The Deck Upstairs

How to combine a deck with a roof that won't leak

by Dan Rockhill

My first rooftop terrace introduced me to the built-up roofing business the hard way. I'd designed a small addition with a nearly flat roof, and I wanted to put a deck on top of it to take advantage of the summer weather, the view and the privacy. I called up the roofing contractors to find out how low the bids would go, and started dreaming of deck furniture.

As the roofers looked over the job, it became obvious that details and prices fluctuated wildly. One wanted insulation on top of the roof sheathing, another underneath; some wanted gravel in the flood coat, and others said gravel was unnecessary. To make matters worse, none of them would guarantee the roof because I wanted to cover part of it with a deck.

I finally got the job done, lost money and learned a lot. Since then I've done a lot of successful and more profitable installations, but I've never stopped keeping a keen eye out for good roof-terrace detailing.

Early decks—Years ago rooftop decks were called promenades or plazas, and were usually found atop fancy commercial buildings. They were covered with a hard and durable surface like quarry tile, laid over a built-up roofing membrane that kept out the water. This type of decking was occasionally used in high-end residential work, but it was too expensive for most ordinary construction.

For a more economical solution, designers looked once again to commercial work, and they came up with the system generally used today—walkboards over a built-up roof. Walkboards, which are simply planks nailed to supports called sleepers, were originally used for scuttleways to reach roof-mounted mechanical equipment on factories, warehouses, office buildings and the like. The sleepers spread the traffic loads, and kept the fragile roofing plies from being crushed.

There are two types of roofing membranes suitable for supporting walkboards or rooftop decks: the tried-and-true bitumen (asphalt or coal-tar pitch) built-up roof, and a modern alternative, the elastomer roof. The built-up roof, with its many layers of hot-mopped felt, is perfect for use on low-pitched roofs because it forms a continuous membrane that keeps out wind-driven rain.

Elastomers are synthetic polymers with elastic or rubberlike qualities. They have gained wide acceptance in commercial work, despite their higher price tag, because they offer excellent flexibility, and resistance to weathering, fire, airborne chemicals, ultraviolet radiation and abrasions. They are also available in a variety of colors. Silicone, neoprene, Hypalon, acrylic and polyurethane rubber are all varieties of elastomers. Some are available in sheet form. Most can be applied as a liquid and finished with a trowel or paint roller. Toxic fumes can be a problem with these products, and you should be sure to pay special attention to instructions involving joining, mixing, curing times and using solvents. Because elastomers are still relatively new to the residential market, many roofers prefer to work with the traditional hot asphalt and gravel, and they continue to install the proven built-up roofs. What I will describe here is how to put a deck over a built-up roof so that the roof won't leak.

The substrate—A rooftop deck has to sit on a structure designed to carry the same loads as the interior floors of the house. Consequently, the members supporting the roof deck should be at least as sturdy as the floor joists below. To divert water away from the building and to prevent ponding, the roof should slope at least ¼ in. per ft. To get this slope, I usually nail tapers ripped from 2x4s to the tops of the rafters, but if the rafters are deeper than required for their spans, it's just as easy to cut the tapers on the rafters themselves.

The roof sheathing is no place to skimp on materials. The deck sleepers could wind up being placed between the rafters, and the sheathing will have to carry this load without flexing. I use ¾-in. CDX plywood over rafters 16 in. o.c., held down with construction adhesive and 8d cement-coated nails. I nail a line of blocks between the rafters to catch the edges of the plywood. For maximum strength, I stagger the joints.

Insulation should go between the rafters, and not between the sheathing and the membrane, where it would gradually get compressed from the deck loads, losing its effectiveness and causing the membrane itself to stretch.

Cants and base—Once the roof sheathing is nailed down, it's time to put on the cant strips and the membrane base. Cant strips are used wherever the plane of the roof meets a vertical surface. They provide a gentle 45 ° slope for the roofing felts to conform to. Be sure to use them. Felts forced to bend at 90° have a weak inside corner, which will fail before the rest of the membrane. Roofing contractors use fiber cants, or you can rip and stack strips from 2x4s, as shown in the drawing on the facing page, bottom left. The legs of the triangle of a section of cant strip should be 3½ in. long.

Hot-mopping—You can install your own hot-mop membrane by renting a kettle and buying your supplies from a wholesaler, but I don't recommend doing this. Lifting pails filled with 525°F asphalt is a hairy job, nasty and dangerous enough to discourage even the most ambitious do-it-yourselfer. One wiggle of the bucket could spill the smoking asphalt and blister your skin or ruin the finish siding below.

