

MINIMIZING PONDING USING FLAT INSULATION

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In the 1950s, designing totally flat roofs was common practice. When roofs were designed to be totally flat, the end result usually was not. Unless camber was built into the structural system to allow for anticipated dead and live loads, deflection between bearing points resulted in low points on the roof.

Typically, roof drains were located along beams or bearing walls, which turn out to be the high points in the roof system. There also was very little room for error in construction. Everything, from the footings on up, had to be constructed to very close tolerances in order to end up with equal elevations across the building.

The industry gradually learned that ponding water acted to reduce the serviceable life of a built-up roof. Getting the roof dry enough to patch a leak was also a problem. And, much more water entered the building if leaks did develop.

Most major manufacturers in the United States eventually came to recommend ¼-inch-per-foot slope for *new* roof design using built-up roof membranes or manufactured single-ply membranes. However, there are many, many buildings out there already that have no slope and have excessive water ponding. The most opportune time to correct this condition is when reroofing becomes necessary.

Ideally, eliminating all ponded water would be the best for the long-term performance of the roof system. However, there are times when eliminating ponded water is not practical because of the complexity of the solution or limitations posed by the existing conditions. It is important to keep the design as simple as possible. A complex design may be the most effective, but costs will rise proportionately, and the contractor may have difficulty in actually executing the work. In these cases, the cost to eliminate the ponds exceeds the advantage of doing so. Many experts believe a roof pond that dries within 48 hours of a rainfall will have little effect on the long-term performance of a roof membrane.

REROOFING DESIGN APPROACHES

Once the existing conditions and the cause of the ponding problem are determined, approaches to the reroofing design can be developed. Many times the addition of roof drains or scuppers is not feasible. Adding insulation of varying thickness, not necessarily tapered insulation, can be a viable solution in many cases.

Flat and Tapered Insulation System

In response to the industry movement toward slope in roof systems for complete drainage, manufacturers are marketing tapered insulation to give slope to relatively large sections of roof area. Tapered insulation board is available in several different types, including polystyrene, perlite-aggregate, isocyanurate, cellular glass and fiber glass. The slope

available in each type varies. The slope should be sufficient to achieve positive drainage, yet not so great that insulation thicknesses become difficult and costly to deal with at the details.

Maybe it's not necessary to use tapered insulation to slope the entire roof area. There may be existing deck slope, no matter how slight, to take advantage of, even in an essentially flat roof.

Let's look at a simple example of a 50-year-old building with an essentially flat concrete deck. The deck has gradually deformed and sagged between supports through the very slow process referred to as "creep". To compound the problem, new HVAC equipment has been suspended from the deck. The net result is a slight slope in the roof section from the supports to the center. The roof is drained at one roof edge through scuppers over one of the bearing walls. The result is substantial ponding in the central portion of the roof area (*Figure 1*).

The reroofing design could include tapered insulation from the scuppers to the opposite roof edge to eliminate ponding. But half the existing roof is already sloping in the direction for drainage to the scuppers, so why not take advantage of it. Flat insulation placed over this half of the roof will have a net positive slope toward the scuppers. Tapered insulation with enough slope to counteract the negative slope of the deck in the other half of the roof will provide a net result of positive slope across the entire roof area at the membrane level.

This approach minimizes the insulation thickness so one can better deal with height limitations at existing flashings, such as through-wall flashings, and at large mechanical units. Likewise, blocking requirements at the details may be less. The final product provides the desired drainage at less cost than a fully tapered system.

Tiered Flat Insulation System

Another, typically less costly, method of reducing ponded water is to increase the thickness of insulation in steps, or tiers, from the drainage points to the perimeter of the area. These tiers are typically made in ½-inch or ¾-inch increments with tapered edge strip installed to provide a smooth transition from one tier to the next.

The same basic concept as in the first example is applicable here. Take advantage of the existing deck slope on half the area. In this case, the insulation is stepped down in four increments rather than a continuous taper (*Figure 2*). The steps are located more closely in the area of greatest ponding, or negative slope, to minimize the existing highs and lows.

The disadvantage of this approach is that it does not completely eliminate the ponding in all cases. However, it can reduce the depth of ponding to a tolerable level by displac-

ing the water in gradual increments. As with the tapered insulation example, height restrictions at the details are more easily dealt with. The primary advantage of this approach compared to the tapered insulation approach is cost. Depending on the type of roof system and the complexity of the insulation layout design, the installed insulation cost for the tiered system can be 10 percent to 40 percent less than the tapered system. This cost saving can go a long way to offset any loss in service life of the roof system caused by minor ponding with the tiered system.

