Roughing in the Drain Lines

Advice on assembling a residential drainage system with plastic pipes

by George Skaates

When you've got a pad of yellow paper in your lap and a set of blueprints, on the table, you can do a lot of plumbing without getting dirty. As I explained in my article on designing and sizing drainage systems (*FHB* #29, pp. 51-55) every well-organized job begins with isometric drawings of the various drain configurations, and lists of the fittings and pipes necessary to make the drawings a reality. Once you've got your drawings and lists figured out, you've got to get down to the nitty-gritty of plumbing, from squirming around in a crawl space with a glue pot in one hand to boring a vent hole in the roof sheathing with a Hole Hawg.

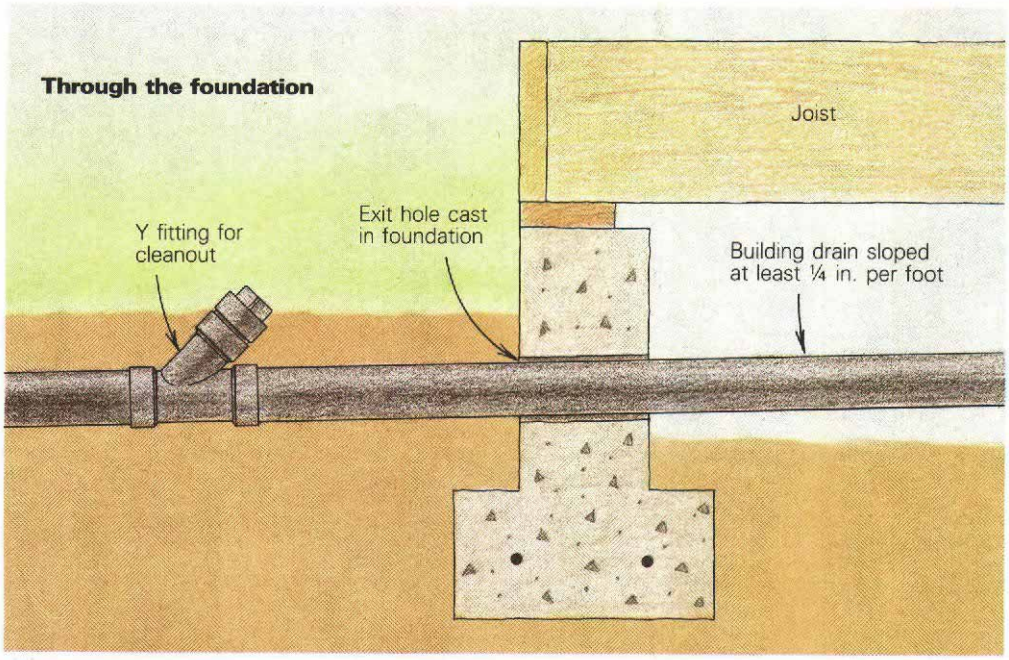
Although I install plenty of cast-iron drain lines for my customers, most of the systems that I put together are made out of ABS (acrylo-nitrile-butadiene-styrene) plastic. My clients often ask about the relative merits of cast-iron and plastic systems. Cast iron is better at absorbing the sounds made by running water, so if you'd rather not hear the system at work you should consider cast-iron pipes. Plastic pipes transmit sound, and they expand and contract at a rate roughly eight times that of cast iron. That means a plastic drain system requires a lot more anchoring devices to keep it from moving out of alignment. Still, plastic is a lot easier to work with than cast iron, and the fittings and pipe cost about one-third as much. Also, plastic weighs a fraction of what cast iron weighs, so one person can handle materials that traditionally took two.

Getting through the foundation—When I bid a plumbing job for a house, 1 make my calculations based on a drainage system that extends 2 ft. beyond the foundation. Tying into the sewer is a topic all by itself. Like my bids, this article will start just outside the foundation, and finish at the roof vents.

If you don't already know the location of the city sewer line, call the appropriate agency and ask them for the location of the sewer to which the drain will be connected. Under most conditions, the corner of the house that is closest to the sewer or the septic system is the point at which you will need a hole in the foundation for the building drain.

