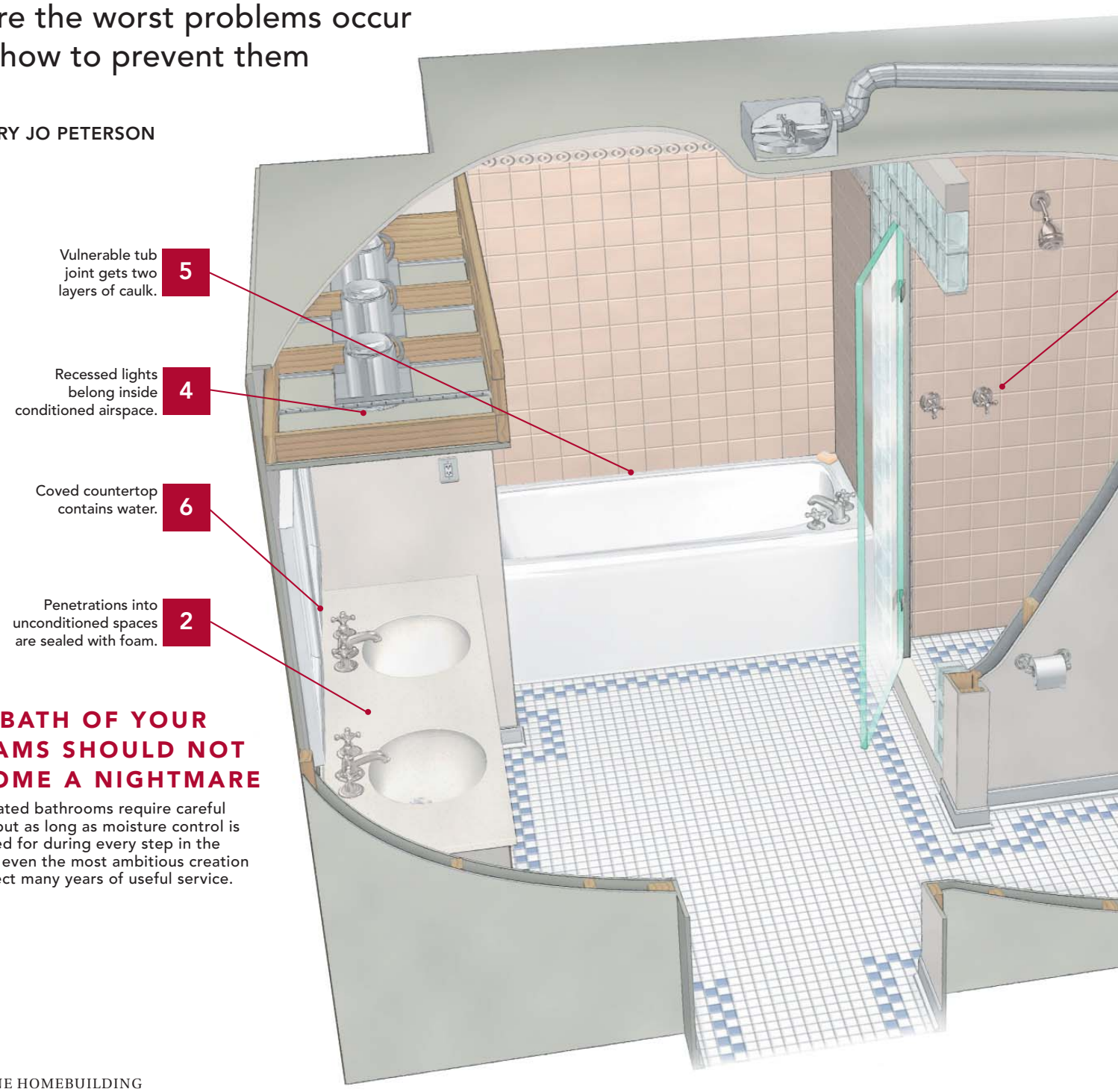
Preventing Moisture Problems in Bathrooms

As a veteran kitchen and bath designer, I've created my share of glamorous bathrooms, complete with oversize showers, giant soaking tubs, whirlpools, saunas and the like. I wish I could say that all of my clients come to me for the bathroom of their dreams; sadly, a lot of them show up at my door after water leaks and humidity have rendered the bath of their

A poorly designed bathroom is no better than a leaky roof; an experienced bath designer tells where the worst problems occur and how to prevent them

