Patented Coating Introduces NEW TECHNOLOGY To Snow Retention

By Mark Blomquist

TRADITIONAL SNOW RETENTION SYSTEMS

Traditional snow retention systems have existed nearly as long as smooth-surfaced roofs have been discharging dangerous and damaging snow slides (*Photo 1*). All of these systems are basically the same in that they secure some physical barrier onto the roof surface in a position to stop the sliding snowpack on its path to the discharge edge of the roof (*Photos 2* and *3*). While some are effective in stopping the most damaging and dangerous discharges, most if not all fail to eliminate discharge completely.

The systems function most effectively when their components are widely distributed across the entire roof surface and increase the points of contact with the snowpack. This reduces the incremental loading of the snowpack on each snow retention component and the distance and speed traveled by the snowpack before being influenced by the resistive force of each component. The most effective systems are well designed to transfer the loading to the roof and remain secure without damaging the roof. The system's structural design and the design of the connection to the roof are the easiest engineering parts of the snow retention puzzle to solve.

Photo 1 – Sliding snow discharge hazard.

The most difficult snow retention issue is the reliable transfer of interactional forces that occur within the snowpack at, and upslope of, the snow retention components. Snow retention systems are most effective in stopping a snowpack that is well consolidated in a solid mass and least effective in stopping a snowpack that has transformed into a fluid flow such as occurs during melting conditions.

When a thick snowpack is being supported by a retention component, the roof area directly below the retained snow and component is usually bare and exposed. The component contact point or edge of the snowpack is also exposed. The contact point or edge is one of the first areas of the snowpack to start melting, reducing the ability of the component to transfer resistive force into the snowpack. Meltwater drains down through the snowpack to saturate the bottom of the snowpack against the roof, reducing the bond between the roof and the snowpack and creating a lubricating, floating influence on the snowpack. Furthermore, the meltwater saturating the lower edge of the snowpack causes additional snowpack melting and softening that transforms the previously solid-bearing condition at each component into an unconsolidated fluid.

As a snowpack becomes fluid, even the most structurally secure retention components fail to transfer the required resistive force into flow of an unconsolidated snowpack. Portions of the snowpack flow around or over well-secured components and slide down the roof. Once larger portions begin to accelerate down the slope, they are increasingly difficult to stop. If there is a retention component in the path of a large slide, it is usually unable to stop and often unable to sufficiently detour the sliding snow from discharging from the roof.

Therefore, traditional retention systems can, at best, reduce the potential for dam-

Photo 2 – Bar retention system.

age or injury caused by discharge. Most, if not all, traditional snow retention systems publish statements disclosing that their systems are unable to completely eliminate discharge.

HOW CAN ANY SYSTEM ELIMINATE DISCHARGE?

The critical characteristics required for any system to eliminate discharge can be summarized as follows:

1) Uniformly distribute a vast number of retention components across the entire slope of the roof, thus reducing the interactional force at each component and preventing any portion the snowpack from beginning to slide.
2) The portions of the snowpack that contact the retention components must be protected from melting conditions, remain frozen, and maintain the ability to maximize the transfer of force to the retention components.
3) The base of the snowpack must remain consolidated in one continuous, frozen, monolithic mass across the entire surface of the roof and transfer interactional forces from the frozen contact points to the upper strata of the snowpack.
4) Systems must facilitate meltwater drainage to the discharge edge of the roof.

Photo 3 – Basic clip retention system.

THE ALPINE GLACIER

The best natural example of snow retention on a sloping surface is an alpine glacier. As the snow falls onto a mountainside, it adheres to the rough irregular surface. Air temperature, solar radiation, and gravitational force cause moisture and meltwater to flow down through the heavy, freshly fallen snowpack. The meltwater settles at the base of the snowpack, refreezes, and forms a monolithic icy base layer directly over the mountain surface. The underside of the icy base layer is also exposed to melting temperatures transmitting and radiating from the earth. Because the dehydrated upper portions of the snowpack insulate the icy base layer from extreme weather conditions above the glacier, the underside of the icy base layer forms a continuous interface between melting and freezing.