Before the foundation is poured, I get together with the contractor and we agree on the best spot for the plumbing penetration. Aesthetics and pragmatism are factors here—the drain should end up below grade after backfill, and it should be far enough below grade to ensure a

Under the floor. **In the center of the photo, a 3-in. soil line leads to a 4x3 closet ell. A few feet in front of the ell, a 3x2 sanitary tee turned at a 45° angle leads to a vent for the water closet. At the plate line, the vent is extended upward with a 10-ft. mast for a water test. To its left, a branch line goes to a stub for a lavatory and an upstairs laundry. In the lower right, a stub protrudes for a bathtub. The drain line in the center is secured with a plastic hanger.**



fall of ¼ in. per linear foot of drain line from the plumbing fixture farthest from the foundation penetration (drawing, above). If the foundation is a stemwall and the drain is 3 in. in diameter, I use a piece of 4-in. plastic pipe as a form insert. The insert leaves enough space for the 3-in. pipe plus a little wiggle room for settling.

If the building drain is 4 in. in diameter, I still use a 4-in. form insert, but I build it up with a ½-in. layer of Flexwrap (Cal Western Supply, 1111A East Houston, Visalia, Calif. 93291). Flexwrap is 1/8-in. thick plastic foam that comes in 8-in. wide rolls. It's mostly used to wrap drain lines that will be entombed under slabs. When removed, the built-up form insert gives me enough room to run a 4-in. line.

I see more and more houses built on pier and grade-beam foundations these days. With these, the perimeter footings are usually shallow enough to tunnel under them, rather than running the line through the concrete.

In the crawl space—With a set of the plans in hand, I walk around the joisted subfloor and mark the locations of each fixture and vent with a crayon. If it's going to be a two-story house, I mark the location of the soil stack that will serve the upstairs bath. This line usually has to be installed with great accuracy because it's often in an interior wall.

Once I've determined how big the drain lines need to be to service the house, I begin my installation by laying out the unconnected lengths of pipe in their approximate locations. While the joists are in place, the subfloor is not, so it's easy to spread out the pipes and gain access to the crawl space. I start laying out the pipes near the exit point in the foundation, working each line toward the cluster of drains that it will serve. ABS pipe comes in 20-ft. lengths, and I try to use pieces that are full length wherever they will fit. Chances are I will be cutting into some of these long runs where drain lines intersect, but it's easier to align them initially if the pipes are as long as possible.

Once I have the pipes spread, I take another look at my isometric drawings, noting the intersections of the various drain lines and the fittings that it will take to join them. Then I lay the fittings next to the pipes, in the spots where they will be needed. This includes all my change-of-direction fittings, couplings and cleanouts. Getting all the parts spread out this way helps me to visualize the way the system will look when it's finished. Even with plenty of planning, I know that I'll have to tinker with the lines to get everything to fit. For making changes in the direction of the drain lines, I keep a good supply of 45° ells, Ys, 90° long-turn ells and combos on hand, in all the common pipe diameters.

Fittings distributed, I go back to where the building drain will exit through the foundation, and begin hanging the pipes with ABS pipe hangers. This type of hanger secures the pipe with a plastic ring that is affixed to a straight piece of plastic rod. When I've got the pipe at the right height, I drive a nail through the rod into a nearby block or joist (photo previous page). Then I snap the rod off flush with the tops of the joists.

As I hang the pipe near the exit point, I make sure that its centerline is close to that of the hole that passes through the foundation. Then I work toward the location of the fixtures that the line will serve, hanging each section of pipe so that it slopes toward the exit at ¼ in. per foot minimum. To calculate the slope, I use a plumber's torpedo level. It has graduations on it that show when a pipe is sloping at the proper angle.

At this stage I don't connect any of these pipes as I hang them. Instead, I butt them together. They will eventually be glued to one another, but for now I want to be able to move them around if need be. ABS pipes have to be anchored every 4 ft., but during this preliminary work I leave out half the hangers, and because I may want to adjust them, I don't drive the hanger nails in all the way.

Usually there is a water closet at the end of each one of these lines, so the pipes are at least 3 in. in diameter. I aim each of these horizontal lines to end up under the water closet, as shown in the photo on the previous page. All the nearby fixtures will drain into this line by way of combination or Y fittings.

