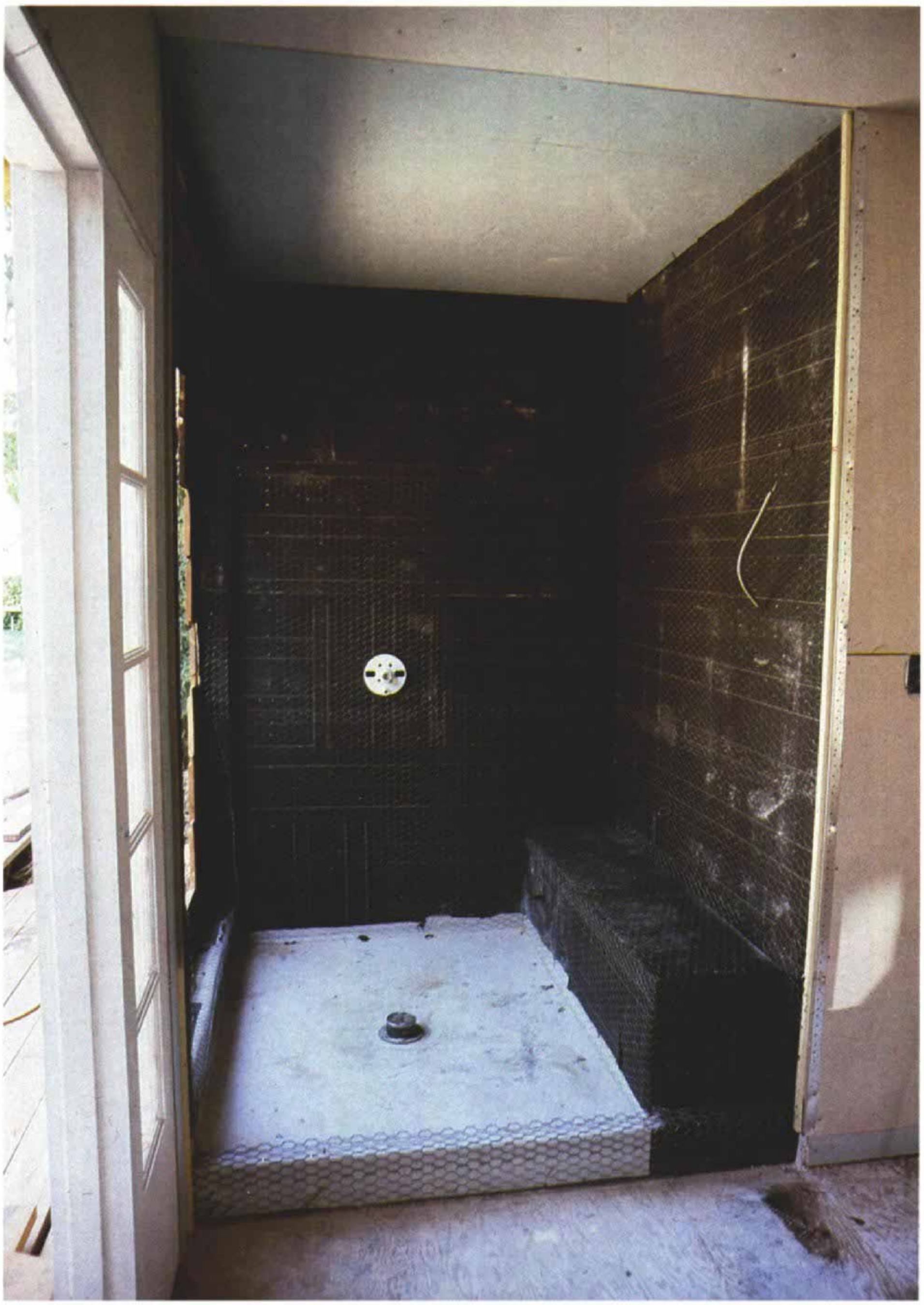




the wall and make a sharp right-angled turn. Subsequent bands of paper should overlap.

Once the wall membrane is in place, the 20-ga., 1-in. wire mesh follows (photo below). The twists in the mesh should always be parallel to the floor. This way they provide the most support for the mud. The bands of mesh should be fastened with 9/16-in. staples every 6 in. so there are no bumps or bulges, and bands should overlap each other by 2 in. The wire should be neatly folded in the corners. I find that working the tips of the tinsnips along the corner keeps the bend sharp and crisp.