Scuppers and Downspouts

Once the surface water gets to the drain, it must be able to flow off the roof. Often the extra materials used to flash in the drain, or scupper, result in a build-up around the drain and some damming of water. This effect can be minimized by placing the drain, or scupper, in the center of a depressed area made by tapering the insulation. The tapered area should be slightly larger than the largest flashing sheet.

In climates where freezing temperatures often occur, ice damming at scupper outlets and ice damage to the downspout are often problems. The open-faced downspout was developed to minimize the potential for plugging while continuing to provide the wall protection and control of water flow afforded by a totally closed downspout. Using a dark color for the downspout allows solar heating to help keep the downspout as ice-free as possible.

Certain types of buildings, such as school buildings, may have other special considerations. It is amazing how a new downspout can provide children with access to the roof. A W-shaped open-faced downspout securely anchored to the wall is a design that doesn't leave much for children to grab (Figure 3). Also, there should be no projections or sharp sheet metal edges that could cause injury. This design has an advantage over the more conventional open-faced downspout when using factory color-coated sheet metal. The entire exposed face will have the colored face showing. The inside of the more conventional open-faced downspout shows the reverse side of the metal, producing a "racing stripe" on the building unless the inside is painted. This "child-proof" downspout provides a reasonable solution to a couple of typical downspout problems. Contractors that have used it have found it to be fairly easily fabricated and installed, while providing essentially the same function as the more

conventional open-faced downspout. Likewise, building owners are satisfied with the reduced potential for injury and traffic on the roofs.

Inside-Outside Drains

A better approach to edge drainage in northern climates is to install an inside-outside drain. This is usually more expensive than an exterior scupper and downspout. But its ability to remove snow-melt water is *much* better, and the risk of damage from ice falling off the wall is eliminated. It is also relatively vandal-proof.

This type of roof drain system is simply a roof drain installed at the low point of the roof surface. The drain leader runs down the inside of the exterior wall and discharges out through the wall a foot or two, above grade (Figure 4). The interior location keeps the drain and leader open during cold weather. Ice build-up at the discharge is minimized because the draining water has warmed slightly. Damage from any ice development is minimal because it forms at grade level, not at roof level.

REMARKS

There are still many buildings out there with ponded water on the roof. With some thought at the time of reroofing, most of these conditions can be reduced or eliminated using some relatively simple methods. The resulting roof system is more likely to reach its maximum serviceable life, at the lowest life-cycle cost.

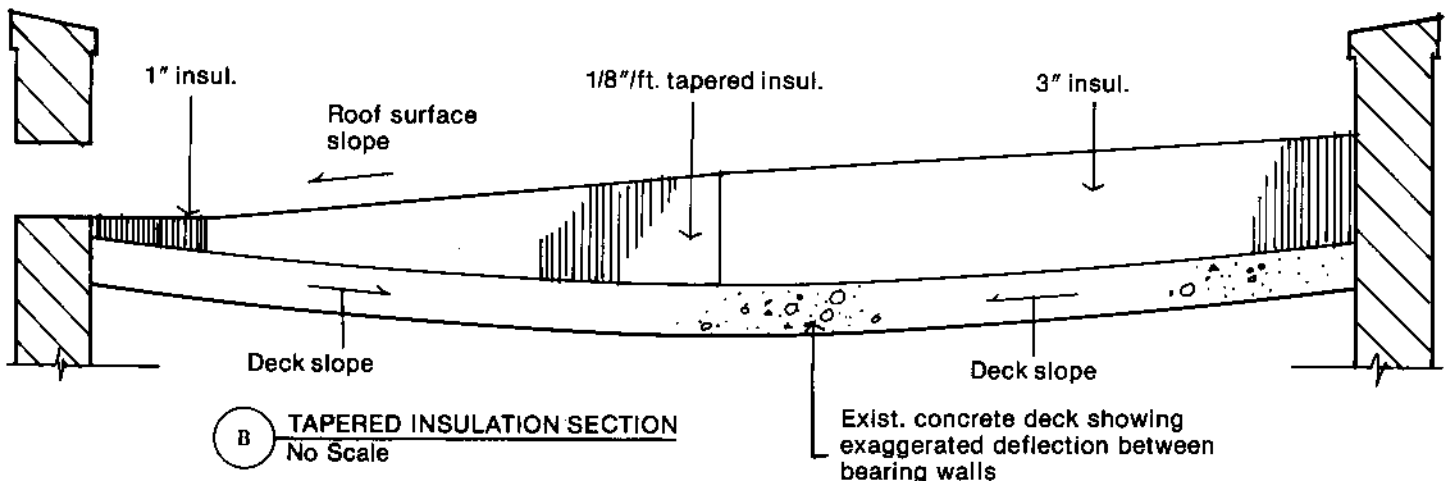
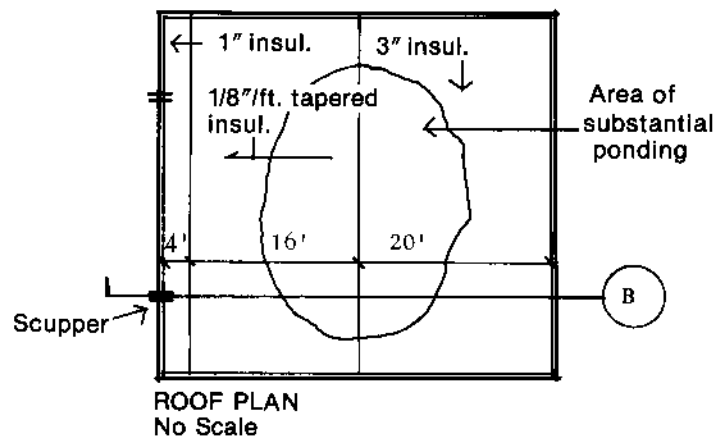