The icy base is supported and freezes to the highest and most structurally sound protrusions on the mountain surface. The snowpack remains in place on the steep mountain surface because of the frozen bond between the monolithic icy base layer

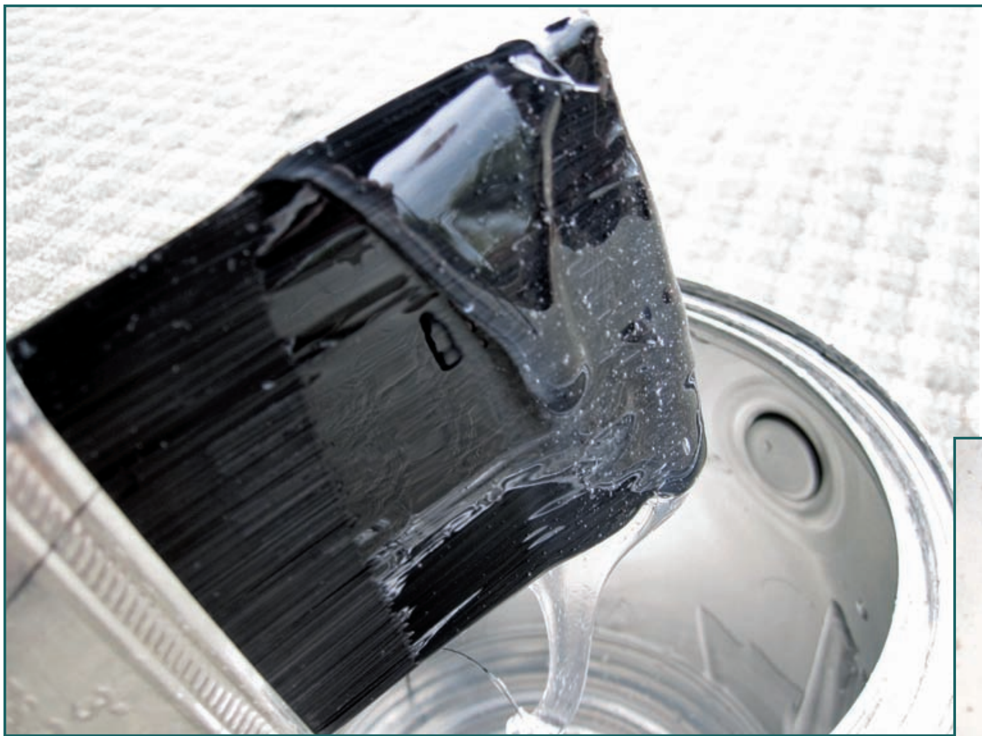

Photo 4 – Clear base coat ready to use.

Photo 5 – Aggregate set in energy-saving white reflective base coat.

and the multitude of structurally sound rock protrusions. This is solid physical connection between solid and structurally sound objects. As conditions change and the snowpack ages, the load at any one of the multitude of bearing points may naturally, gradually, and unperceivably transfer to other, more structurally sound adjacent protrusions.

Melting conditions at the earth/mountain surface cause meltwater to form and drip from the underside of the icy base layer. Meltwater falls to the sloped earth surface and flows through naturally created drainageways to the base of the mountain, leaving the glacier in a flowing river.

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ORIGIN OF A NEW SNOW RETENTION SYSTEM

Wes Fontecchio spent years making repairs to installations damaged by sliding ice and snow in the snow country of Michigan's Upper Peninsula and in northern Wisconsin. He started applying various elastomeric coatings onto old metal roofs. The inventor established that a cured elastomeric coating could hold a uniform matrix of protruding aggregate and provide effective snow retention upslope of items such as chimneys, vents, and gutters that were being damaged by snow slides.

