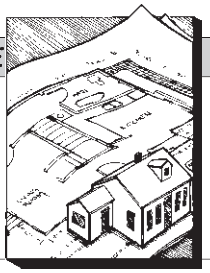


Water-Shedding Details, Part II

by Gordon Tully

One of the chief concerns in detailing is to keep water from penetrating the building through cracks and joints. There are many ways to keep water out of a joint. I will discuss some of the most obvious: overlapping, layering, sealing, overhanging, and weeping.

Overlapping

Overlapping relies on the creation of a dam high enough that water cannot be driven over it by air pressure. The principle is used in (for example):

- siding
- roof shingles or tiles
- most flashing
- louvers
- ridge vents
- window and door sills

In principle, it is possible to calculate the height of a safe overlap for any application, but simple calculation is defeated by other complexities, such as:

1. The air pressure difference that a joint or surface experiences depends on the geometry of the joint and the wind pattern.
2. Capillary action can help lift water over a dam in a small crack.
3. Air pressure differences caused by chimney effects within and around a building can pull water over a shingle dam.

Luckily, a reasonable overlap will exclude water most of the time (see Figure l), and most wooden houses have enough wood to soak up any water that occasionally spills over the "dam."

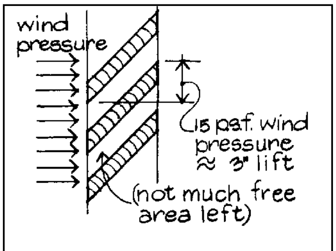


Fig. 1. Wood Louver

At a vertical surface adjacent to a roof or the ground, the overlap must be increased to account for the buildup of debris or snow next to the joint. A 3- or 4-inch overlap is typically fine at a well-drained intersection—for example, along the side of a dormer (see Figure 2). At a wall that abuts a flat roof, however, even 8 to 12 inches might not be enough in a bad winter.

Layering

Shingles overlap and therefore act like dams. Yet each layer contains vertical joints that can allow water straight in. In shingling, the installer attempts to stagger the vertical joints, but later cracks and occasional errors make this approach risky in exposed locations if only two layers are used.

The strategy of using several layers rests on the assumption that each one gets rid of part of the water until the inside is finally dry under almost all circumstances. The outer layers function to slow the wind down, allowing the inner layers to shed water by gravity. In a way, layers of shingles are like fur on a mammal.

Joint Sealing

Joint sealing is an important part of our arsenal against water penetration. Sealing can be done with a variety of materials, notably plastic sealants, gaskets, tape, and tightly nailed covering materials.

In high-rise construction, plastic sealants have finally been perfected to the point that leaks are not a serious problem. Unfortunately, this technology has not been systematically applied to wood-frame house construction, probably for reasons of cost. In practice, plastic sealants do not work in wood-frame construction over the long run.

First, we almost always make a sealant joint too narrow. A bead of sealant moves with the inevitable movement of the materials it is attached to (the "substrate"), but only up to a percentage of its width. This percentage depends upon the kind of sealant, but 25 percent is a good range to use for sophisticated sealants like polyurethane. (More exact calculations are possible.) So if you expect the joint to move 1/8 inch, you need a sealant bead that is 1/2-inch wide. Cheaper sealants would have to be even wider (see Figure 3).

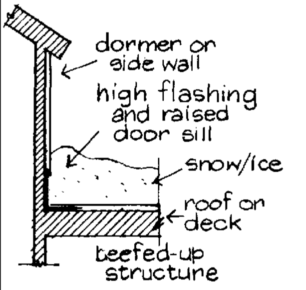


Fig. 2. Condition with Dormer or Roof Deck

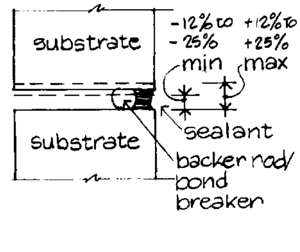


Fig. 3 Properly installed sealant bead

Second, sealants only work if they are properly bonded to the substrate. Each pair of substrates (one on each side of the joint) will need a particular kind of sealant to guarantee adhesion. Some substrates require preparation with suitable primers or chemicals. An unbonded sealant simply opens up a hairline crack, which invites water in by capillary action.

