

Water Intrusion From Rooftop Mechanical Equipment

By Joseph D. Shuffleton, P.E.

In the Washington D.C. area and many other parts of the country, the winter of 1995-'96 will long be remembered for many undesirable things. The dreaded Dallas Cowboys once again became Super Bowl Champions. The federal government shut down twice (but at least rush hour traffic was more tolerable), and record snowfalls, in conjunction with extreme winter weather, created water intrusion problems in previously unaffected sections of many buildings.

One of the areas that seemed hardest hit was rooftop mechanical equipment. We received numerous calls concerning buildings with apparent watertight, sound roof systems that experienced extensive water intrusion near rooftop mechanical units.

Inspections often revealed open flashing seams, shrunken fillers in pitch pockets, or other, more common roof-related openings for water intrusion. However, in a number of instances, water testing and follow-up investigation revealed that the real culprits were the rooftop mechanical units themselves.

Most roofing contractors and consultants have probably run into these problems from time to time. Everyone in the industry with whom we spoke provided stories of frequent visits to properties (and water testing) required to convince a client that the reported "roof leakage" was really due to defects within a rooftop mechanical unit.

To help explain this problem to our clients, we decided to gather published articles and reports related to water intrusion from rooftop mechanical units. Inquiries were made to the National Roofing Contractors Association (NRCA), the Roof Consultants Institute (RCI), the Single-Ply Roofing Institute (SPRI), the Roofing Industry Educational Institute (RIEI), and other organizations. Unfortunately, not one article or report could be produced on this subject. However, everyone acknowledged that this was a fairly common problem, similar to water intrusion at walls (such as parapet or penthouse walls) that is often reported as "roof leakage."

We finally found a technical bulletin published by the Canadian Roofing Contractors' Association (CRCA) in

October of 1995. (See sidebar). It does a good job of explaining the various aspects of water intrusion in and around rooftop equipment. In particular, it points out several important factors/items.

1. While it is not a wise practice to install mechanical equipment on building roofs, designers do this regularly because it is efficient and the equipment can be hidden from view.
2. Mechanical equipment consists of metal shells with detachable panels, access doors and louvers; however, they rely heavily on factory-applied gaskets, caulking, etc. to prevent water intrusion. Often water intrusion occurs because these gaskets are:
 - a. Not perfectly watertight in all weather conditions;
 - b. Damaged (or misaligned during transit or during installation); or
 - c. Not properly maintained and replaced when needed.
3. Condensate drainage plans that are inadequately designed, constructed or maintained can cause apparent "roof leaks" during even the worst summer drought.
4. Mechanical units must be properly installed and flashed. This includes:
 - a. Making sure they are properly leveled so that internal drainage systems operate as intended;
 - b. Maintaining minimum flashing heights (of over 11" in Canada);
 - c. Installing saddles or crickets on the upslope sides of units to divert water around the curbs;
 - d. Using permanent metal flashings whenever possible and avoiding the use of pitch pans;
 - e. Not penetrating base flashings with service lines; and

- f. Installing protective pads around units for service personnel.

To this list of prudent measures, we would add the following cautions and recommendations.

1. Building staff should carefully check the area around rooftop units after service is performed. Obviously, access panels must be properly reinstalled and the area around the units should have fluid spills or debris (such as screws, wires, parts, etc.) removed.
2. The top edges of base flashings should be properly covered and protected by metal counterflashing. In certain cases, the body of the rooftop mechanical unit may protect the edges of some flashing. However, the added cost of metal counterflashings over the tops of curbs at the time the curbs are installed is generally insignificant compared to the cost of finding and correcting water intrusion problems later.
3. Whenever possible, equipment should be mounted on curbs that are firmly secured to the deck. Avoid mounting units on top of the roof membrane.
4. Firmly secure mechanical units to supports to limit vibration that can cause damage to the roof membrane and flashings.
5. Condensate drain lines can be extremely problematic and require special attention.
 - a. Due to the design of many large mechanical units, the drain lines may not operate properly unless there is a goose-neck trap in the line that is primed (filled) with water. This is a special concern after a reroofing project where the condensate lines were disconnected and/or modified.
 - b. Whenever possible, drain lines should discharge into roof drainage systems, not onto the roof membrane, because oil leakage from the unit can be collected and discharged through the condensate line.
 - c. Building staff should regularly check the operation of condensate collection pans in the mechanical units and the drain lines.

Our experience with water testing rooftop mechanical units has been very good when specific procedures are followed. We have had good success working with mechanical repair contractors when we include them in this process. Generally, our testing involves the following items/procedures.

1. Spray the base flashings with water for at least thirty minutes. If enough hoses and water outlets are available, the entire roof area around a mechanical unit can be checked in this manner fairly quickly.
2. Once the membrane and flashings are tested, we then spray water on the top of the unit for at least 30

minutes. If no leakage develops, we spray each side of the unit for 30 minutes

3. We generally use a very strong spray because we cannot recreate the exact conditions (or length of time) that Mother Nature can bring to bear.
4. Whenever water intrusion is noticed, we stop spraying for a period of time (about 15 minutes) to let the leakage subside. Then we reapply the spray in the same manner to verify that this was the cause of the water intrusion.
5. As another check, we will sometimes respray the base flashings and membrane below the area of suspected water intrusion, just to help verify that the roof covering is not a contributing factor.

Armed with this information, hopefully everyone will have a more prosperous year. As for those of us in the Washington D.C. area, the government will continue to function, the Redskins will keep trying (there is always hope) and the weather will continue to be an interesting factor in our lives.

I would appreciate hearing from other readers about their experiences related to leaking rooftop mechanical units. If I get some good tips or insight into these problems, I will write a follow-up article and share the information. Until then, at least we now have one published article on this "common" but poorly documented problem.

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About The Author

Joe Shuffleton received his bachelor and master of science degrees from Rensselaer Polytechnic Institute in Troy, NY. He is a registered engineer and geologist in various jurisdictions and has over 23 years of engineering and consultation experience involving evaluation of building elements, particularly roofing systems. In 1982, he founded Engineering and Technical Consultants, Inc. (ETC) and now has offices in Sterling, VA and Columbia, MD. Joe has published a number of articles on roofing and is a respected lecturer.