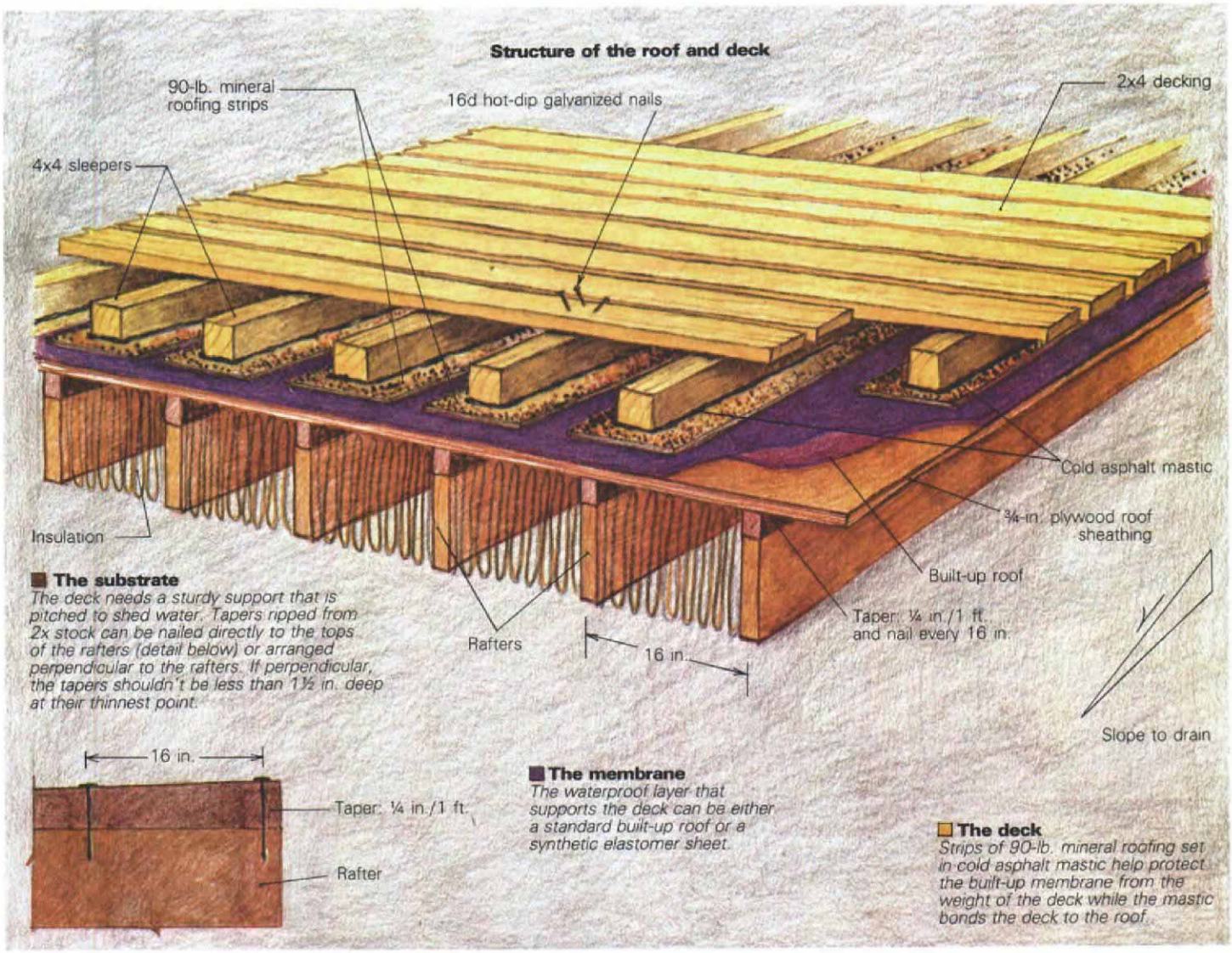
I hire a subcontractor to do the membrane work. This isn't always easy either. Because it costs as much for the roofer to fire up the kettle for one square (100 sq. ft. of roof coverage) as it does for a hundred-square warehouse, many roofers aren't interested in a small job. So specify precisely what you want, then solicit bids. To make sure there are no surprises, don't accept any bids from contractors who don't look at the job in person. At current prices you can expect the roofer's share of a small deck job to be between $400 and $1,000. I also get an agreement before work begins about damage compensation in case a misplaced bucket of hot tar damages part of the building or grounds. Here's how things should go.