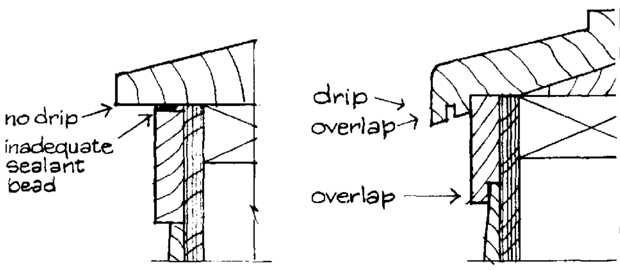
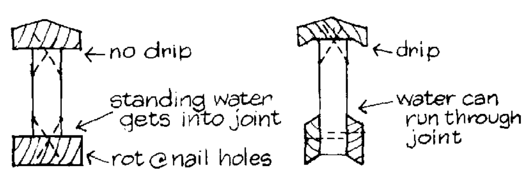


Fig. 4 Not-so-hot Window Sill Better Window Sill



High Maintenance Painted Balustrade Lower Maintenance Painted Balustrade

Fig. 5

Third, sealants can move with the joint up to their safe limit (for example, 25 percent of the joint movement, as above) only if they are properly shaped. A bead that attaches to the back of the joint will be torn before it can expand much. Properly applied sealants require a "bond-breaker" such as a polyethylene rod to make sure the bead only attaches to the two sides of the joint.

Can you imagine a competitive home builder following all these rules! Usually, sealants are spread on buildings like butter on toast, with almost no lasting effect. The builder feels good, having stuffed something into the obvious cracks. He or she goes away, and the building gets to work. The building always wins.

Where the detailing allows, sealing can be done more effectively with closed-cell foam gaskets placed between two materials. Such gaskets have to be chosen carefully, but once properly applied, they can move a lot, and do not need adhesion to the substrate.

In certain applications, such as joining two sheets of vapor barrier, tape is a good material. Again, the right tape must be used: the red 3M sheathing tape is a good choice for plastic sheets.

All these sealing materials are organic, and can easily be destroyed or degraded by chemicals in or on adjacent surfaces. Be particularly careful about plastic sheet flashing in and around masonry, as in cavity walls. A new material will sometimes be used extensively before it is discovered that a common neighboring material is destroying it. Such things make one conservative.

Overhangs

Overhangs protect the surface below from water on both a large and a small scale. A typical detail that relies on an overhang is the lip of a sill, which protects the vulnerable horizontal crack under the sill. This detail only works when the horizontal crack is properly sealed or tightly nailed and painted. Such a joint often works since it is protected from most sun, rain, and wind. Even so, an overlap is advisable as added insurance, especially when you cannot assume a good sealant joint (see Figure 4).

Overhangs require drips to prevent water from moving along under the overhang by surface tension, thus evading the defense. A drip can be formed by a piece of thin metal, a slot cut into the underside of the horizontal surface, or by tilting the overhang to form a sharp downward edge.

Weeping

The principle of weeping is similar to layering. Water is slowed down by an outer layer, which does 90 percent of the water-shedding. Water that gets through the outer layer enters a void space, which is at neutral pressure, as in a cavity wall. Water can fall freely by gravity within this backup space, ultimately running back out through a hole or crack designed for the purpose.

This principle can be quite sophisticated in its application. For example, wall joints in high-rise structures can be made in two layers, the outer one of which deliberately leaks air, to create a neutral inner space that is tightly sealed off from the building. In this way, water cannot be sucked into the building by internal negative air pressure. This is sometimes called the "rain-screen" principle.

Low Maintenance Versus Initial Cost

Many of these strategies are well-known to good builders. What they want to know, and no one can tell them for certain, is to what extent these rules can be evaded. For example, most outdoor railing has unprotected joints (see Figure 5), either to lower cost or achieve an authentic historical effect. How can we get away with this?

The answer is that we are merely passing the problem on to the buyer, saddling him or her with a maintenance problem. Builders and designers do not often get the chance to see the consequences of their shortcuts and ill-considered joint designs until long after the fact. Even if they do, the market pushes both builder and buyer to ignore the maintenance consequences of initial low cost. It is hard to keep high standards in a competitive market.

The problem is acute these days, in part because of the demand for 19th-century detailing. The trouble is that our grandparents had an endless supply of cheap, skilled mechanics to keep their buildings together. Today's homeowners are lucky to find an incompetent repairperson, let alone a skilled one.

I would be happier if the tradeoff between maintenance later and first cost were made more consciously by the buyer. Who knows what Mr. and Mrs. Average Homeowner would choose if they were truly aware of the consequences of bad joint detailing?

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