At the curb, I like to double up the wire and prefold it so that it hugs the curb tightly. This allows me to use staples on the outside face only, where leaks are less of a problem. Staples are not allowed below the top inch of the curb, so to keep the wire snug here, I sometimes glue the wire in place using small strips of CPE like little belt loops. I also double the wire below the junction of the pan and the drywall to reinforce the thicker mortar (drawing, p. 46, right).



Water test—Except for placing the screeds, the job is now ready for floating the mortar bed, but at this point, do a water test. Plug the lower drain and fill the pan with water right to the top of the curb and let it sit, undisturbed, for 24 hours. If possible, get under the floor with a flashlight and look for any sign of leaks.

If I spot a leak, I first check the drain. Did I tighten the bolts firmly and evenly? If the leak is behind one of the envelope folds, I peel back the wire and cover the corner with more glue, a scrap of CPE or an accessory piece made by Noble. Any punctures are easily repaired with a little square of CPE glued on like a tire patch.

Placing the float strips—I begin on the back wall by plumbing two 1/4-in. by 1 1/4-in. wood float strips that are bedded in vertical columns of mud (photo facing page, top). The strips are located 6 in. to 8 in. in from the corners. The flanged elbow for the shower head is usually on this wall, and at this point I thread a 6-in. pipe nipple into the elbow to keep mortar out of it as the walls are floated.

To form the mortar columns that secure the float strips, I press a thin layer of mud tight onto the wire to ensure a good grip. This layer need only be thick enough to cover the wire—no more. Additional layers can then be built up 1/4 in. at a time. I cut the float strip to run the full height of the mortar bed, and then I wet it on both sides to keep it from warping. I push each one into its column of mud. With a level held against it, each float strip is plumbed so the minimum wall thickness equals 1/2 in. Due to the vagaries of wood framing, the thickness of the float will vary on the wall. But the mud allows you to make up for these framing inaccuracies, and to create plumb walls and parallel rows of tiles that don't have to be tapered. This is one of the benefits of a mortar-bed shower.

Once plumbed, the strips guide a straightedge, which screeds off the excess mud floated between the strips. After the central part of the wall has been screeded off, the two areas at the sides are in turn floated and screeded. The side walls need a slightly different treatment.

The portion of side wall nearest the back wall should be plumbed so that when tiled, the corner does not appear tapered from top to bottom. Along the outside portion, where the trim tiles meet the drywall, the bed must be a consistent 1/2 in. thick—even if the wall is out of plumb. Otherwise the grout joint between trim tiles and drywall will be tapered and unsightly. In other words, when tile meets tile—make it

Top, Byrne spreads a layer of asphalt gum on the drywall backing before he applies the felt membrane. The asphalt will help to keep the felt tight to the wall, and it seals any holes made by driving staples into the drywall. With the pan, membrane and wire in place (left), the shower stands ready for its layer of mortar. This shower is fancier than most, with a bench and what will be a glass-block wall on the left. The wire hanging down is a thermostat to control a steam-bath attachment. At this stage be sure the nipple that goes to the shower head is in its fitting. Many a shower has gone to the tiled-and-grouted stage with the supply fitting entombed somewhere above the mixer valve.

plumb. When tile meets drywall—keep the bed thickness uniform. I do this by tacking a ½-in. thick float strip vertically along the margin of the paper and wire (photo bottom right).

Mixing mortar—The mud I use for walls is different from the mud that will be used for the curb top and floor of the shower. Both are made up of 3 parts clean, sharp sand to 1 part portland cement. For the wall mortar, I add extra liquid to the mix to make a thick, spreadable paste called fat mud.

Fat mud for walls always seems to behave better if mixing is kept to a minimum. The purpose of mixing is to homogenize all the ingredients. Proportions may allow a wide margin of error, but I prefer to play it safe and measure out the dry ingredients in 5-gal. buckets. The mixing process can be a messy one, so I try to work outdoors when I can.

Once measured, the sand and cement are layered evenly in a mixing box and combined using small bites of the mixing hoe. The dry stuff needs to be mixed about three times. That means gradually chopping the mix first to one side then the other, piling it up each time. Once the sand and cement have been combined, I pour in about three-quarters of the latex admix and chop the dry stuff into it, once again back and forth with small bites. Temperature and humidity will affect the consistency of the mix. I want to end up with mud that is wet enough to be sticky and spreadable without being runny. Excess moisture weakens the mortar bed, so I add the remaining liquid carefully. Once the mud is mixed, it's dumped onto a 3-ft. sq. plywood mud board that has been dampened so it doesn't suck any moisture out of the mix. The hawk is then loaded from the board by plowing mud onto it with the trowel.