Figure 1

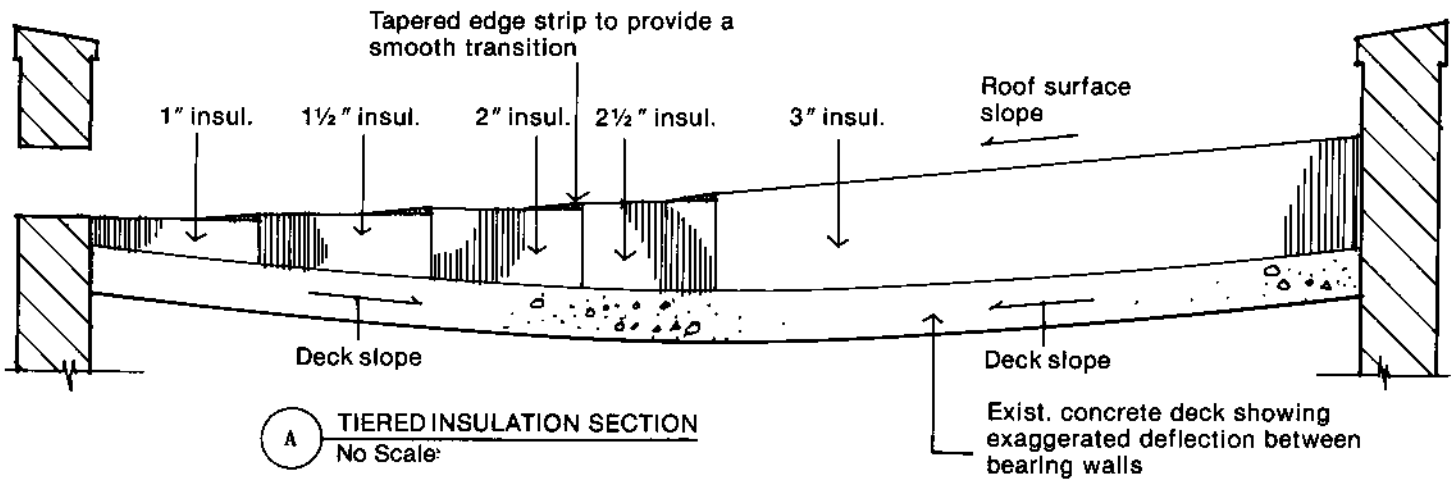
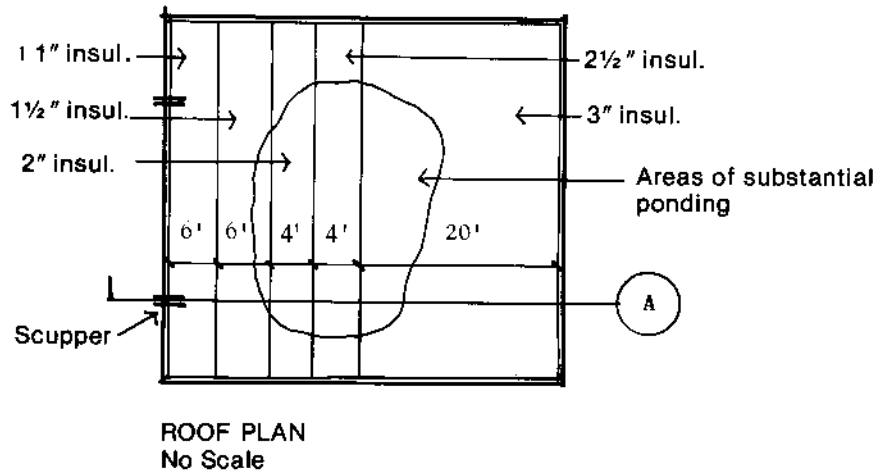


