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## ROOF CONDENSATION: A COSTLY PROBLEM

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### 1. WHAT IS IT?

Roof condensation is moisture that develops at the roof ceiling area and is trapped by foil insulation or other types of radiant barriers. **IF LEFT UNTREATED, IT CAN DESTROY THE ENTIRE ROOF STRUCTURE!** This problem can be a 10-cent or a 10-dollar per square foot problem, depending on how long it goes uncorrected.

### 2. HOW DOES IT FORM?

In most cases, a roof structure contains a vapor retardant, which is a foil radiant barrier, R-11-faced fiberglass batting, attached to the sub-purlins or wrapped around the purlin beams at the underside of the roof structure. In some buildings, you will see batting insulation covered with foil insulation--one of the worst scenarios for creating damaging roof condensation.

As the building heats up during the day and the roofing material (especially dark roofing) absorbs the sun's rays, heat is created in the air cavity between the insulation and the roof. This area can achieve a temperature 50 to 70 degrees warmer than the rest of the building.

Hot air increases the evaporation of the ambient water molecules, drawing moisture into the air cavity. Because of the insulation, the individual roof cells (the area between the foil and plywood roof, usually constructed of 2x4 sub-purlins) are not able to vent and dry out.

When the building cools off, the cavity cools and the trapped water condenses and seeps into the wood roof members. Until corrected, the building cycles through this process day in and day out. The following factors can intensify the condensation process:

**Humidity** - Structures located near water or in other humid regions are more susceptible to condensation damage because air trapped in the roof cells can hold more moisture at identical temperatures.

**Building Construction** - Lumber utilized in construction often has a moisture content of 19% or more. If it is not allowed to dry out before the insulation is installed, excessive condensation can occur.

**Roof Leaks** - Over time a roof may suffer minor or major leaks that allow moisture into the roof wood system, which of course, becomes trapped by the insulation.



**Occupant Operations** - Boilers, foam production, bakeries, and similar operations produce additional moisture in the roof cells. A tenant may induce condensation damage by sealing the vented skylights, closing the HVAC economizers, preventing ventilation at the roof line, keeping the building closed up, or building full-height walls inside the structure. Some tenants install their own foil insulation or overload the roof from above, increasing the likelihood of condensation-related damage. Extended vacancies leave a building un-vented and can cause additional moisture buildup as well.

### 3. WHAT TO LOOK FOR

When you enter a concrete tilt-up building with a foil barrier attached to the bottom of the sub-purlins or wrapped around the purlins (one of the worst cases), you may find black (dark) streaks running down from some or all of the purlin hangers. This is an indication of a roof condensation problem.





If you can see a white surface at the bottom of the sub-purlin hanger(s), the condensation process is affecting these hangers as well. In more severe cases, the sub-purlin hanger is rusting and is becoming ineffective.

#### 4. REPAIR OPTIONS

**Option #1-Vent or Remove Foil** - The existing foil insulation can be removed or vented by cutting the edges of the foil back 2-3 inches from the area where the foil attaches to the other wood members like purlins and/or a Glue Laminated Beam (GLB), enabling the foil to breathe. The building must be vented and allowed to dry out.

(This picture shows V-cuts in the foil. Typically, this is used at loading dock areas due to wind)



**Option #2 – Add wood ledger** – If sub-purlin hangers are corroding, the best remedy is to attach a 2x4 wood ledger below the sub-purlins, flat against the purlins and ledgers, to support the existing 2x4 sub-purlins. Because of the existing damaged hanger's inability to hold the sub-purlin down in place and the possible deterioration of the roof nails, the optimum application would be to use Simpson SDS screws at 1 foot on center and use Simpson H2.5A hurricane clips every four feet to hold the sub-purlins in place.

**Option #3** – Install GLB connections - GLB connections first need to be inspected for rusting. In cases where the hanger is staining the beam it is attached to, but is not severely corroded, the hanger can be cleaned with a wire brush and coated it with a rust inhibitor like “Rust Grip,” which seems to perform very well. After cleaning and coating an existing hanger that is severely rusted, a retrofit hanger can be added over the existing one. The new hanger is protected from possible transfer of corrosion by putting plastic or duct tape between the hangers. An alternate to the wrap-around retrofit hanger solution is to use an 8 to 10 inch long piece of angle iron to support the existing purlin hanger at the bottom by installing one side to the GLB and the other side of the angle tight to the bottom of the existing purlin hanger. If the rusting is too severe to be fixed by grinding and painting the GLB hinge connector, a structural detail will be required. (There are too many loading issues to have a standard solution.)



**Option #4** - Roof Nailing – A disruption to the roof nailing is possibly one of the worst conditions of roof condensation that can exist. Moisture absorbed by the roof sheeting can affect the roof nailing (roof diagram) and the shear value of the plywood. This is what holds the building together at the roofline. Unfortunately, this problem can easily go undetected by roofing, HVAC, insulation, and other contractors.

The solution begins with an inspection of roof area nailing to determine if the shanks of the nails are being affected. If in fact the nails are deteriorated, the roof needs to be removed and the plywood roof has to be re-nailed or re-stapled. Another option is to install anchors underneath the roof and attach them to the plywood and the structural roof members. This option is time consuming and expensive.



## 5. OWNER RESPONSIBILITIES AND PROACTIVE MEASURES

### MAINTAINING A ROOF

When a roof membrane is replaced, it should be a standard practice to inspect the roof structure. Many roofing contractors do not know what to look for and new roofing problems may follow! An inspector with expertise in roof condensation issues should look for the following:

**Roof Nailing Problems** – Some nails should be pulled and inspected for deterioration. The nailing pattern should be checked and verified by a structural engineer for a correct nailing schedule. This is a good time to upgrade the nailing pattern for seismic strengthening. Re-nailing the roof is a simple process costing between 10 and 20 cents per square foot.

**Roof Replacement Damage** – When a new roof is installed, the removal and replacement will cause a good deal of the foil to drop or hang from the ceiling. If this foil cannot be easily removed, this is a good time to “vent” the foil in conjunction with the roof re-installation.

**Skylight Problems** – Skylights should be checked to make sure the vents are not sealed. This is also a good time to raise the skylights higher to prevent rainwater from splashing into the skylight vent.

**HVAC Rooftop Platforms** – HVAC platforms should be raised if they are less than 6 to 8-inches off the roof.

### **BEING ALERT FOR TENANT IMPROVEMENT PROBLEMS**

Even though your tenant acquires a permit to upgrade the building, there is no building code requirement in regard to venting and airflow. With this in mind, it is important that the building owner and an experienced contractor review and approve all changes to the building, making sure the design will not affect the airflow in ways that might lead to damaging roof condensation.

### **INSPECTING THE ENTIRE STRUCTURE**

A periodic, thorough and proactive **inspection of the building itself** can help guarantee the safety and financial security of a structure. This inspection can also provide vital information about the health of building and potential affects to the health of the roof area.

Building owners or managers are almost always responsible for reparations resulting from condensation damage. Because this is true, the importance of obtaining a solid inspection from a company experienced in roof condensation problems cannot be stressed enough.

If a building owner uses only roofing, insulation, mechanical or general contractors to inspect a building, it is more likely that the inspection will be incomplete. Saunders Commercial Seismic Retrofit can provide a thorough and multi-faceted inspection of a building, based on years of preventing and repairing roof condensation problems, thereby promoting the safety and security of your commercial property, including its occupants, machinery and inventory.