Base felt is a heavy, bitumen-impregnated sheet that weighs about 40 lb. per square and comes in 36-in. wide rolls. It is used only for the first layer, and it should be nailed down, not hot-mopped. Nailing it to the sheathing allows some movement between the substrate and the membrane, and makes it a lot easier years down the road to remove the roof if it should need replacing. It has to be firmly attached though, or a stiff wind will put it in the neighbor's yard. Nail it down with roofing nails spaced 6 in. o.c. on the edges and laps, and staggered at 18 in. o.c, in the field.

Membrane—Next, the base is covered with the membrane. It's made up of alternating layers of felt and molten bitumen. The felt acts as a reinforcement, while the bitumen bonds the layers of felt together and forms a waterproof film between each.

Each layer of felt in the membrane sandwich is called a ply. These felts are typically 15 lb. per square, and are held together by a matrix of fiberglass, asbestos or organic fibers. I prefer fiberglass felts because they have terrific

Structure of the roof and deck

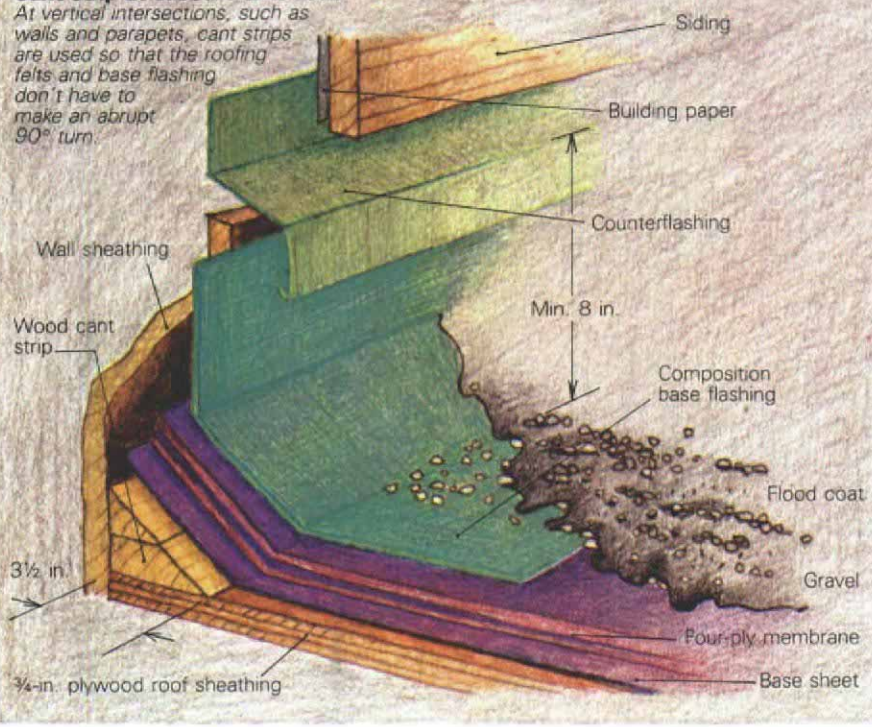


The substrate
The deck needs a sturdy support that is pitched to shed water. Tapers ripped from 2x stock can be nailed directly to the tops of the rafters (detail below) or arranged perpendicular to the rafters. If perpendicular, the tapers shouldn't be less than 1½ in. deep at their thinnest point.

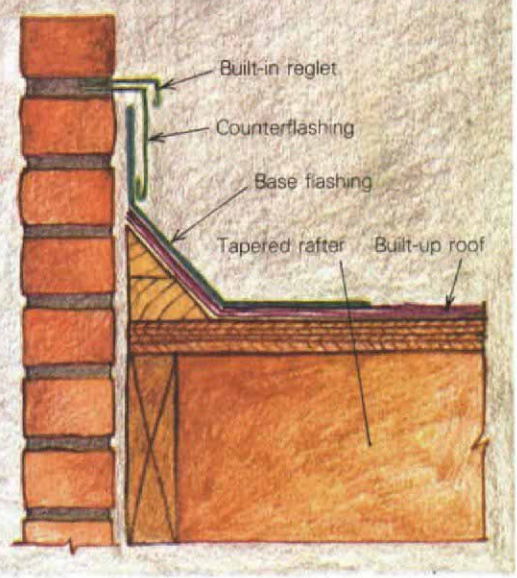
The membrane
The waterproof layer that supports the deck can be either a standard built-up roof or a synthetic elastomer sheet.