His simple early systems showed immediate success but also less-than-optimal durability and appearance. Years of refinement developed a highly effective, durable snow retention coating system that became the basis of a U.S. patent application filing in late 2006. On July 20, 2010, the Michigan Limited Liability Company–owned by Fontecchio, Mark Blomquist (architect and author of this article), and others-obtained U.S. Patent #7,757,456 for the Snowgrip system. The company also has a patent pending in Canada.

ROOF GLACIER

The new retention coating is described as a two-part, monolithic, abrasive snow retention coating for smooth-surfaced roofs or other surfaces requiring snow retention. Part one is an elastomeric base coat applied to a clean, dry substrate (*Photo 4*); and part two is a matrix of uniformly distributed aggregate secured into the cured base coat (*Photo 5*). The system is recommended to coat the entire roof/substrate (from bottom to top of slopes and all roof surfaces of a building) to prevent any portion of the snowpack from beginning to slide and to eliminate destructive dynamic loading on structures.

BASE COAT

The system base coat (clear, reflective white, or colored) has material properties of solvent-based elastomeric coatings. The base coat provides excellent adhesion, high flexibility, and elongation properties. Base-coat flexibility is critical to facilitate movement of both the substrate and the aggregate, while durably securing retention components.

The acrylic-based coatings tested have not remained as flexible, don't adhere to the substrate, and don't hold aggregate as well as a polyurethane, hybrid, solvent-based coating with stabilized, permanent elastomeric properties (high tensile strength and elongation greater than 500%). The nonacrylic base coats used in the system are not subject to freezing and can be installed at colder temperatures, with the clear coating having an installation temperature as low as 0°F.

While a thorough and deliberate installation of the base coating as an elastomeric leak repair/prevention coating could provide substantial waterproofing benefits, the system is primarily intended and prescribed as a snow retention system. For example, an effective snow retention system installation may not necessarily need to coat the seams or flashing. Only one base coat is required for effective snow retention; but multiple complete, edge-to-edge coats, including special reinforcing and installation methods, may be required to provide additional benefits of waterproofing, enhanced aesthetics, and extended durability.

AGGREGATE

The aggregate is a recycled material, and the durable granules have relatively sharp points and edges (though not cutting, like glass or metal). The granules are the