Getting through the floor—Once the horizontal lines are hung, it's time to install the fittings that get the pipes above the subfloor. Most of them will end up in walls. If the wall is to contain 3-in. or 4-in. pipes, it should be framed with 2x6s. Experienced contractors know this, but I have to remind owner-builders from time to time. The goal is to leave pipe stubs for each fixture and vent protruding at least 4 in. above the tops of the joists. This leaves enough pipe to glue to a coupling once the subfloor and wall plates are installed. When the pipe stubs are in place, each one is capped and the system is filled with water to check for any leaks. Then the inspector pays a visit. More on this in a bit.

Every plumbing job presents its own set of challenges, and the conditions I find influence the way I approach a job. There are plenty of ways to run pipes from the building drain to a water closet. The challenge is to do it with as few fittings and contortions as possible. I have to think about how I can install the system with a minimum of cutting into the framing, or getting in the way of other mechanicals still to come, such as heating ducts.

Some knowledge of framing carpentry is essential for a plumber. Sometimes the framing has to be changed, and I have to know what the options are. For instance, a floor joist may fall directly in the center of a closet flange. In a case like this, I've got to get the contractor to pull the joist and head it off.

Usually I begin final assembly of the horizontal lines by anchoring a fixture stub that requires accurate positioning to the framing, and then I work back toward the drain exit. For example, the center of the closet flange for most water closets has to be 12 in. to 12½ in. from the unfinished wall. After I mark the centerline on a nearby joist I nail a 2x4 block between the joists and strap the closet ell to the block (top photo, facing page). This way I've got the ell secured on the right centerline, and firmly supported from below. To strap plastic plumbing, I use ABS plumbers tape, with at least one full wrap around the pipe or fitting. Metal tape is not allowed by code because it will score the plastic as the pipes flex with temperature changes.

Cutting and gluing—When I first started plumbing with plastic pipe I used a crosscut saw to cut the stuff. This works okay, but it's hard to get a square cut with a handsaw, and the sawteeth leave burrs that have to be removed with a pocket knife. Now I use a big tubing cutter that is made specifically for plastic pipe. Both Reed (Reed Manufacturing Co., 1425 W. 8th St., Erie, Pa. 16512) and Ridgid (Ridge Tool Company, 400 Clark St., Elyria, Ohio 44036-2023) make good ones. The tubing cutter makes square cuts without burrs.

Glue specially formulated for ABS comes from your supplier in cans that range from half-pints to gallons, with applicator brushes affixed to the lids. I use pint cans for small-diameter pipes, and quart cans for 3 in. and up because

Drawings; Chuck Lockhart

the brushes are sized accordingly. To join a pipe and a fitting, both must be dry and clean. Fittings have hubs on their ends that taper inward toward flanges that restrict the travel of the pipe. When you are measuring the length of a pipe between two fittings, measure to the flanges.

To join a pipe and a fitting, generously swab the inside of the fitting with a glue-laden brush. Then quickly do the same to the end of the pipe—you want the glue to be wet when they go together. Now push the pipe into the fitting. When it bottoms out against the flange, twist it a quarter-turn. If you've used the right amount of glue, there should now be a wet bead of glue all the way around the pipe where it enters the fitting. When it dries (in a few minutes), the two are welded together and you can forget about trying to pull them apart, ever.

Unfortunately, ABS glue tends to stick not only to the pipes but to the plumber as well. It inevitably gets on my hands. If I have a lot of gluing to do and I have a helper handy, I sometimes wear cheap cloth gloves. Without a helper, it's difficult to get a good grip on-the pipes while wearing gloves, so I end up using acetone to get the dried glue off my hands.

Assembly—Once I have a fitting such as the closet ell (photo top right) secured, I gather the pipes and fittings necessary to add a vent line and to connect it with the uphill end of my horizontal drain. Code requires a vent within 6 ft. of a water closet plumbed with 3-in. pipe and within 10 ft. with 4-in. pipe. So installing a vent is the next task. In this instance, I used a 3x2 sanitary tee turned at a 45° angle along with a 90° elbow to lead the 2-in. vent line toward the wall cavity. To make sure the sanitary tee ended up at 45° after I glued it in place, I dry-fit the tee on the pipe coming from the closet ell, and made registration marks with a crayon on the pipe and the hub of the tee. This way I could tell how far to twist the freshly glued fitting to have it end up at the right angle.