The deck
Strips of 90-lb. mineral roofing set in cold asphalt mastic help protect the built-up membrane from the weight of the deck while the mastic bonds the deck to the roof.

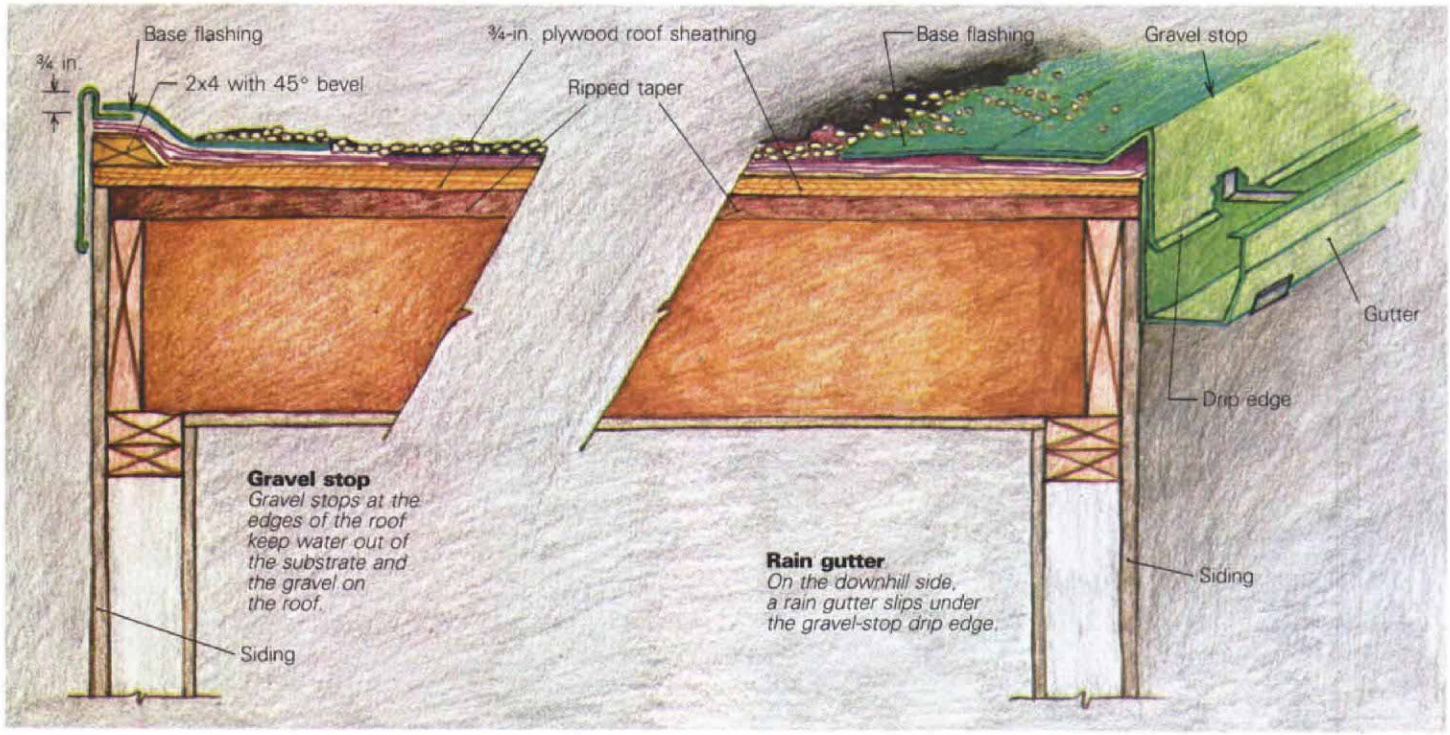
Cant strip at wood-frame wall
At vertical intersections, such as walls and parapets, cant strips are used so that the roofing felts and base flashing don't have to make an abrupt 90° turn.



Section at masonry wall
A two-piece flashing protects the edge of the roof at a masonry wall. Copper is the preferred material because it's easy to fold back when the roof needs replacing.



Illustrations: Frances Ashforth



strength, won't rot like the organic ones, and save my worrying about the possible ill effects of asbestos.