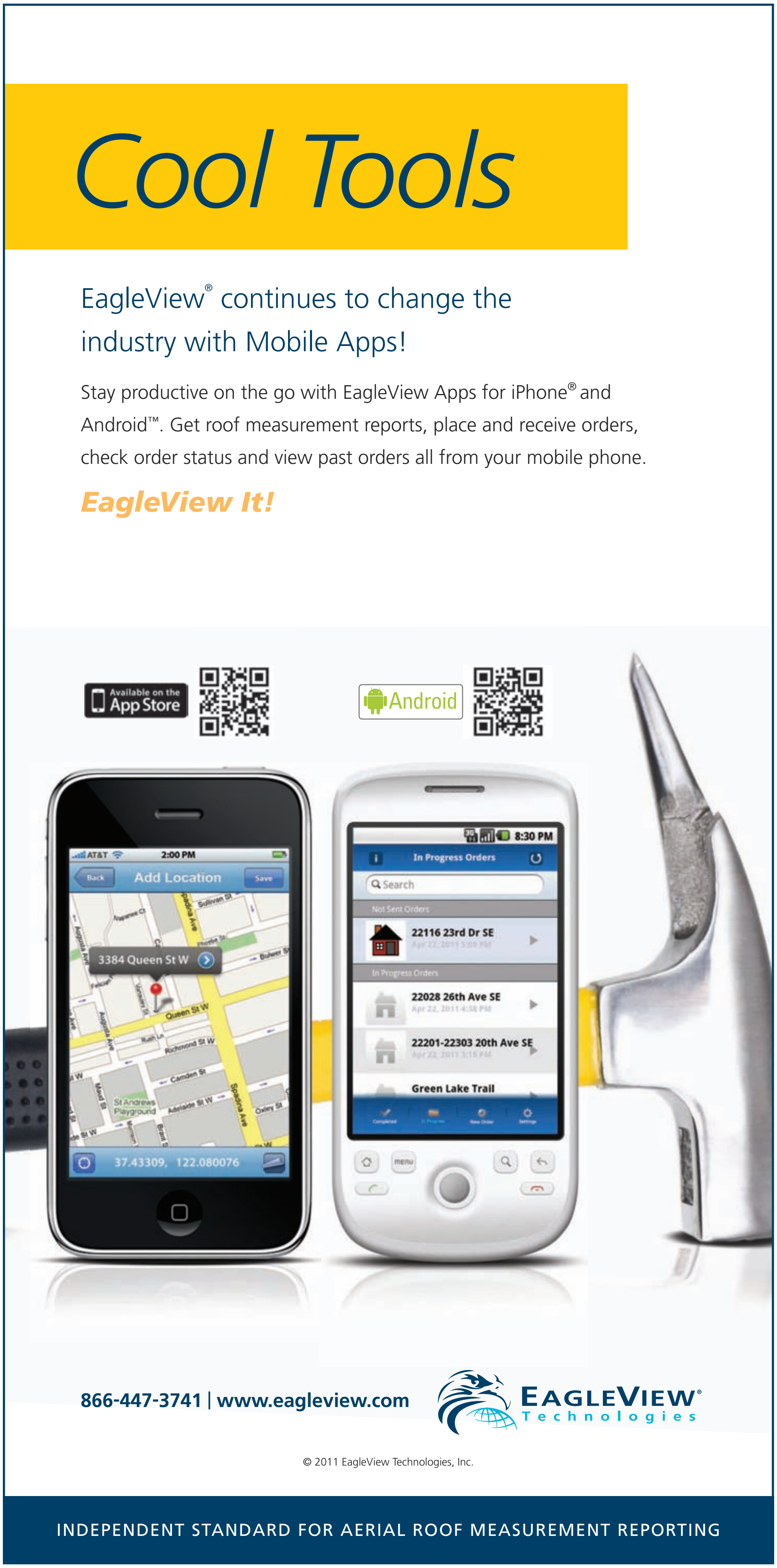


Photo 6 – SR coating on glass.

size of course sand, and it is recommended that they be sparsely distributed at about 20 granules per sq in (*Photo 6*). Each granule has a unique irregular shape that creates firm embedment into the cured base coat and frozen icy base layer of the aging snowpack. The aggregate material is not impacted by the freeze/thaw cycles, erosion, or corrosion.

The liquid base coat can be brush-, roller-, or spray-applied to any clean, dry surface that needs snow retention treatment (the clear base coat is too thick to be sprayed). (See *Photos 7, 8, 9,* and *10*.) While the base coat is still wet, the aggregate granules are uniformly broadcast onto the surface so that the granules partially sink into the liquid base coat. As the base coat cures, it bonds to the substrate and holds the granules protruding from the base-coat surface.

Regardless of the snowpack thickness or environmental conditions, the snowpack retained by the coating system will age like an alpine glacier as follows (*Figure 1*):

1) The upper level of the snowpack develops into a uniform lightweight dehydrated insulating snow layer as

Photo 7 – Application on metal shingle prior to installation.

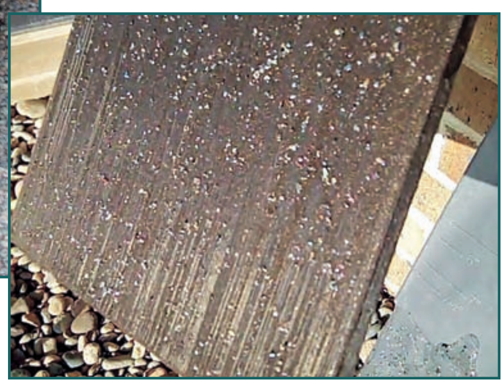


Photo 8 – Application on composite shingle prior to installation.

Photo 9 – SR coating sample on brick.

