1001 reasons not to roof over wet insulation

Even with vents, practice is taboo

by Dick Baxter

Water is the cancer of any roof, whether it's a built-up, modified bitumen or sheet membrane system.

Water in its "free" or vapor form degrades the roof assembly from the structural deck to the membrane surface. It forms corrosive substances with organic elements in the roofing system that eat away at roof and structural components. Once inside a roof assembly, water can cause long-term deterioration and early roof failure.

When a new roofing system is installed over an existing system that contains water, it can subject the roof and structural system components to long-term moisture exposure, which can result in corrosion and/or rot. This is not to say, however, that every last ounce of moisture must be removed before reroofing can begin. Minor quantities of retained moisture in excess of equilibrium moisture may not significantly contribute to the roofing assembly's decay, depending on the system's insulation and the structural members' susceptibility to moisture. But generally speaking, the typical roof tolerates moisture on its surface much better than moisture vapor from below. For this reason, it is essential for the overall health of the roofing assembly to protect it from the effects of moisture vapor trapped within its components.

This protection from entrapped moisture cannot be achieved with roof vents or breathable roofing membranes. These products have not proven effective in releasing trapped moisture from most overlay roofing systems. The inescapable fact is, when a new roofing assembly is installed over existing wet roof insulation, it usually contributes to the early failure of the recover roof system even in the best of conditions.

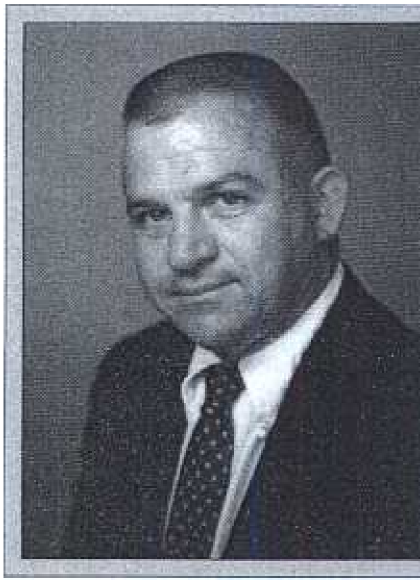
No stopping moisture damage

There is little a contractor can do to prevent trapped moisture from moving throughout a roofing system. Moisture vapor is all-pervasive, capable of penetrating the smallest openings in a system's components. Even though roofing membranes are highly impermeable, water vapor can migrate into or through even the most moisture-resistant materials when there is enough of a difference in vapor pressure between the ambient conditions outside and the building's interior. In recognition of the fact that moisture vapor is extremely difficult to control, the industry recently replaced the term "vapor barrier" with "vapor retarder" in roofing jargon.

Moisture that does not migrate is also dangerous to the roof system. Free water in a roofing assembly can be vaporized by heat on the membrane's surface or from the interior. This causes the water and gas to expand, forcing moisture vapor through the path of least resistance in the roofing assembly. Vapor that is trapped in a confined area can expand with significant force, stretching roof membrane materials and causing separation in the area of encapsulation. This phenomenon is sometimes referred to as "blistering." Blistering is not peculiar to BUR membranes; it may occur beneath impermeable modified bituminous membranes or at laps in sheet membrane systems.

Damage begins with decks

All roof components will suffer some damage if they remain in contact with free water or moisture over an extended length of time. Structural decks, regardless of



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their composition, are usually the first building system components to be affected by residual moisture.

Even structural concrete is susceptible to moisture damage. The material conveys the false impression of permanence and is often considered relatively immune to the moisture's effects. But when volumn changes cause cracks in reinforced concrete, it allows moisture to enter the core of the concrete assembly. Once inside, the water attacks and corrodes the reinforcing steel that gives concrete nearly all of its tensile and shear properties. As the rust causes flaking of the surfaces of the reinforcing steel, the concrete is divorced from the reinforcement and loses some of its structural integrity.

The deterioration of concrete's structural properties will vary significantly depending on concrete mix, quantity of steel and many other factors that are unknown at the time of reroofing. A conservative approach to the problem of moisture trapped over concrete decking is warranted to minimize potential deterioration of structural components. Structural concrete decks are not easily replaced.

Constant exposure to moisture has severely rusted this metal deck. Before reroofing could begin, it was necessary to install sheet metal between the deck and the new insulation.