BY MARY JO PETERSON

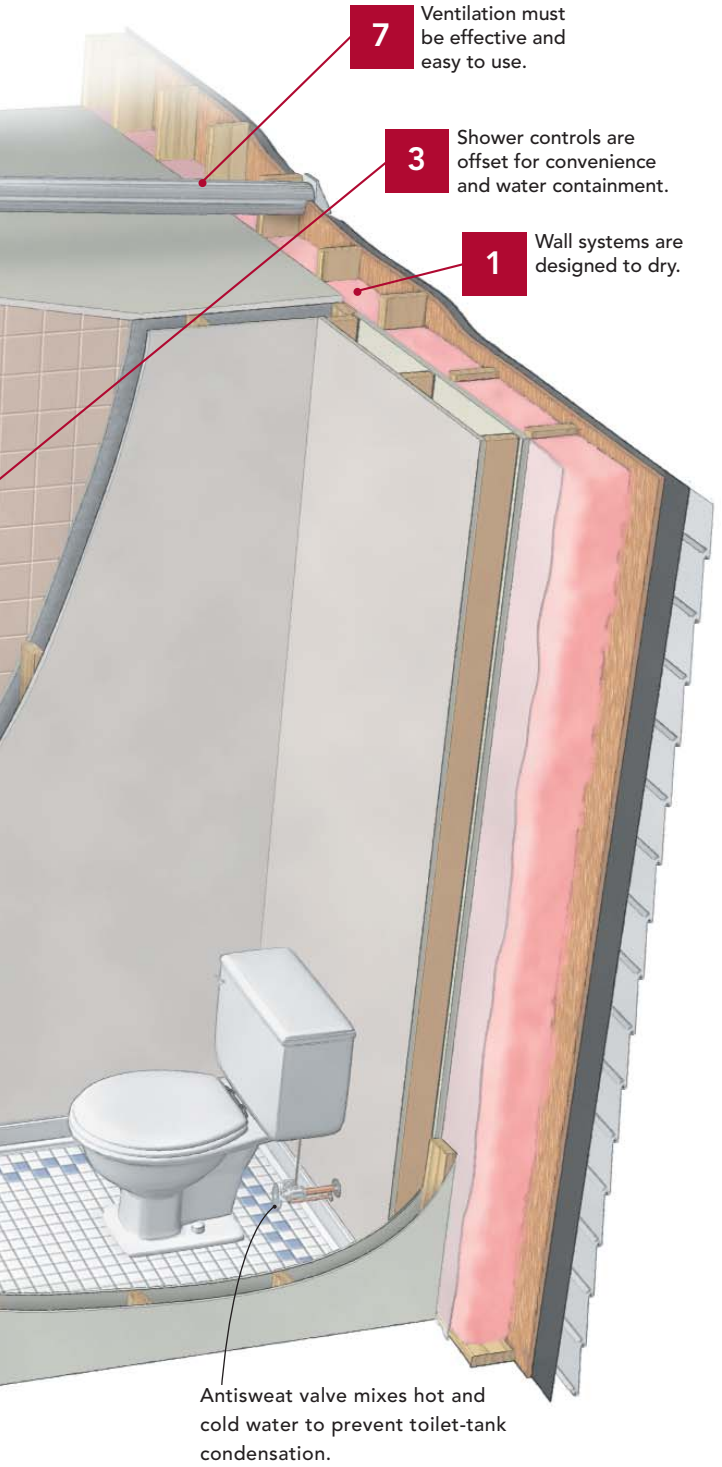


THE BATH OF YOUR DREAMS SHOULD NOT BECOME A NIGHTMARE

Complicated bathrooms require careful design, but as long as moisture control is accounted for during every step in the process, even the most ambitious creation can expect many years of useful service.

dreams unusable. Today's bathrooms unleash copious amounts of moisture, all of which must be carefully controlled, or the results can be devastating (can you say mold?).

