

TAPERED INSULATION

An Ideal Solution for Recover, Rehab and New Construction

By Tony Garone

Tapered has become the roofing insulation of choice in renovation work and all-new construction. It has become the cost-saving way to add slope to a flat roof so water runs off, or provide adequate roof slope for an older building which has settled.

Since ponding water is bad for any roof, built-up or single-ply, the first rule for extending the life of the roof is to keep water off it. Whether pre-engineered or not, a sloped roof drains water, thereby preventing ponding water and ice buildup in winter, and fungus and vegetation growth in summer.

Positive drainage is so important that some roofing warranties can be voided if the roof ponds water. In addition, local officials are so concerned that a new high-school in mid-state New Jersey has not been allowed to open its doors because its roof is already leaking due to inadequate slope. So, since structural defects like settling and sagging could lead to warranty-voiding ponding, tapered roofing looks better and better for both new construction and rebuilds.

The tapered insulation concept is designed to provide optimum pitch for good drainage. For new construction, tapered insulation saves cost of design, materials, labor, and time over pre-engineering and building a pitched roof. In rehab work where the roof is pitched to begin with, tapered insulation can add extra slope where needed or compensate for settling and sag. On a dead-level roof, tapered plays an even larger part.

Design of Tapered Insulation

Tapered insulation is sloped, usually with a pitch of either 1/8-in. or 1/4-in. per running



When a tapered insulation system is provided, insulation boards are marked with letters and directional arrows that tie into layouts provided by the manufacturer.

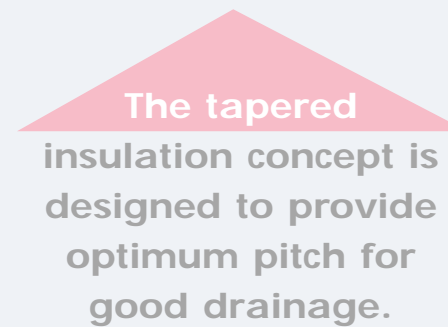
foot. To taper a flat roof deck, standard insulation is stacked up progressively thicker, then finished off with sloped pieces. The construction forms a smooth transition sloping to a drain or to the drainage points of the structure: interior roof drain, scuppers through the parapet wall, gutters, etc.

Figure 1 shows typical construction of a 1/4-in. per foot tapered slope system using two panel sizes. Panel E slopes in height

from 1/2 to 1-in. over its 2-ft. width; panel F slopes from 1 to 1 1/2-in. Panels E and F are laid on top of standard 4-ft. x 8-ft. rectangular boards, 1-in. and 2-in. thick.

Correcting the Sagging Roof

On re-roofing and retrofit work, tapered insulation can correct many of the problems of a sagging or settling roof. In older construction, drain lines were usually located along the line of the roof joists.



Originally flat decking tends to deflect and settle with time, due to snow, equipment, live and static loads. The decking sags down between its supporting joists, so the drain lines are now running along the high points of the roof. Even though such a roof was originally designed to drain properly, it's not likely to happen!

Positive Drain at Minimum Cost

Tapered insulation can put the positive drain slope back in the roof. And, whether building or rebuilding, it is more cost-effective to construct a flat roof deck than an intrinsically sloped deck, while the difference in purchase price and installation cost between flat and tapered insulation is quite minimal. A designer can save substantially by specifying a flat roof and maintaining positive drainage with tapered insulation.

Types of Tapers

A roof may be tapered in various ways. The easiest is a single-direction slope. Starting with a flat, rectangular deck, one side is built up to a certain thickness of insulation, sloping evenly down to the opposite side. Water flows right down this inclined plane to a gutter at the back of the building.

Often, however, the shape of a building or roof area demands multiple directional

Figure 1. 1/4-in./ft. Tapered Slope System, Utilizes 2 Tapered Panel Sizes (E&F)

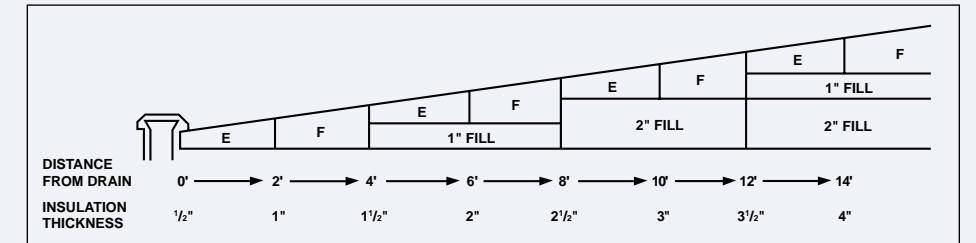


Table 1. System Average R-Value

	SYSTEM AVERAGE R-VALUE					
Distance from Drain	0-ft. – 4-ft.	0-ft.–8-ft.	0-ft.–12-ft.	0-ft.–16-ft.	0-ft.–20-ft.	0-ft.–24-ft.
"R"-Value Avg.*	5.00	7.50	10.00	12.50	15.00	17.50
"C"-Value Avg.*	.20	.13	.10	.08	.066	.057

* @75°F mean temperature

slopes. The diagrams (Figure 2 - 5) show examples. Most of these systems incorporate saddles: raised areas at the low point of the tapered system; or half-saddles, also called "crickets", used mainly at the perimeter wall and around roof penetrations such as HVAC equipment.