Moisture can also affect lightweight aggregate concrete and gypsum roof decks. When wet, these materials are subject to spall damage during periods of extreme weather, reducing the deck's structural integrity and weakening its ability to hold fasteners. The deck's painted metal form material and tees/bulb tees are subject to rust deterioration when continually subjected to wet deck materials. This makes it difficult for these components to support the lightweight deck material and the mechanical loads imposed on the roof assembly. Because of moisture's devastating effects on these materials, areas of wet or damaged lightweight decking and rusted structural components should be removed and replaced prior to installation of the new roofing assembly.

Wood decks, even when treated, will eventually decay when continually exposed to wet roofing materials, causing local or general degradation of structural integrity. Continuous exposure to accumulated moisture will cause plywood deck components to delaminate and weaken, and wood plank decking to rot. Wood decking decays from the top down, making it difficult to detect deteriorated decking from the building's interior.

Vapor retarders lying between wood decking and wet insulation will not prevent the deck from deteriorating. In this situation, it is likely that the vapor retarder will fall below the dew point temperature, allowing moisture to accumulate on the bottom side of the vapor retarder and the top of the deck surface.

It is best to check wood decking lying under wet insulation before reroofing. Unless the existing roofing assembly is removed to allow assessment of the existing deck conditions and the needed repairs are made, the new roofing assembly may fall in with the old system as structural decking deteriorates and is unable to support the roof and imposed loads.

Painted steel decking is particularly susceptible to rust caused by continuous contact with wet roof insulation. The steel decking, like wood decking, rusts from the top surface down, making accurate assessment of deck conditions just as difficult from inside the building.

Roof insulation materials that hold water in contact with the steel decking must be removed. The deck must then be treated to retard the rusting action, or replaced or overlaid as required to restore structural integrity to the system. If rust has significantly deteriorated the vertical or bottom flute sections, structural integrity of the steel decking has been compromised and the steel deck sections should be replaced.

Regardless of the type of decking involved, harsh environments will typically accelerate the deterioration of structural components containing unnecessary moisture. Wet roof insulation or wet decks in cold climates are subject to freeze-thaw cycles, which can cause the spalling of cementitious materials and the general breakdown of moisture-sensitive insulation and structural components. High humidity interior environments in very cold winter climates are the most harmful. The potential is great for humidity generated inside the building to condense and accumulate as moisture in the roofing assembly. Contractors encountering this situation should carefully evaluate the existing roof's condition prior to reroofing.

Dangerous weight gain possible

The weight of the water trapped in the insulation may also put a dangerous strain on the structural members. Free water weighs approximately 5 pounds per square foot per inch (a board foot). Some insulations are capable of absorbing and holding most of this water in each board foot, increasing the structural load by approximately 5 pounds per square foot per inch of insulation. If 2 inches of saturated insulation are contained in the existing roofing assembly, 8 to 10 pounds per square foot of insulation may be added to the structural load. Depending on the building's design live load, the additional weight of the water left in the roofing assembly, when combined with the weight of the recover roofing system, may significantly affect the building's remaining structural safety factor.

When wet insulation adds weight to a roof system, ponding becomes an important consideration. The additional weight may contribute to the permanent deformation of structural members, which can cause further ponding on a low-sloped roof surface. As the ponds grow, more weight is put on the structural system. To prevent the eventual collapse of the roof, wet insulation should be removed from the roofing assembly prior to installation of the new roof system.

Deterioration of existing insulation

Water or moisture can also break down the insulation in which it is trapped, destroying the material's thermal resistance and structural integrity. The water replaces the air or, in the case of polyurethane foam, the freon gas that is the actual insulating element. Without the air or gas, the insulation board becomes ineffective. Studies by the Army Corp of Engineers' Cold Regions Research Engineering Laboratory (CRREL) and the National Bureau of Standards indicate that common rigid board roof insulation can lose up to 80 percent of its insulation value depending on the degree of saturation.

The glass fibers, cellulose fibers, expanded perlite or plastic cells that trap and hold the insulating gases may also be susceptible to water damage. With the exception of polystyrene, the common insulation materials contain organic fillers that degrade on prolonged exposure to moisture or moisture vapor. Some insulations are also capable of holding large quantities of moisture and generating corrosive acids in the roof system. If these materials become saturated with water, the integrity of the insulation board can be compromised. As the insulation structure begins to decay, its insulating efficiency may be seriously and permanently compromised, and its ability to support the roofing membrane may be diminished. Moisture absorption may also destroy the insulation's ability to retain adhesive bonds.