Mortaring the walls, and screeding—The mud is applied to the walls in stages. With the float strips already in place, I press a thin coat of mud firmly into the rest of the exposed wire mesh (middle photo, right) to ensure that the entire bed will be keyed into the wire. Then I apply a fill coat, depositing a layer about ¼ in. thick with each pass. When troweling over the wire coat, I don't have to press so hard, and the face of the trowel is tilted at about 35° to the wall. This can be hard work, but when I'm working with a sweet batch of mud, it becomes a pleasure. When there's enough mud on the wall, I make a pass with my screed to check for depressions in the mortar bed that need to be filled in.

For screeding, I have a set of ten nesting aluminum straightedges, which range in length from 18 in. to 6 ft. They have an L-shaped cross section, which keeps them fairly rigid and true. When I'm screeding a wall float, I use a straightedge that's at least 6 in. longer than the distance between the two float strips. Facing the wall, I grip the straightedge with both hands and ease the long blade onto the float strips. Starting at the bottom, I move the straightedge back and forth against the strips, lifting upward at the same time. This removes the excess mud (photo bottom right). The pressure against the strips should be fairly light—they should act as guides, not supports.

Where a lot of excess mortar must be removed, the straightedge may not even touch the strips. Screeding off too quickly usually tears chunks out of the mortar bed, leaving holes that have to be packed full and screeded again. Screeding too slowly may agitate the bed enough to loosen the setting particles of sand and cement and cause the bed to slump.

If the mortar is too wet, it may sag and slump away from the wall. This kind of mix must be allowed to sit a while before screeding. Mud that is too dry will take considerable effort to screed, and the float strips are often forced out of alignment.

When the straightedge is filled with mud, I remove it from the wall by continuing a sideways motion and gradually pulling it away from the surface. Good mud has a tenacious grip. If I simply pull the straightedge up and away from the wall, it may pull some mud off with it, leaving me with more holes to backfill.

Once the central portion of the back wall is screeded off, the two edge voids must be filled. I go through the floating and screeding routine first on one side, then the other.

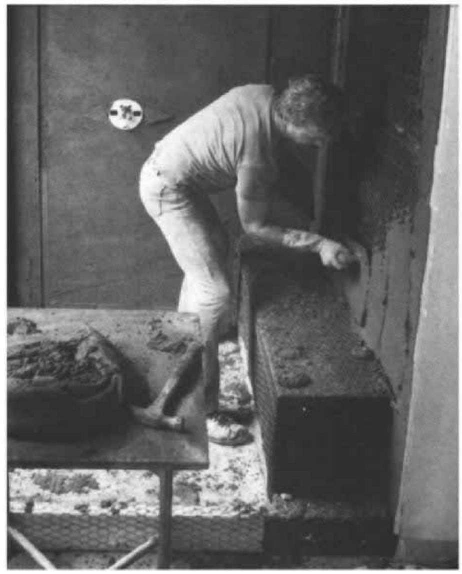
Each individual plane is treated this way until all the vertical surfaces have been covered. After each is finished, I remove the embedded float strips and pack the channel with mud. To "do this, I flatten the mud on the hawk until it's about 1 in. thick, and then I cut a strip of mud about 1 in. wide and about 1 ft. long and trowel it into the channel.

Finishing the mortar bed—The surface of an unfinished bed will be pockmarked with craters. Filling these voids increases the potential for adhesion between the tiles and the bed.

After about an hour, most of the walls have set up firmly enough for me to finish the bed with a wood float. Floats are sometimes confounding tools. My favorite is twisted all out of shape when it is dry, but after soaking in water for about five minutes the face is perfectly flat. The finish is noticeably coarser than a steel-troweled finish. I prefer the coarse finish because it leaves tiny crannies that help bond the tile to the wall.

The wooden float should literally "float" on the surface of the mud. The mortar bed is already flat from screeding, so the float is used to slice off the excess above the float-strip channels, and to pack the voids with mud. To be most effective, the float should be in constant motion, lightly carving away at any excess mortar with its edge. Whether the float is moving up or down, it must also be moving sideways as well, or the tool will begin gouging the surface. Inside corners are cleaned up by moving the float vertically, with the edge at about a 35° angle to the corner. I sometimes further sharpen an inside corner with a steel trowel to allow additional clearance for thin glass mosaics or tiny penny-round tiles.