Plenty of Help with Installation

Some of the multi-directional roofing tapers could be complicated to install, but many manufacturers make it easy by supplying accurate shop drawings: a complete roof plan, a cutaway of thickest section of insulation showing where the pieces go, assembly drawings, etc. Insulation panels may be printed with type, location and direction of installation. In some cases tapered-insulation packages are provided, custom-assembled to suit various roof areas, with each piece labeled to show its place in the scheme.

Insulating Value of a Tapered Roof

Most roof designers call for an average insulating or thermal ("R") value: the thickness of insulation all over the

tapered roof is averaged. Referring to Figure 1, based on the insulating rating of extruded polystyrene boards (R = 5 per inch), the first panel has an R value of 3.75; this is the average for a panel which tapers evenly from 1/2-in. thick (R = 2.5) to 1-in. thick (R = 5). Many manufacturers supply tables for quickly figuring R-value (Table 1).

An average R-value works well enough for general purposes, but when building temperature control is very important – a cold storage building, for example – minimum R value is usually specified. That simply means that nowhere on the roof can the insulation be thinner than minimum requirement. If a minimum R-value of 5 is required (1-in. of insulation for extruded polystyrene), the roof would be covered with an overall layer of 1/2-in. fill material before the tapered panels were applied.

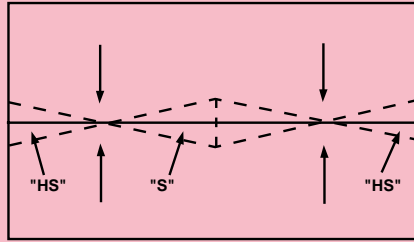
Tapered Insulation Materials

Various types of tapered materials are available, including wood fiber, perlite, extruded polystyrene, expanded polystyrene, and polyisocyanurate. Most of

Typical Tapered Layouts

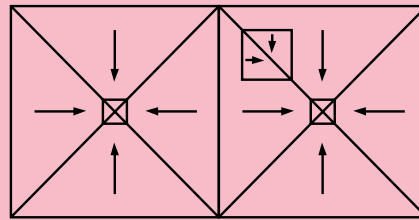
The two-directional taper system shown in Figure 2 utilizes tapered panels installed in two directions accompanied with saddles ("S") between the drains and half saddles ("HS") between drains and outside walls. The saddles assist in directing the water flow to the drains.

Figure 2. Two-Directional Taper System



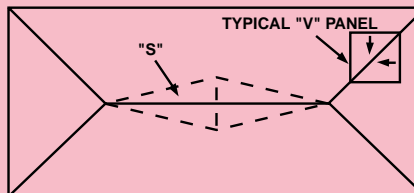
The four-directional taper system shown in Figure 3 utilizes tapered panels installed in four directions. Mitered valleys are created leading to the drains.

Figure 3. Four-Directional Taper System



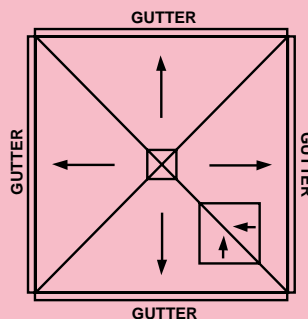
The modified two-directional taper system shown in Figure 4 utilizes tapered panels installed, primarily, in two directions with a saddle ("S") placed between the drains; however, two of the four sides have utilized mitered valleys. This system is desirable when a constant thickness of insulation is required at the outside perimeter of the roof.

Figure 4. Modified Two-Directional Taper System



The four-directional taper system shown in Figure 5 utilizes a four-way taper system directing the flow to the outside perimeter. This system may be selected when gutters are employed rather than roof drains. Desired drainage is obtained with the creation of hip miters.

Figure 5. Four-Directional Taper System – Perimeter Drainage



these are tapered by cutting, causing a tendency to cup and curl, as well as breaching the protective surface skin. For this reason, materials which are directly extruded to shape – certain extruded polystyrenes (Foamular®), and the more costly isocyanurates – have advantages of dimensional stability and better inherent resistance to moisture.

Experts predict that within a few years, all new commercial construction will be tapered, either by pre-engineering a sloped roof, or by use of tapered panels

Tapered Finds Favor with Many Authorities

A basic tenet of the National Roofing Contractors Association (NRCA) is that all roofs should shed water; that is, maintain a positive drainage. BOCA and ICBO codes go farther, imposing minimum slope requirements of ¼-in. per foot. Use of sloped roofing is also endorsed by the Asphalt Roofing Manufacturers Association (ARMA), National Roofing Contractors Association (NRCA), Midwest Roofing Contractors Association (MRCA), Army Corps of Engineers, ARAA, the Single Ply Roofing Institute (SPRI), and others. Some state construction standards also set a minimum slope.

Maximizing Investment

Experts predict that within a few years, all new commercial construction will be tapered, either by pre-engineering a sloped roof, or by use of tapered panels. Many specs today call for tapered insulation for new construction. It is often the only way of accomplishing recover and renovation in a reliable and cost-effective manner. ▲

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About the Author

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