Although I'm glad to have the business, I want my work to last, so I'm always alert to improvements in products, design and construction that address these issues. Following are a few of the strategies that I use to ensure



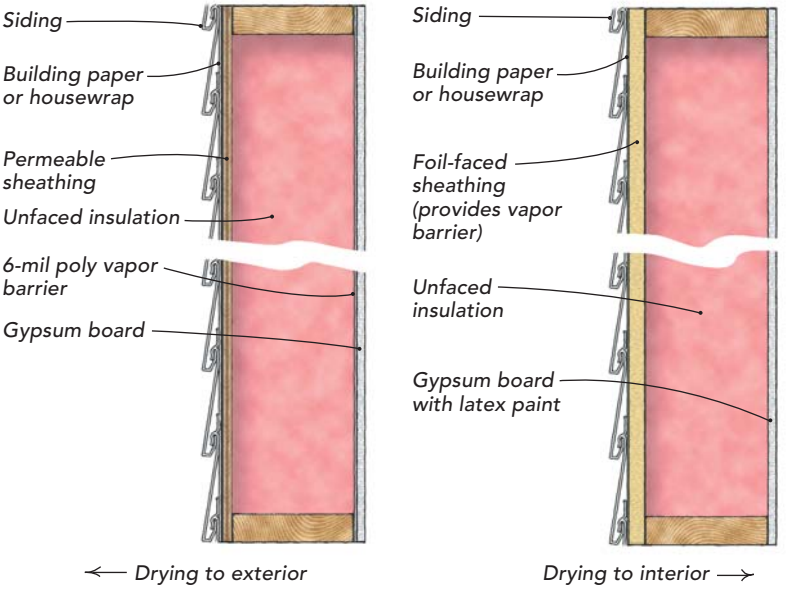
1 Exterior bathroom walls must be able to dry

Cold-climate wall assembly dries to the exterior

In regions where interior humidity levels are typically greater than those on the outside, a vapor barrier is placed on the interior surface of the wall, while permeable sheathings are used on the exterior.

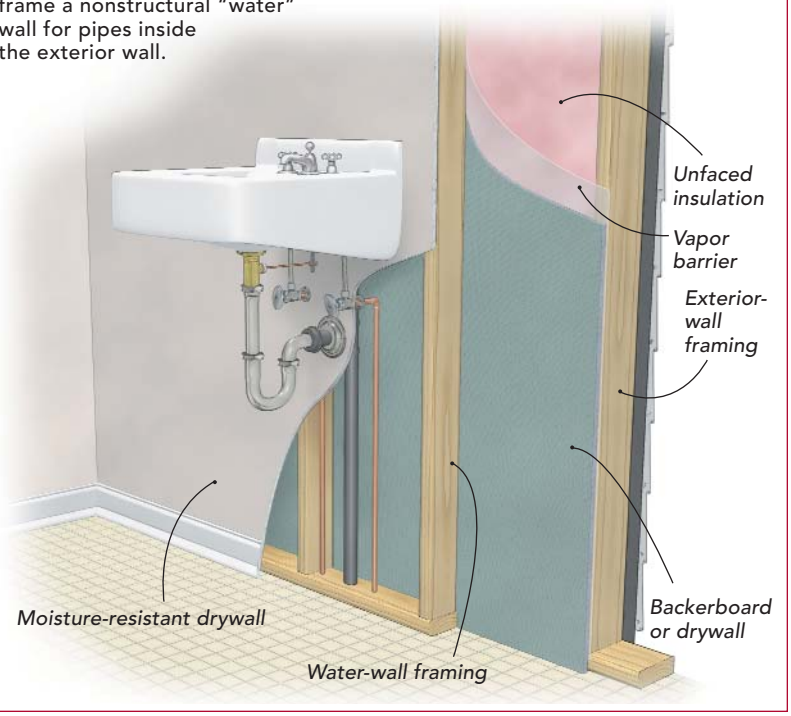
Hot/humid-climate wall should dry to the interior

In regions where exterior humidity levels are typically greater than those on the inside, the vapor barrier goes on the outside of the wall, while permeable sheathings go on the inside.



Plumbing lines belong indoors

If plumbing lines have to be located along exterior walls, the best way to maintain an impermeable vapor barrier (and to ensure that the pipes won't freeze) is to frame a nonstructural "water" wall for pipes inside the exterior wall.