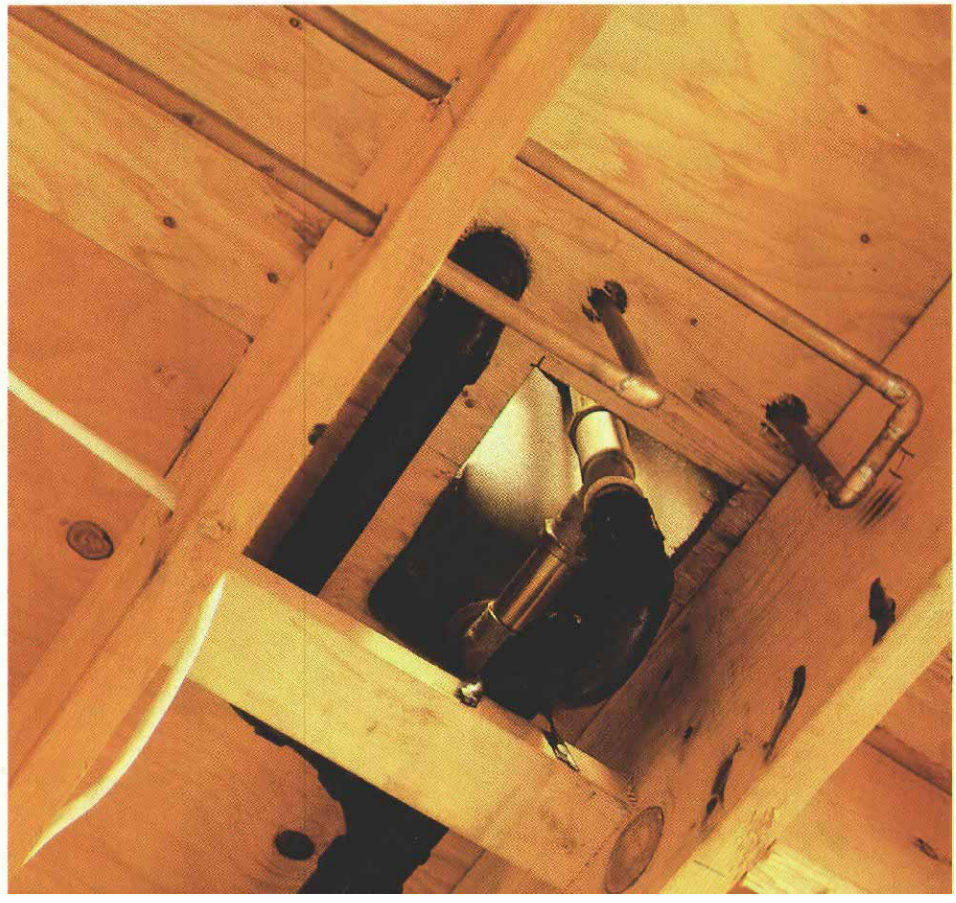
With this assembly, I next cut a short length of 2-in. pipe to connect a 90° elbow with the 2-in. outlet from the sanitary tee. Then I held another 90° elbow against the rim joist, and measured the flange-to-flange distance between the two ells. This measurement gave me the length of the horizontal vent. After cutting a piece of 2-in. pipe to that length, I glued a 90° ell onto one end of it. Then I glued the other end to the elbow coming from the sanitary tee, making sure the elbow at the opposite end pointed upward.

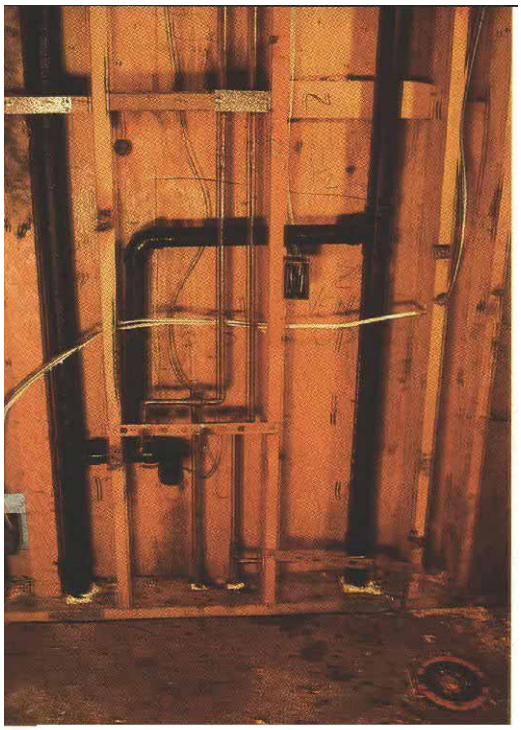
Because the location of the vent in the wall wasn't critical in this situation, I didn't have to secure the elbow next to the rim joist before connecting a pipe to it. In this manner, subassemblies of pipes can be glued together, then fitted into difficult-to-reach areas.