Photo 10 – Snow retention coating on limestone sill.

it reduces in density (snow load) as gravity pulls meltwater down.

2) Meltwater refreezes and forms a monolithic, structurally sound icy base layer that freezes to the clustered aggregate.
3) The securely supported icy base layer is melted from below, and meltwater drips onto the treated surface.
4) Drainageways develop in the clearest areas between the clusters of aggregate. Meltwater drainage naturally carves into the underside of the icy base much like a river system forms, with small tributaries on upper slopes and large "river" channels on lower slopes.
5) The snowpack recedes from the edges and safely and gradually melts away, one drop at a time (*Photo 11*).

OTHER SNOW RETENTION SYSTEMS (SRS)

Unlike other SRSs, Snowgrip provides the following:

1) The new coating system promotes uniform roof loading (minimal loading at a maximum number of points) of roof structures and membrane substrates rather than the much more concentrated loading (imposed at considerably fewer multiple points or lines) provided by other SRSs.
2) The coating system promotes free

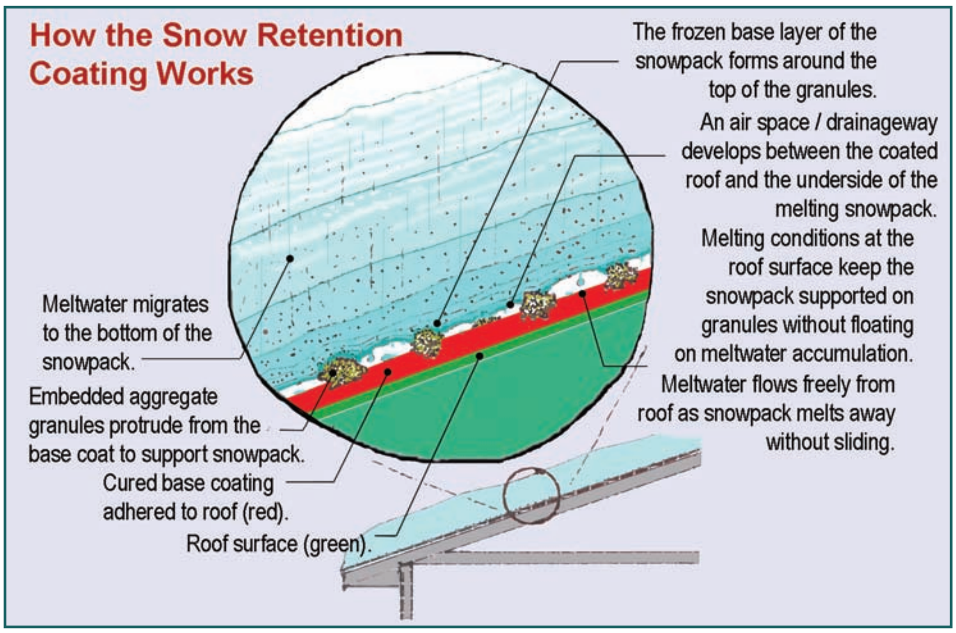
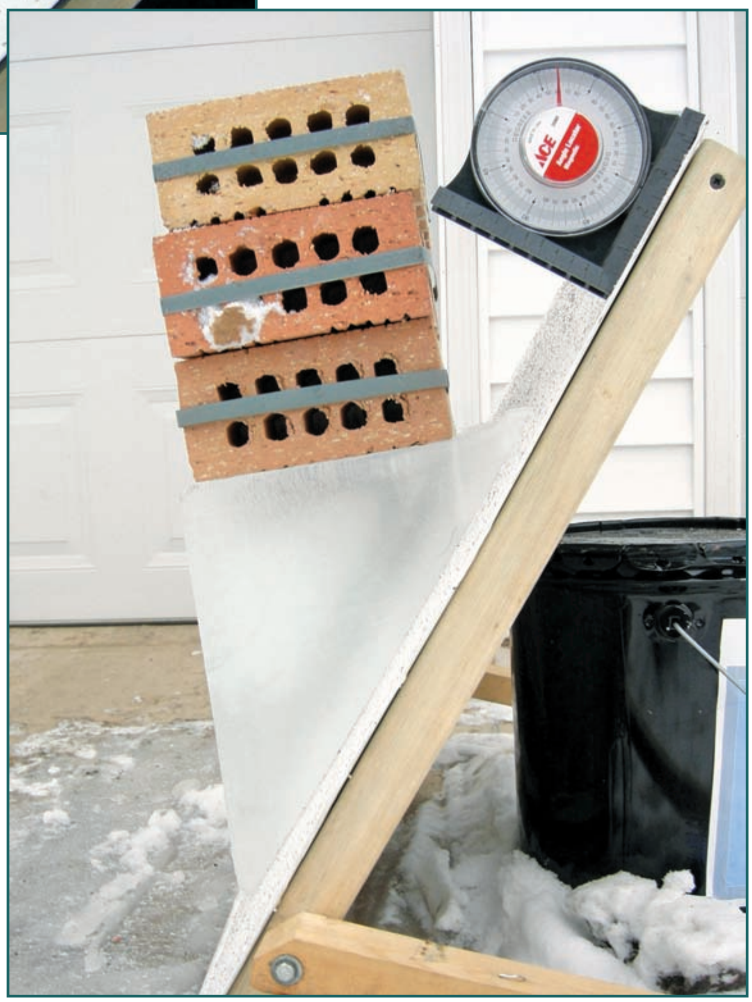