Figure 2

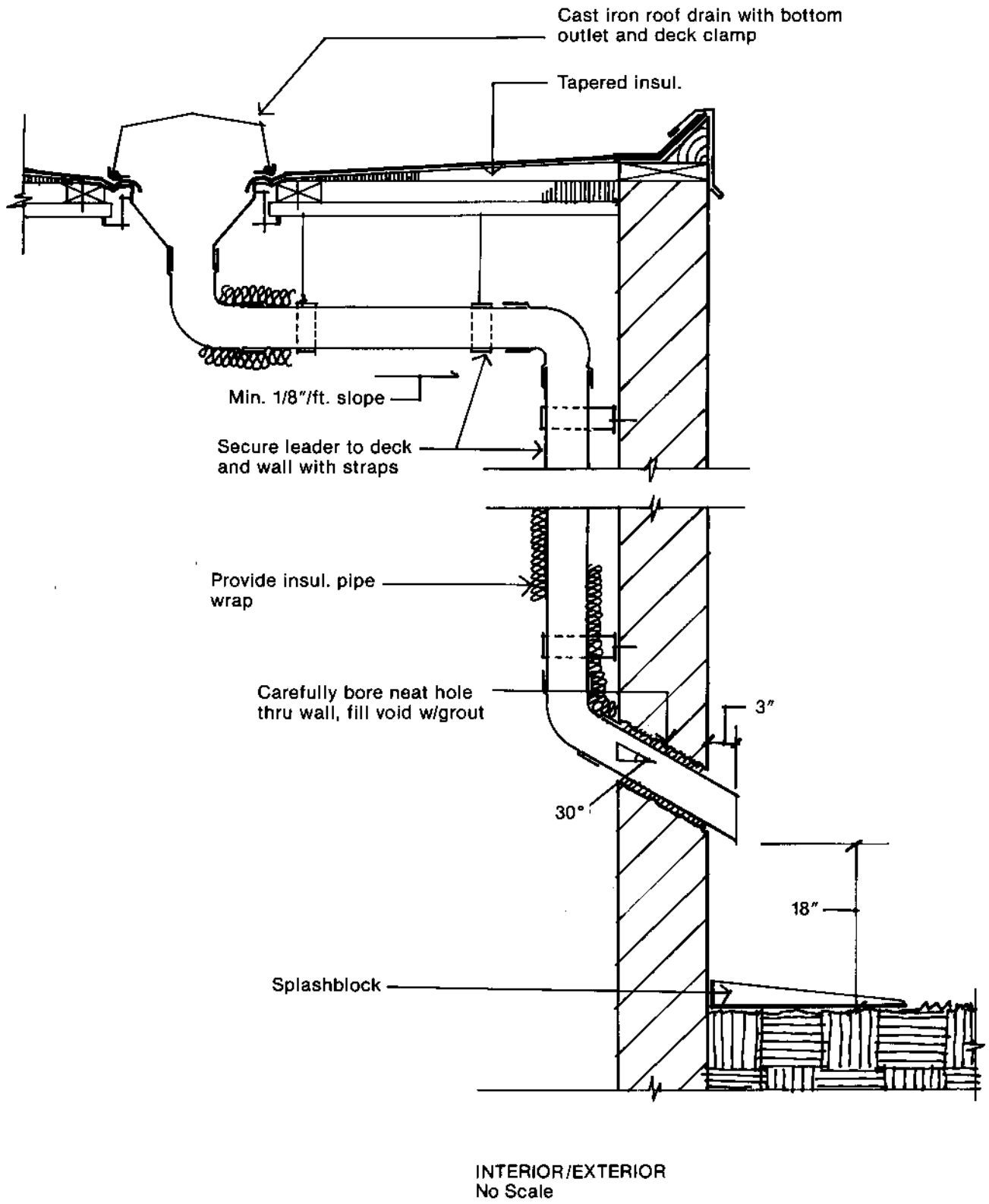


Figure 4