As I glue the pipes together, 1 pay attention to the labeling on the pipe. Once installed, the labels are required by code to be visible to the inspector. I like to see all labels on horizontal lines pointing straight up, aligned on high noon.

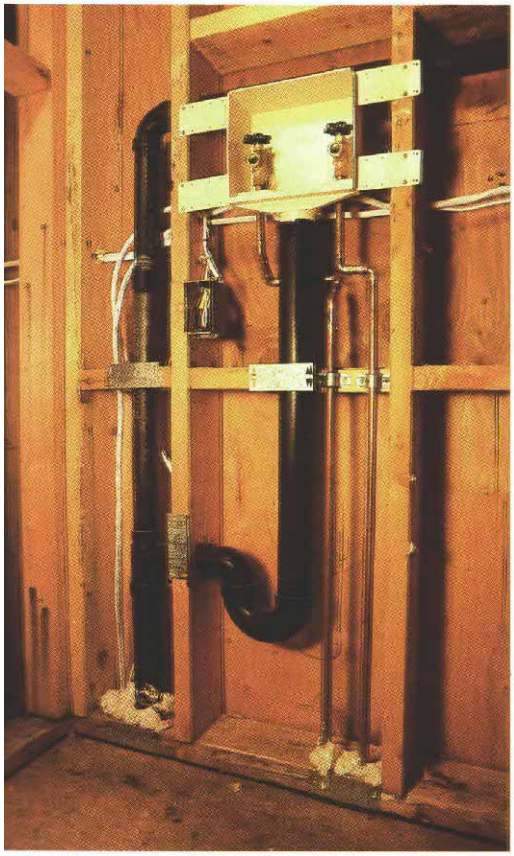
A rule of thumb for assembling ABS drain pipes is always to work away from fittings and pipes that have been secured. Sometimes though, you've got to link a couple of fastened fittings

***Alignment is* critical. The mark on the joist to the right of the water-closet drain stub in the photo above shows the closet flange centerline from the wall. Above it, the X marks the line of the wall. The tub p-trap (photo below) was positioned after the bathtub was in place. Most bathtubs have a skirt that conceals the floor behind them, so you can cut a fairly large hole in the floor to make it easier to align the fittings.**





After enclosure. **The same bathroom as the one on p. 33 with walls shows how the pipe stubs have been extended. A lavatory will connect to the branch drain feeding into the drain stack on the left. A vent rises from the branch drain, and turns right to connect with the toilet vent. A closet flange has been attached to the stub coming from the closet ell. Note the metal plates on the framing to protect the plumbing.**



A recessed laundry box organizes the washing-machine supply lines and drain. The drain stack in the lower left corner is the extension from the downstairs bathroom in the photo at the top of the page. Urethane foam fills the gaps around the pipes at the plates, securing the pipes and cutting air infiltration.

with a section of pipe. In this case, a repair coupling can help. This coupling lacks the interior flanges of the regular coupling, which allows it to slide over a pipe. To use it, glue your pipes to their fixed locations so they end up butting one another—don't forget to slide the coupling on one of them first. Now swab the ends of the two adjoining pipes with glue, and slide the coupling back to where it overlaps the two pipes equally. This requires quick work.

As I do the final assembly of the pipes and fittings, I make sure everything that needs gluing in the immediate area gets glued. It is not pleasant to pull a system apart to glue the forgotten fitting. I also stress to all of my employees the importance of securing the pipes as you go. On horizontal runs, ABS has to be supported every 4 ft., and as I work my way toward the exit point I add any missing hangers. Plastic hangers are expensive, so instead of using more of them I use ABS tape wrapped around the pipe and screwed to a 2x4 block when the pipes are in a joist bay. Below the joists, I use sway braces. Sway braces are lengths of 2x4s with a wide V cut in one end (drawing, below). A double wrap of ABS tape secures the pipe at the V-cut end. The brace is nailed to a nearby joist or block. I install my sway braces at opposing angles—this way the pipes really stay put.