Drawings: Wow House

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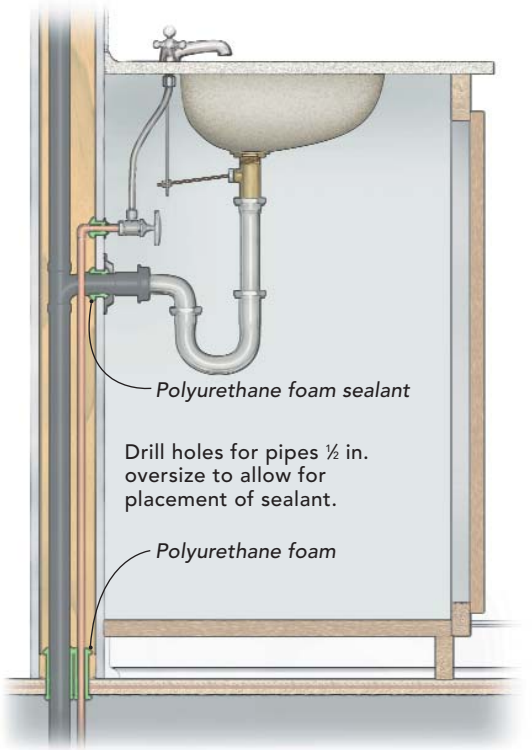
Seal all gaps to keep moisture in its place

To prevent moisture from escaping a humid bath environment and condensing within walls, floors or ceilings, every penetration should be sealed with a long-lasting, flexible sealant such as polyurethane foam.



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Looks funky but makes sense

Placing water controls closer to the door (rather than centered on the shower head) makes them easier to use and lessens the likelihood of water escaping from the shower.

that none of my dream baths ever become someone else's nightmare.

Use the proper wall assembly for the climate

Today's tight construction methods yield big dividends in terms of comfort and energy efficiency, but they don't dry out like the drafty walls of old (for more information, see "Ensuring the Durability of Energy-Efficient Houses," *FHB* #132, pp. 72-77). To prevent trapped moisture, exterior bathroom walls must be designed carefully. In certain climates, a properly installed vapor barrier can be a valuable part of that design.

Assuming all other aspects of moisture control are handled correctly, the main influence on the location of the vapor barrier is climate. Moisture tends to migrate from areas of greater (or warmer) concentrations into areas of lesser (or colder) concentrations. In a heating climate, such as New England where I work, a vapor barrier is placed on the interior of wood-frame walls and ceilings, and permeable exterior sheathings are installed to allow any moisture that gets into the wall cavity to dry to the exterior (detail 1, top right, p. 53). In a cooling climate, however, the opposite might be true. Wall assemblies in general and vapor barriers in particular are controversial subjects. Consult a building-science expert in your area to find out what might work best for you.

Leave no draft unsealed

Because most moisture that enters framing cavities is airborne, air leaks present significant opportunities for moisture to build up behind walls or under floors. Common spots for drafts include rough-ins for electrical, plumbing or mechanical systems; drains for tubs and showers; and cutouts for recessed lights. My policy is that any penetrations in the floor, wall or ceiling must be sealed with polyurethane foam, silicone sealant or some other appropriate material. My subcontractors make sure that any holes they cut in the subfloor are large enough to allow for at least ¼-in. thickness of flexible sealant around the pipes (detail 2 above).

Recessed lighting presents another draft problem. Conventional fixtures are way too porous for use in a bathroom. To avoid filling the space above with moisture, recessed fixtures located in insulated ceilings must be airtight and carry the IC-rating, which indicates that they are designed to be covered with insulation. A better solution is to place recessed lights within soffits or dropped ceilings. From my designer's standpoint, a well-framed soffit creates interesting sightlines and avoids any penetration into unheated spaces (detail 4, facing page).

Locate showers and tubs on interior walls, if possible

The best solutions from a designer's standpoint don't always agree with those of a building scientist. These experts tell me, for example, that tubs and showers should never be located along exterior walls. Unfortunately, I don't always have a choice.

Having done my first bath designs on the Connecticut shoreline—where winter winds off Long Island Sound can freeze pipes in short order—I would never take the risk of placing plumbing pipes within exterior walls. If I were stuck with an exterior-wall location, I would frame a second wall for pipes just inside the exterior wall that would provide room for proper insulation and for the cre-

ation of a healthy wall system (detail 1, bottom right, p. 53).

In addition to the placement of the shower, the location of the shower fixtures can have a big impact on moisture control. I like to offset the water controls closer to the shower door to make them easy to reach without opening the door all the way (detail 3, facing page). I also try to make sure that the shower head is not easily directed at the door opening.