Figure 1 – How the snow retention coating works.

Photo 11 – Meltwater (dyed here for clarity) flows under the block without moving the block.

Photo 12 – 100 psf load on snow retention coating surface.



flow of meltwater. It creates an air space/drainageway below a well-supported insulating snowpack rather than the meltwater-damming condition at clip/fence points or lines of other SRSs.

3) Retention points are protected from melting conditions. The multiple points of frozen physical connection between the icy base of the snowpack and retention components are well insulated and protected from melting conditions above the snowpack. Because the connection points between the snowpack and retention components of other SRSs are extremely exposed to melting air temperatures and solar exposure, they have the inherent inability to prevent the failure of the snowpack structure to transfer loading to their relatively few and isolated retention points. The melting of the snowpack destroys the ability to transfer load to other SRSs as the snowpack melts and transforms from a relatively solid mass to an increasingly heavy and fluid flow.

ENGINEERING OR EXPERIENCE

The inventor's trial-and-error method of development was initially not well received by members of the architectural and engineering community. Design professionals wanted quantitative and qualitative design criteria and not just the display of a system sample holding a block of ice on a 60° to 70° incline (*Photo 12*).

Photo 13 – Demonstration of aged ice block on sample in nearly vertical position.

In an effort to give engineers some requested design criteria, developers determined that each granule could easily support a load of five pounds before dislodging from the base coat. At 20 granules per sq in and 144 sq in per sq ft, the Snowgrip could potentially support 14,400 lbs per sq ft. Thus, further evaluation indicates Snowgrip is only likely to be loaded to a level of well under 10% of its capacity.

So far, developers are not aware of any sliding snow discharge from roofs treated with the coating system that have followed 100% coverage recommendations. In some isolated cases where the recommended full coverage was not installed, sliding discharge has been prevented, though some creeping of the snowpack was observed and required maintenance to remove small portions of the snowpack that extended beyond the roof edge.