First rough inspection—The first visit from the inspector is to check the subfloor plumbing. All the horizontal drain lines in the crawl space have to be connected and secured, and the building drain taken beyond the foundation to a Y fitting. All the drain and vent lines have to extend above the subfloor, where they are capped for the first water test. There are exceptions to this. If I don't know the exact location of a shower or a tub p-trap I can cap the branch drain below subfloor height, and install the p-trap once the tub or shower is on site. Under these circumstances, I usually cut a big hole in the subfloor behind the tub surround (bottom photo, previous page), giving me enough room to work.

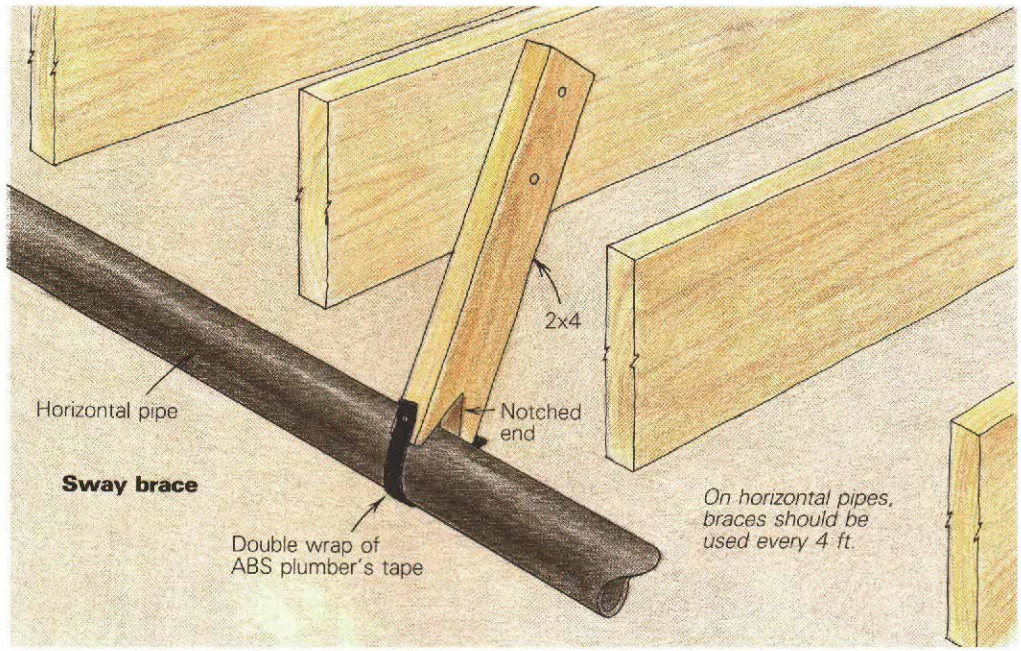
There are three kinds of caps that can temporarily seal ABS pipe for water tests. Two are glued in place, one clamps on. One of the glue-ons fits inside a pipe, while the other fits over a pipe like a jar lid. Of the two, I prefer the former—it's easier to remove and less likely to leak. I like the clamp-on kind the best of all. It's a rubber cap with a metal band that can be tightened. Clamp-on caps rarely leak, and they can be reused.

Once the glue has had a chance to dry for 24 hours, you have to pressurize the system to check for leaks. To do so, attach a vertical length of pipe to an uncapped vent or drain, as shown in the photo on p. 33. It has to extend 10 ft. above the highest fitting in the system. It will eventually be filled with water, so brace it with a stud. Now plug the Y fitting outside the foundation with a mechanical test plug or an inflatable rubber test ball. If you don't own one of these, a contractor's rental yard will have one. I prefer the mechanical plug. In a pinch, a cap backed by a stake driven into the ground will also work.

If a system is going to leak, it usually does so around the threaded cleanout plugs. I've found that wrapping the plug's threads with Teflon tape and then coating the wrapped threads with a liberal application of pipe dope will keep these leaks to a minimum. (Make sure the pipe dope is compatible with ABS pipes.)

When you're sure everything is capped and plugged, stick a hose down the pipe mast and fill up the system. When it overflows, turn it off and let it sit while the air bubbles come to the surface. Then top it off, and let it sit overnight. The 10-ft. head is enough to put about 5 lb. of pressure on the system. This will make unglued joints quite evident. If you're losing water and can't see it, the test bulb is leaking.