Once the insulation loses its thermal resistance, it reduces the vapor retarder's ability to resist the accumulation of interior-generated moisture in the roofing assembly. Vapor retarders rely on the insulation installed on top of them to maintain a temperature above the dew point. If the insulation becomes saturated and loses its thermal resistance, it will allow the vapor retarder's temperature to drop below the dew point in cold weather. Once the retarder's temperature falls below the dew point, interior moisture can begin to condense and accumulate between the retarder and the deck, causing the decking material to corrode or rot. An overlay roof containing a minimal thickness of insulation will probably not add enough insulation value to improve this situation.

Moisture attacks fasteners

The mechanical fasteners that secure the roofing system to the deck are also vulnerable to moisture, even though mechanical fastener manufacturers have developed a number of coatings to minimize fastener shank corrosion. Often, these coatings are damaged during shipment or installation, allowing retained moisture to attack the fastener shank immediately in any area where the protective coating is not intact. As the accumulated moisture becomes more acidic, the deterioration of the metal components is accelerated. Stainless steel fasteners appear to be the most foolproof means of eliminating shank corrosion, but they are usually relatively soft and are limited in their applications.

Fasteners, as they penetrate a steel deck and interrupt the deck's zinc or paint coating, can make the deck more susceptible to moisture. By exposing the deck's base metal, the fasteners make it possible for the

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deck to rust out at the point of penetration, compromising the deck's holding power. When the holding power is lost, fasteners can no longer secure the roofing assembly.

The metal plates some fastening systems use to improve wind uplift performance can also corrode. If the area on the plate around the fastener head rusts away, the uplift resistance of the fastening system is reduced to nil and positive attachment of the roof assembly will not be possible. In some fastening systems this problem is avoided by the use of plastic plates that are not susceptible to corrosion.

New roofing in danger, too

Retained moisture can be as damaging to a new roofing system installed over wet materials as it is to the existing system. In general, no roofing membrane presently in use is immune to the effects of moisture accumulation. If the overlay system contains insulation, it will certainly experience the same damage that accumulated moisture causes in existing insulation. Bituminous waterproofing materials will suffer accelerated deterioration if exposed to moisture. Adhesives used to bond rubber sheets may fail when affected by moisture in its vapor form, causing delamination of the field and factory laps. And some PVC plasticizers may leach out when exposed to moisture trapped within the roof assembly.

Can vents help dry insulation?

Roof vent manufacturers and suppliers have claimed that their products are effective in drying out existing wet insulation. At one time, it was advertised that the use of vents eliminated BUR membrane blistering, a concept that has generally been proven false. "One-way" and "solar-powered" vents have also proven to be of limited value in drying out existing wet insulation. Despite the manufacturer's claims, roof vents are not likely to significantly reduce retained moisture—especially if the source of infiltration has not been definitely located and eliminated. Even if an effective roof vent were developed, it still would not be able to improve the integrity of the rigid insulation board, which could have been significantly compromised by prolonged moisture exposure.

CRREL studied the effectivness of roof vents on different types of roofing assemblies, including various types of rigid board roof insulation. In a report on the test results, CRREL's Wayne Tobiasson said a vapor retarder may affect the drying of existing wet insulation. "However," he added, "there is little evidence to indicate that edge vents or breather vents can dry out wet insulation" with or without a vapor retarder in the system.

"Since it is extremely difficult to dry wet insulation trapped between a membrane and a vapor retarder," Tobiasson continued, "it is critically important to install the insulation dry and prevent it from getting wet during its service life."

It may take 100 years for roof vents working alone to completely dry out most insulations, according to Tobiasson. He did determine, however, that free water could be pumped from fibrous glass insulation, and the residual moisture essentially eliminated after a period of eight to 10 years. In any case, however, the time frames involved are long enough to allow the significant corrosion of the metal and decay of other structural components.

The consensus among the industry is that wet insulation should be removed prior to a new roof system's installation, and that roof vents will not provide sufficient drying of existing wet roof insulation before other serious system complications arise.

The one common denominator in the deterioration of all roof system and structural components is the unnecessary accumulation and retention of water. If wet materials are not removed prior to the installation of a new roofing system, the moisture retained in the existing roof system will affect the performance of the new roofing assembly and the condition of the structural substrate supporting the roof systems.

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