Current installations have performed 100% effectively in preventing sliding discharge on slopes up

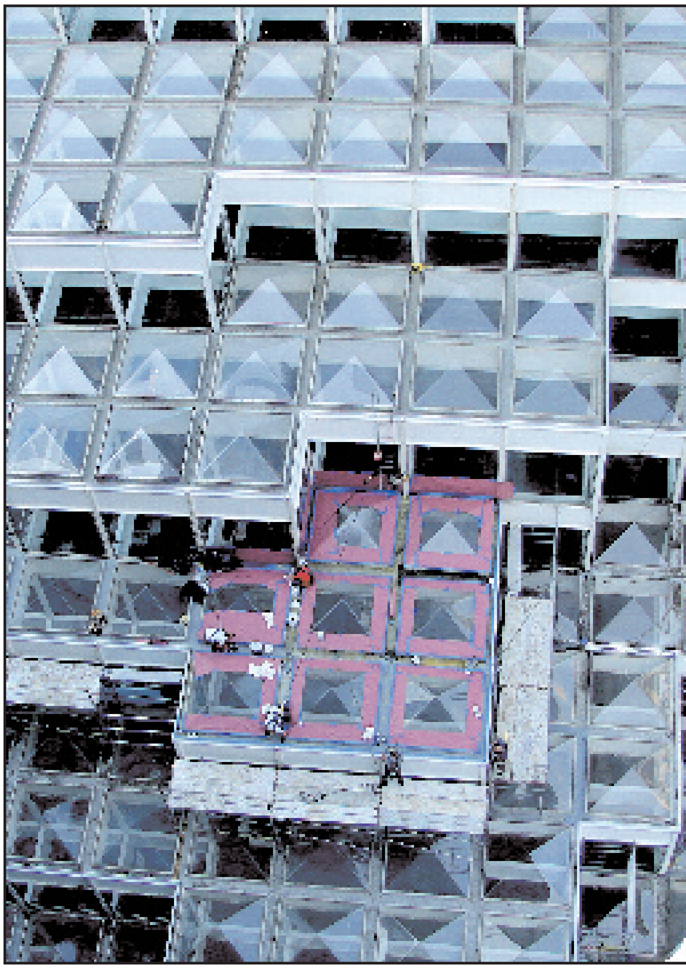


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Photo 14 – Green snow retention coating on 10/12 pitch. A snow slide in a prior winter tore the railing off the deck.

Photo 15A and 15B – The top photo shows a residence coated with Snowgrip in early winter, while the bottom residence shows it in the late winter.

to a 12/12 pitch, but theoretically would perform on steep pitches (*Photo 13*). However, it is anticipated that snow on snow slides and wind-influenced discharge beyond the control of the snow retention coating system becomes more likely on steeper-sloped roofs.

CODE-REQUIRED SNOW RETENTION

The developers introduced a Public Code Change Proposal to the International Code Council during the 2007/2008 Code Development Cycle. The submittal proposed requirements for snow retention or other design features that would greatly reduce the likelihood of injury caused by sliding ice or snow discharge from buildings. Like most first-time code-change proposals, the proposal was opposed by several established industry representatives and was rejected by the code council. Nevertheless, there was a significant level of support that may provide the basis for a similar code change request in the future when the performance of the new coating system can be more reliably documented by successful installations (*Photos 14* and *15*).

LEARN MORE

The best way to become familiar with this new, first-of-its-kind snow retention coating is to view the 8-minute video available at snowgripit.com and youtube.com videos at youtube.com/watch?v=FxD59aaZvPg, youtube.com/watch?v=L5bGU-MWDB0, and youtube.com/watch?v=nOu1ALdvevs.

Mark Blomquist

Mark Blomquist, co-owner/developer of Snowgrip, is a second-generation architect practicing in the upper Midwest based out of Iron Mountain, Michigan, for the last 30 years. Over the last ten years, Mark has been a principal architect on building projects totaling over $250 million. Contact Mark at mark@blomquistarchitects.net or 906-396-7000.

METRODOME IS REINFLATED

Almost seven months after a snowstorm destroyed the roof of the Metrodome, the Minnesota Vikings' home was restored on July 13, 2011. Workers reinflated the bubble roof in about 45 minutes (see time-lapsed video at www.startribune.com/local/125478268.html). A dozen 100-horsepower fans pushed the new Teflon-coated fiberglass into place on the Minneapolis skyline following a $20 million repair job. To watch the original collapse on December 11, 2010, view the film at www.liveleak.com/view?i=bf0_1292178398.