Glass doors provide better water containment than shower curtains, but access can be a problem. Shower curtains can be weighted to hold them to the floor for better water containment. Another simple solution for keeping water inside a curtained shower is to fashion a dam in each corner using a bead of silicone placed at a diagonal.

One-piece tub enclosures are boring but leakproof

When it comes to the materials to be used for a tub (or shower) enclosure, there are almost no limits as to what is available: tile, glass block, solid surface, cultured marble, plastic laminate, acrylic and gel-coated fiberglass, to name a few. If I listened only to building scientists, the choice would be clear: one-piece tub units. As long as the drain is installed properly, the framing is correct and the floor is supported adequately, experts tell me that the chance that one of these units will ever leak is minuscule.

Most of my clients want more pizzazz, and most of the time they choose tile. Unlike one-piece shower surrounds, tile is not impermeable to moisture—largely because of the grout. In my experience, however, as long as tile is installed properly over a cement board substrate S, a tile enclosure will be fine (see "Sources," p. 56). Applying tile directly over the moisture-resistant gypsum (green board) is asking for trouble.

Solid-surface materials such as Corian S also require a proper substrate, but they eliminate the need for maintaining grout. Glass block is a good choice for a custom shower because it's less permeable to moisture than tile. Glass block is also available in many shapes and textures and includes structure and finish in one complete package.

Accessories and built-ins for custom showers also must be designed carefully. Soap and shampoo cubbies must not compromise the water or vapor barriers, so I never design these niches to be set into an exterior wall. I also make sure that the horizontal surfaces of

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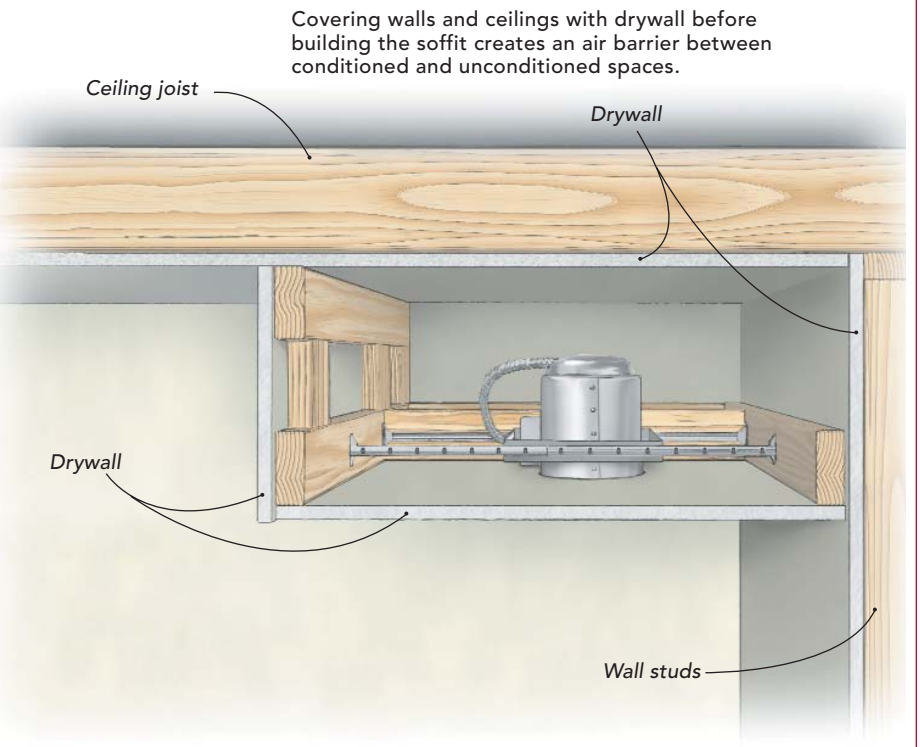
Keep recessed lights inside conditioned airspace

Although recessed lights that carry an IC-rating can be placed in an insulated ceiling, an airtight installation is extremely difficult to achieve. A better solution (if ceiling height permits) is to install these lights inside a soffit or a dropped ceiling.