Wall-tile installation—Once the mortar beds have been finished with the float, I let them sit overnight to get good and hard. The additive I



***Floating a shower* begins with the back wall—the one where two float strips have to be embedded in mortar. In the top photo, Byrne checks the strips for plumb, adjusting them inward with a tap of his hammer. The mortar, a sticky blend, is applied in thin layers with upward strokes of the trowel (above). The float strips on the back wall have been removed, and their cavities await backfill. Below, the excess mortar between the float strips is removed with a straightedge worked back and forth while it is simultaneously lifted slowly upward. On this wall, one ¼-in. thick float strip is embedded in a column of mud, while the other ½-in. strip is tacked to the drywall at the edge of the shower.**

use frees me from having to keep the bed damp and covered.

Before I start setting the tile, I snap in some chalk lines to divide the walls into quadrants so I don't have to fuss with the level once the walls are covered with goo. On a typical shower such as the one in the top drawing on p. 49, one vertical and one horizontal line are usually all I need on each wall. Most walls will need to have some tiles trimmed along the side to fit. Rather than just cut the tiles on one side of a wall, I take an equal amount off both sides.

I don't like to rely on shims or sand to help level the first course of tile. Instead, I use a high-quality thinset mortar that holds the tiles in position on the wall without sagging. This way I can start setting the tiles at the intersection of the plumb and level layout lines and move outward. For more detailed information on setting and grouting tile, refer to *FHB* #17, pp. 70-75 and *FHB* #25, pp. 32-37.

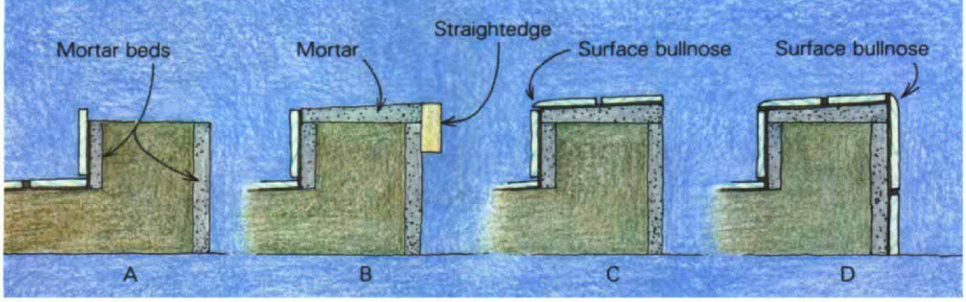
***Crumbly deck mud* is built up to half the thickness of the final depth over the pan (top left), and then a layer of wire mesh is laid upon it. Care must be taken not to clog the weep holes in the top half of the subdrain. A deposit of pea gravel or the tile spacers used here (top right) keep the mortar from plugging the holes. The last layer of deck mud is applied over the wire mesh and spread about with a wooden float. Byrne checks the slope of the mortar with a level (right), and brings its finished elevation to the edge of the drain so that the tile will be flush with the drain screen.**

Floating the floor—After the wall tiles are set, the curb top and floor can be mortared. These areas both receive a layer of deck mud—the same mix used for the sloped fill under the pan.

The floor should be floated in two steps to allow a sheet of wire mesh to be placed in the center of the bed. First I spread out enough deck mud to build up half the thickness of the finished bed (top photo, far left). To allow the water to flow freely into the weep holes in the drain, I surround the bolting flange of the drain with a handful of either pea gravel or the little plastic spacers used to align tiles (top photo, near left). The sheet of chicken wire is then placed over the first layer of mud, and the remaining mud is troweled over it to bring the bed to its finished height (middle photo, left). I level the perimeter of the bed using the wall tiles as a guide. From this height, the floor should match the subfloor's slope as it makes its way to the drain. I could use float strips to regulate the float's thickness, but I've done enough of these to use only a wood float and level to check my progress; there must be no level spots where water can collect. I usually use two wood floats for this type of work: a 14-in. float for the bulk of the mud moving, and a 10-in. float for the final forming and finishing.

Curb details

Once the vertical mortar beds are in place on the curb, the inside of the curb is tiled (section A, below). The top edge of the tile stands above the mortar, and along with a straightedge, becomes a guide for the curbtop mortar (B). Surface bullnose and field tiles are placed on the curbtop mortar (C), followed by bullnose and field tiles on the outside of the curb (D).



Setting the curb—If I'm using surface bullnose trim for the curb, I wait until the tiles on the inside of the curb have set up to float the top of the curb. This lets me use the tiles as a guide for the thickness of the mortar (drawing, left). The curb top is pitched inward at an angle of about ½ in. per foot so water sheds quickly.

When the last of the tiles is set, I allow the job to rest for a day so the thinset can harden. This lets me really force the grout into the tile work. As a final precaution against leaks, I wait until the grout has cured (three days with additives, twenty-eight days without) and then I run a bead of silicone caulk along all the inside corners to seal off any cracks that may appear once the shower is in use. □

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