Cutting into the frame—Once the inspector signs off the subfloor rough, I pull the plug on the exterior Y fitting and drain the system. Now the carpenters go to work, and I don't return until all the studwalls are in place, the roof sheathing is nailed down and the pipe stubs are



protruding through the bottom plates. Then it's my turn to cut wood.

I carry a skillsaw, a Sawzall and a Hole Hawg in my tool box for modifying the framing. They are all indispensable, but the Hole Hawg gets used the most. Along with the Hole Hawg, I bought Milwaukee's plumber's kit, which includes self-feeding bits that are sized for pipes. They cut holes that are about ⅜ in. oversize for each diameter pipe.

Like all high-torque drills, the Hole Hawg has to be used with caution. If you hit a knot or a nail with the bit, the bit stops but the tool wants to continue in the opposite direction. Be aware of this. Always position yourself so that the tool won't smash your hand into a stud or whack you in the face if the bit binds. Try to rest the tool against something solid while operating it. Because nails are common obstacles in wall drilling, I keep a cat's paw in my kit.

Sometimes cutting holes in plates and studs that are large enough for pipes leaves very little wood in some parts of the frame, so the pipes have to be protected by metal plates where the remaining wood isn't thick enough to take the length of a drywall nail (top photo, facing page).

Sometimes you have to cut through a floor joist to get a drain into the right location. When this happens, never remove wood from the tops or bottoms of the joists. To do so would destroy the loadbearing, compression/tension properties of the joist. You can however, cut a hole in the center of a joist to accommodate a pipe. The largest allowable hole is equal to a third of the depth of the joist.

This basic lavatory drain is secured to a 2x4 block. The outlet from a sanitary tee atop a vertical drain is capped with a threaded plug. The plug is screwed to a threaded trap adaptor that is glued to the tee. When the sink is installed, its tailpiece will fit into the trap adaptor, where it will be sealed with a compression ring.

Washing machines and sinks—In addition to water closets, kitchen sinks and lavatories, a typical residential plumbing system will have a drain for a washing machine. 1 like to run its fouling chamber (the drain line above the p-trap) into a recessed laundry box (bottom photo, facing page). The box fits flush with the drywall, and includes space for the water supply valves.

Typically a sink will drain into a sanitary tee. The drain will go straight down, and the vent straight up (photo left). The top photo on the facing page shows a variation on this. Here the sink will drain into a 90° long-turn ell, which is connected to a trap arm. The vent comes off the trap arm, rises and makes a turn to the right where it links up with the water closet vent.

There are a lot of ways to handle the various conditions you find in a plumbing job. The best way to find out about what works and what is legal is to get a copy of the Uniform Plumbing Code ($34.00 plus applicable tax from the International Assn. of Plumbing and Mechanical Officials, 5032 Alhambra Ave., Los Angeles, Calif. 90032) and scrutinize the pertinent sections.

Vents—In the walls or in the attic space, a vent line can be at any angle from horizontal to vertical. It cannot, however, slope downward. Vents leave the building vertically through the roof, where they pass through a flashing. They have to extend at least 6 in. above the roof. Horizontally, they have to be at least 10 ft. away from a window, and at least 1 ft. from a vertical wall such as a dormer or a parapet. According to ABS pipe manufacturers, the carbon pigment that turns the plastic black will protect it from the sun, so you don't have to paint it.

When I install an ABS system, I use roof flashings made by the Oatey Co. (6600 Smith Ave., Newark, Calif. 94560). They have neoprene collars that are sized for the common pipe diameters. The neoprene fits tightly around the pipe, preventing leaks while still allowing the pipe to move up and down as it expands and contracts with temperature swings. Since I'm usually not around when the roof gets shingled, I ask the contractor about the roof finish. For composition shingles I leave the standard flashings—shake roofs need larger ones.

When the vents are through the roof, it's time for another inspection. I plug the Y outside the foundation again, and I make sure that any open drain lines are closed with glue-on plugs or threaded caps. Then I stick the hose in one of the vents, and fill the system until the lowest vent on the roof overflows. If I can't find any leaks, I call the inspector. I don't return to hook up the fixtures until the walls have been painted, but that's another story.

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