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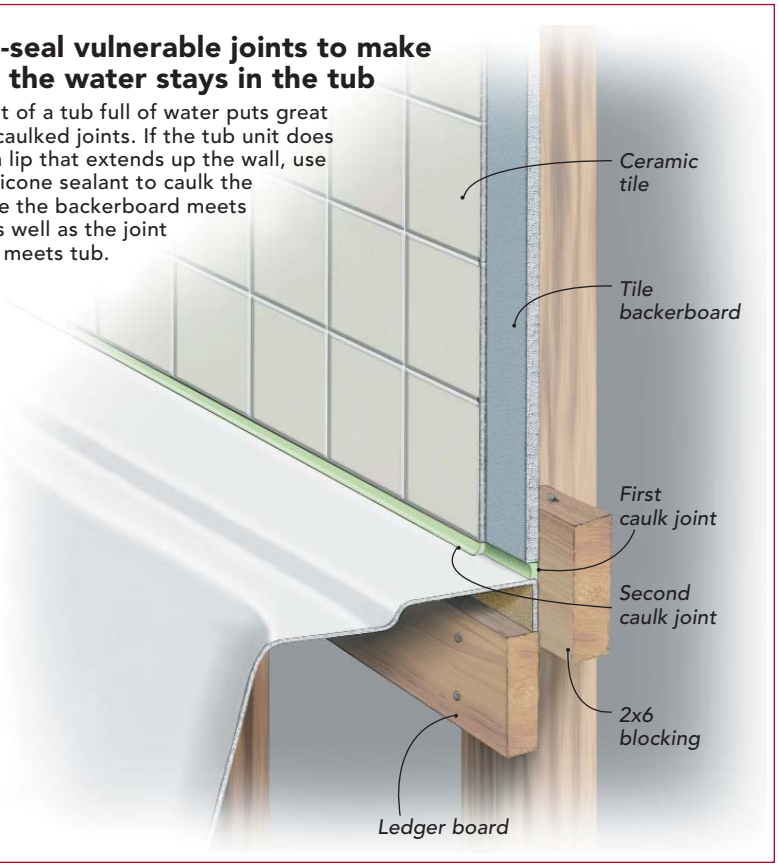
Double-seal vulnerable joints to make sure all the water stays in the tub

The weight of a tub full of water puts great stress on caulked joints. If the tub unit does not have a lip that extends up the wall, use 50-year silicone sealant to caulk the joint where the backerboard meets the tub, as well as the joint where tile meets tub.



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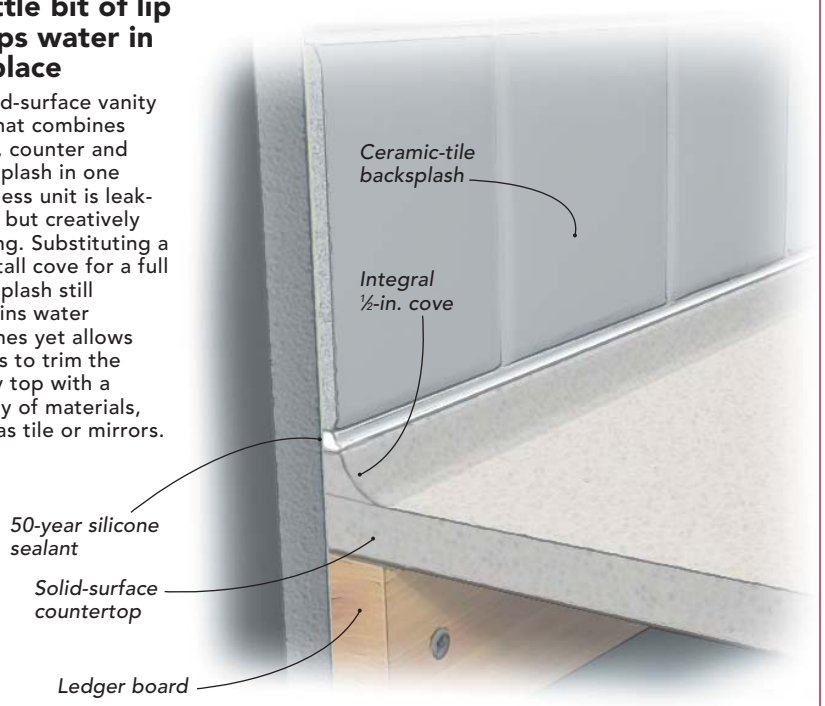
A little bit of lip keeps water in its place

A solid-surface vanity top that combines basin, counter and backsplash in one seamless unit is leak-proof but creatively limiting. Substituting a ½-in. tall cove for a full backsplash still contains water splashes yet allows clients to trim the vanity top with a variety of materials, such as tile or mirrors.



