



Roof Top Equipment

Low slope roof assemblies provide the primary function of separating the interior building environment from the outside elements. The membrane must be monolithic and continuous in order to prevent the infiltration of rain and snow. The construction of the typical flat roof, however, has been made increasingly difficult by the large number of penetrations and openings resulting from today's construction practices. Not only is the equipment placed on the roof because it is the most efficient location, but it enables the designer to hide it from pedestrian view, maximizing a building's architectural features. Most low slope roofs on our buildings are replete with a variety of roof top equipment, which must be carefully sealed into the roofing system to be rendered watertight. Unfortunately, little thought is usually given to the critical nature of their terminations or how they will be roofed in the initial design.

Even worse, communication between the parties responsible for the installation and servicing of this equipment, and the roofing contractor who must render it watertight is, for the most part, either poor or non-existent. For these reasons, roof penetrations, openings and terminations account for the majority of roofing problems reported.

Problems associated with roof top equipment are primarily the result of improper:

- Design and Assembly
- Installation
- Maintenance

This bulletin discusses some of the measures which can be taken to avoid them.

Heating, Ventilation and Air Conditioning Equipment

A wide array of mechanical, heating and ventilating equipment can be found on most any roof. These range from small electrical fans to large air make-up units weighing several tons. A visual examination of this equipment unit will reveal that the exterior is normally comprised of a metal shell formed from detachable panels, access doors, and open louvres.

These units are ostensibly waterproof relying on factory assembled systems of gaskets, caulking and other weatherproof connections to prevent the infiltration of rain and snow. Although they may perform reasonably well under normal conditions, few if any are designed to be completely watertight when exposed to severe weather during periods of wind driven rain and snow. In addition, the factory seals are often compromised by dislocation or damage during transit or when mounted on their bases on the roof.

As these units are located over openings in the deck and portions that are not covered by the roofing, water penetrating their seals can easily migrate into the building interior. These leaks are often erroneously identified as leaks emanating from a defect in the roofing membrane or flashing, when the real culprit is a breach in the unit enclosure itself. Leaks that occur in the immediate vicinity of a roof top

unit should be carefully investigated prior to calling the roofing contractor and facing an unwarranted service charge. Leaks in the area of a roof top unit that mysteriously occur only under specific conditions, such as a wind driven rain in one direction, and disappear as mysteriously as soon as the precipitation ends are most likely due to a flaw in the weatherproof enclosure, and not the roof membrane.

Even if the enclosure is watertight when it leaves the plant, its performance depends on the integrity of the installation, and particularly the method by which it is sealed into the roof. Many of the larger units are mounted on prefabricated metal curbs furnished by the manufacturer. As these units are designed to operate when level, the proper installation of the curbing is essential. The large HVAC equipment units are equipped with drainage pans that collect water condensate, which is discharged outside and onto the roof by means of a small diameter tube or pipe. If they are not properly positioned and level, water can collect in the pan to a depth that will overwhelm its sides and cause leakage into the interior. They must be routinely inspected and cleaned to ensure unobstructed flow and discharge.

Furthermore, these curbs are manufactured in standard sizes which often make no allowance for the roof's slopes.

This may be of particular concern on roof assemblies that incorporate tapered or thick insulations. If the curbs are mounted directly to the deck, the height of the side walls can fall well below the minimum 300 mm recommended by the CRCA. For this reason, curbs should always be secured onto solid wood blocking, shimmed level and cut flush with the top surface of the insulating layer.

The curb walls must be insulated prior to the application of the membrane flashings. Unfortunately, the type of material, and method of attachment are rarely specified. In many instances these curbs are insulated with whatever materials are available on site, whether or not they are appropriate as a base for roofing. The CRCA recommends that all metal curbs be insulated with materials suitable as a base for the application of the membrane flashings.

The effect of the location of curbs should also be considered when designing the roof. Curbs placed in valleys, in low areas, or close to drains can restrict the drainage of surface water from the roof. Saddles and crickets to provide counterslopes should be installed at curbs that may impede drainage. Curbs should never be placed over joints, or so close to protrusions, walls and parapets that there is insufficient clearance to allow for the maintenance or servicing of the roofing system.

All equipment with electric motors require a source of power, and regulations require that some have an accessible switch box mounted on their exterior. Power is usually supplied through a conduit, or electrical cable from the building interior to the unit. Although there are several knockout plates on the units that can be removed to provide an opening for these cables, they are not always used. In many instances, the cables penetrate through the roof near the curb. The most expedient although inferior method of sealing these penetrations has been to bring them through a "gum box" or pitch pan, which is filled with roofing mastic. These items should be avoided whenever possible. Pitch pans have been shown to be a constant source of roofing problems. There are very few caulking materials used as fill that will not shrink, harden or flow under conditions of exposure on a roof. Accessory products designed specifically for sealing cables and conduits into roofs are available from a variety of manufacturers and should be used instead. Under no circumstances should cables, conduits or piping penetrate through the side wall of the curbs and roof flashings.

Gas fired equipment also requires special attention. Supply pipes on the roof must be supported. This is sometimes accomplished by the poor practice of simply placing wood blocking under the pipes and on the roof surface. Damage to the roof covering can easily occur from sharp corners or punctures, especially when the blocking is placed directly on top of the gravel surfacing. To avoid such damage, the membrane must be protected at all support locations. In addition, allowance must be made for the considerable linear expansion and contraction of the pipe that will occur. This movement has sufficient force to dislocate the supports, abrade the roof surface, and cause significant damage to the membrane. Supports for roof piping that allow for their movement and protect the roof are currently available from a variety of manufacturers and should be used wherever possible.

The potential adverse effects on a roof's performance from roof top equipment are not limited to their initial design and installation. All roof top equipment will require servicing from time to time. Serious damage to the roof can result from the lack of proper care and precaution during servicing. Dropped tools, access panels and doors can easily puncture the roof, and the damage can remain undetected until a serious resulting leak occurs. The roof can be ruined by the careless spilling of lubricating oils, and other chemicals incompatible with the membrane. Even prolonged foot traffic resulting from regular servicing can have harmful consequences. For this reason, the CRCA recommends that walkway pads, pavers, or other forms of protection to the membrane be provided around units and along access paths on the roof. It is always a good idea to post a notice identifying the roofing system at all entrances onto the roof. By doing so, service personnel will know what precautions may be required, and what temporary measures should be undertaken should accidental damage occur.

Too often, the roofing contractor is called upon to investigate and repair reported leaks only to find that they are related to the faulty performance of the roof top equipment. Many of these costly problems can be avoided or eliminated by the careful design and initial installation of the equipment and their roof terminations. One should always bear in mind that both the equipment and the roof itself will require some degree of regular servicing and maintenance. Poor planning or the failure to consider these requirements or their effect can result in the significant reduction in the roof's performance and service life.

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