Plies are laid successively over the base, starting at the low end of the roof and moving up. The first layer is a 12-in. wide strip butted to the roof edge, which is then covered by a 24-in. wide piece and then a full 36-in. wide sheet. Subsequent full sheets are then shingled over one another to leave 11⅓ in. of exposure.

Roofing felt is bonded with a glazing of hot bitumen between each layer; no two layers of felt should touch anywhere on the roof. A three-ply roof is common here in Kansas, but I always specify four plies. The extra layer costs more of course, but I feel that the added lifespan of the roof more than outweighs the greater cost.

Flashing—According to the National Roofing Contractors Association, the most likely place for a roof deck to develop a leak is at the junction of the horizontal and vertical surfaces. The only way for a builder to prevent these potential leaks is to install the right flashing for the particular condition.

You need two types of flashing on a bitumen membrane roof—base flashing and counterflashing. Base flashing is similar to the nailed-on membrane base, but it's reinforced with fiberglass so that it can bend more easily. It comes in 36-in. wide rolls and has to be cut to the appropriate width. Counterflashing, or cap flashing, overlaps and protects the exposed edges of the base flashing.

When the membrane felts are mopped onto the roof, the roofers will lap the felts over the cant strips and a few inches up the walls. The base flashing covers this intersection and extends at least 8 in. up the wall. In parts of the country where snow is likely to accumulate, 12 in. is better. The extra width will make it more difficult for the snow to work its way behind the counterflashing.

Once installed, the base flashing is counterflashed with a strip of metal folded into a Z pattern, or with shingles or siding if the exterior wall finish permits. If the wall is masonry, you'll have to let strips of metal flashing into a mortar joint. If you can afford it, use copper. It lasts longer than other flashing materials, and when the roof needs replacing, it's soft enough to be folded back out of the way while the new roof goes on, and then be bent back into place.

At the eaves—The next step is installing gravel stops and rain gutters. Gravel stops come in various profiles. They create a clean, waterproof cap at the eaves and keep the loose gravel on the roof from being blown or washed away. At the downhill edge, a gravel stop should overlap a rain gutter. If your roof has a parapet wall, you'll have to install a metal inset through it for water run-off. Your roofer or sheet metal supplier can make this scupper up in the shop.

Top coat—When the base flashings are down, a thick flood coat is mopped over the entire membrane. Gravel is then added to the molten bitumen. It serves several purposes. The light-colored stones refract and reflect sunlight, blocking out destructive ultraviolet rays. This keeps the roof cooler, and reduces temperature fluctuation. The gravel prevents direct abrasion from the weather, and it acts as a weight to hold the plies on the roof.

The part of the roof under the deck shouldn't have a gravel coating. The deck itself will shield the roof. And you don't want any gravel to get between the deck sleepers and the roof as it will eventually work its way through the membrane and cause trouble. For the same reason, don't walk on the gravel-covered membrane.

Decking—Sleepers should be either pressure-treated wood or the heartwood of a rot-resistant species like redwood. Try to locate them over the rafters and be sure to lay them parallel with the roof slope so that the drainage remains unimpeded.

I used to use 2x4 sleepers laid flat, but I've recently begun to use 4x4s instead, because the extra 2 in. of depth makes it easier to fish out the leaves. The extra wood also lessens your chances of driving a 16d nail through the decking and sleepers into the membrane. Since ¼ in. per ft. is an almost imperceptible slope, I don't taper the sleepers to compensate. But if the slope were any greater, I would taper them to make up for the tilt.

Some roofers may want to hot-mop the sleepers in place, but I would advise against having this done. The sleepers usually rot out before the membrane fails, and hot-mopping them to the roof could mean damaging the membrane when the sleepers have to be removed for replacement.

Instead, I set each sleeper in a bed of cold asphalt mastic on top of a 12-in. wide strip of 90-lb. mineral roofing. This strip, mineral side up, is bonded to the flood coat with the cold mastic. When it comes time to remove the sleepers, the cold joint will give way well before the flood coat. The beauty of this system is that the membrane remains intact while the entire structure is firmly glued to the roof.

For the deck itself, I use either treated southern yellow pine or redwood 2x4s, and I space them ¼ in. apart. If the gap is any larger, things like pencils and envelopes fall through the deck with depressing regularity. I nail each plank to my 4x4 sleepers with three hot-dip galvanized 16d nails. □

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