Sources

DOW CORNING
(989-496-6000; www.dowcorning.com)
Silicone sealant #795

DUPONT
(800-426-7426; www.dupont.com)
Solid-surface countertops

GEORGIA-PACIFIC
(800-284-5347; www.gp.com)
Denshield tile backerboard

JAMES HARDIE BUILDING PRODUCTS
(888-542-7343; www.jameshardie.com)
Hardibacker tile backerboard

PANASONIC
(866-292-7292; www.panasonic.com/building)
Ventilation fans

PRECISION PLUMBING PRODUCTS INC.
(503-256-4010; www.pppinc.net)
Antisweat valve kits

TAMARACK TECHNOLOGIES INC.
(800-222-5932; www. tamtech.com)
Timer switches, humidistats

UNITED STATES GYPSUM CO.
(800-874-4968; www.usg.com)
Durock tile backerboard

cubbies as well as shower seats are sloped to shed water back into the shower.

Tubs and whirlpools require flexible sealant

Stand-alone tubs generally have fewer moisture problems than showers because they contain water better. The weight of that water can be a problem, however, as can frequent splashing, such as children like to do.

The constant filling and emptying of a tub demands flexible seams where the sidewalls meet the tub. My installer uses only the highest-quality silicone sealant S. In addition to caulking the joint where tile meets tub, he caulks the joint between the backerboard and the tub (detail 5, p. 55).

Wall surfaces surrounding a whirlpool tub that doesn't get heavy use simply can be painted green board. Whirlpools release a lot of steam, however, so if I know that the client has big plans for the appliance, I insist on the same type of wall assembly I'd use for a shower.

Integral countertops make trouble-free vanities

Undermount lavatories are popular these days because they offer clean lines and easy cleanup. Their only drawback, however, is a vulnerable seam that's hidden beneath the countertop. For clients who don't mind poking their heads under the sink a couple of times a year, this seam is not a problem. Some clients want their baths to be as maintenance-free as possible, however. For them, I recommend an integral basin/countertop made from a seamless material such as cultured stone. Integral countertops can be ordered with or without a seamless backsplash. Occasionally, the client requests a tile backsplash to be installed over an integral countertop; in these cases, I specify that the countertop be formed with a ½-in. tall cove on which the tile will rest (detail 6, left). The cove eliminates the seam against the wall where water can collect and eventually escape.

Don't sweat about the toilet

The plumbers that I use add extra blocking around the toilet's drain line to stiffen the subfloor. This practice helps to ensure that the wax ring seal will never be broken (for more on proper toilet installation, see *FHB* #121, pp. 78-83). Properly installed toilets don't leak, but they might sweat. Condensation on the toilet tank typically occurs during the summer months when the water in the tank might be 20°F or even 30°F cooler than the air. This seemingly harmless occurrence can result in some serious problems: Moisture drips onto the floor and seeps beneath the floor covering, and eventually, the subfloor starts to rot.

Air conditioning is one way to prevent condensation; if that's not an option, you can retrofit an existing toilet with a prefabricated toilet-tank insulation kit, or install an antisweat valve in the water-supply line. (An antisweat valve S adds a small amount of hot water to the toilet's water supply. Adjustable models can regulate the hot-water supply during those months when it's not needed.)

If purchasing a new toilet, consider one with factory-installed tank insulation or a pressure-assist system that stores water in a pressurized plastic tank within the porcelain tank.

An open window is not a ventilation system

Toys such as steam showers, whirlpools and soaking tubs dump huge amounts of moisture into the air. Even a perfectly designed bathroom will suffer if it doesn't have an adequate ventilation system. While some codes still consider an operable window sufficient ventilation, that's asking for trouble, as is trying to get by with a cheap, noisy fan. On every one of my bath designs, I specify a high-quality, ultra-quiet fan S that's correctly sized to the space (sidebar facing page).

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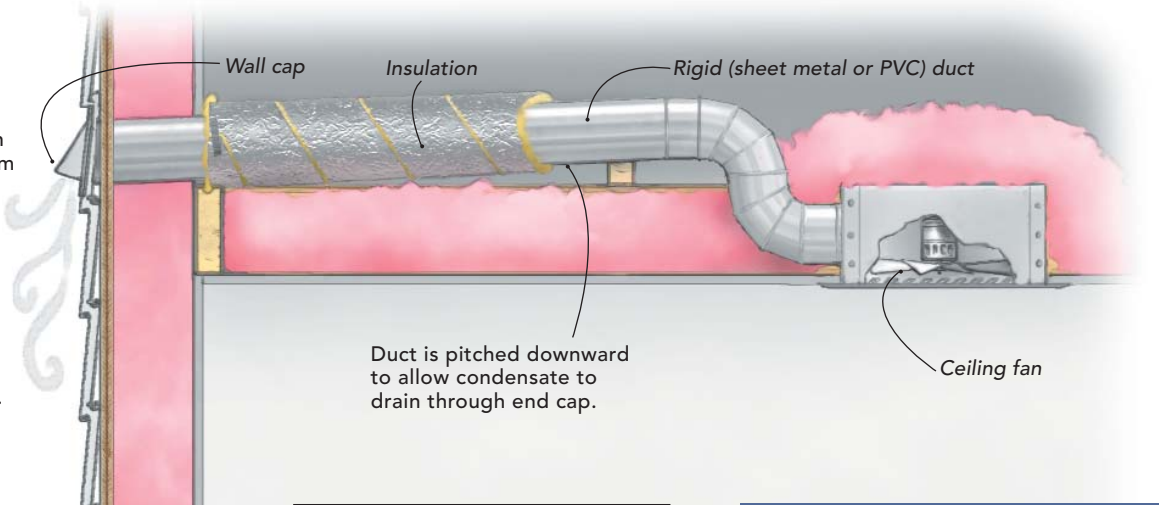
Don't just dump it in the attic

The necessary components of an effective bathroom exhaust system include a high-quality, quiet fan unit, and a short run of insulated ducting that directs water vapor out of the house before it's able to condense.



Foolproof switch guarantees fan is used

This programmable timer-switch (S) ensures that the fan runs long enough and often enough to clear the air.

The installation of a ventilation system is critical. The duct system should take the shortest, most direct route to the outside; but even a short run of ductwork can be troublesome. To prevent trapped condensation, I use insulated, rigid pipe, and I make sure that the pipe has a slight pitch, either to the outside or back to the fan (detail 7 above).

In tight, modern houses, an adequate supply of return air must be provided in conjunction with the ventilation. This can be as simple as making sure there is at least an inch of airspace under the entry door or as complicated as providing a passive makeup-air duct.

Even if it's perfectly installed, an exhaust system won't get the job done unless it is used. I strongly recommend to my clients that they leave the fan running—with the door closed to make sure moisture cannot escape into neighboring rooms—for at least 30 minutes after taking a shower or using a whirlpool. Placing the ventilation fan on a timer (S) makes following this advice easy. An even easier solution is to connect the fan to a humidistat (S) that will automatically turn the fan on and off according to the humidity levels.

Baths need regular maintenance

After eliminating unnecessary moisture problems, constant vigilance is the key to maintaining a dry bathroom. Indoor air humidity and temperature must be controlled throughout the home. What might be a comfortable condition for the homeowner might not be ideal for the home. Relative humidity between 40% (winter, generally) and 65% (summer), with a constant temperature around 68°F, is best. Frequently inspect visible caulk joints and redo them when they first show signs of degrading. At least a few times a year, get a good flashlight and summon the courage to poke around in the basement, crawlspaces and attic, looking for any signs of moisture leaks, musty odors or nasty bugs. □

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FIXTURES AS WELL AS ROOM DIMENSIONS DETERMINE WHICH FAN UNIT IS NECESSARY

Exhaust systems are rated in cubic feet per minute (cfm) of air moved, and the National Kitchen and Bath Association (NKBA) offers a formula as a starting point for calculating the minimum ventilation needed for a bathroom: cubic feet of room x 8 (air exchanges per hour) / 60 (minutes) = required cfm rating.

Another easy guide is to figure 1 cfm per sq. ft. in bathrooms that are smaller than 100 sq. ft.; in bathrooms that are larger than 100 sq. ft., allow 50 cfm per standard fixture (shower, tub, toilet, steam shower), plus 100 cfm per hot tub.

Oversize bathrooms can benefit from multiple intake points connected to one remote fan (see *FHB* #143, p. 126). Typical locations of exhaust inlets are near moisture sources, such as the whirlpool, shower or steam shower and toilet area, as well as near closet or storage areas that might be exposed to moisture. With this type of system, it is important to check the cfm at each location.

—M. J. P.