Tech Talk
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Roof Drainage Systems

Allianz Risk Consulting

Introduction

Whether you believe in climate change or not, the indisputable fact is property insurers are recording greater peak events with increased rainfall amount, intensity, frequency and duration. Such events are predicted to further increase in the future. Many roof designs are not able to cope with these changes and designers need to take increased rainfall intensity into account in future designs. All this translates into more frequent and larger water damage losses.

Roofs may be drained by two basic methods:

1. Towards the outer edges and into external gutters
2. Towards internal gutters or outlets within the main roof area

If gutters and downpipes do not perform adequately due to rainfall intensity, or become blocked by hail or other debris, water may enter the roof space or building, possibly resulting in property damage. We therefore need to consider where the water goes – is it over the edge, through a dedicated overflow, or back into the building?

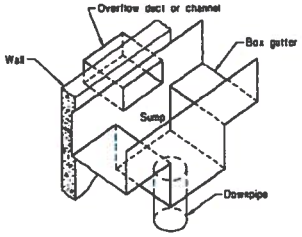
Design Factors

In the design and detailing of a roof drainage system, consideration must be given to a range of factors such as rainfall intensity, roof catchment area, gutter size/capacity, gutter fall, gutter outlets (sumps, rainwater heads, nozzles), downpipes (size, quantity and placement), material selection, jointing, etc. Overflow (secondary) drains are considered a key to preventing gutters from overflowing water into the building.

Building codes generally require that where high-fronted gutters or box gutters are installed, provisions must be made to avoid any overflow back into the roof or building structure by incorporating overflow measures.

Methods of providing for overflow in the design and installation of roof drainage systems with high front gutters include:

a) **Slotted gutter front** to allow for water overflow through the slots visible on the front face of the gutter (see photo and schematic below)



In the photo above, the overflow channel was at the correct level; however, it needed to be re-sized to cater for the highest intensity rainfall event.

b) **Inverted downpipes drop/pop nozzle** at high points in the gutter, but set at a level below the fascia top (see photo below)

c) **Stop ends** cut down to a lower level to act as a weir
d) **Rainwater heads** with overflow weir
e) **Holes, slots, or weirs** at downpipes

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Conventional and Siphonic Roof Drainage Systems

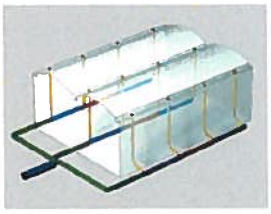
Conventional roof drainage systems consist of a gutter and vertical downpipes into which water flows by gravity. The driving head of the water into the downpipe is limited to the gutter flow depth. The water in the downpipes flows downward under gravity and reaches a maximum velocity of about 2 m/s (6 ft/sec). Due to the presence of air and its effects in the downpipe, water flow never exceeds a third of the pipe's capacity. A conventional roof drainage system's capacity is usually dependent upon the capacity of the gutters rather than the capacity of the vertical downpipes.

Siphonic (or symphonic) drainage systems work when the downpipe is completely filled with water. This produces negative pressures and high driving heads, resulting in high-flow velocities up to 7 m/s (23 ft/sec). The system self primes to exclude air, which creates an operating head that sucks the water to any point in the building.

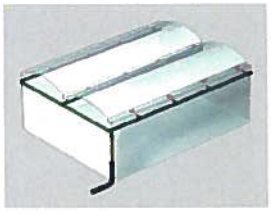
Air and water enter a gravity outlet

At a given head of water, only water enters the outlet

The main advantage of a siphonic drainage system is that it replaces the need for multiple downpipes required for conventional drainage systems. Instead, the water collected in gutters can be piped horizontally at roof level to a single collection point, where it is brought to ground level in one downpipe. The system uses a gravity-inducted vacuum principle, allowing a quick and efficient way of draining roofs.



Conventional roof drainage system



Siphonic roof drainage system

Presently, standards or codes of practice governing siphonic systems are not widely available, except in the United Kingdom.

These systems are becoming increasingly popular, especially for larger building projects, due to the cost and design benefits available compared to conventional roof drainage. These benefits can include the following:

- A siphonic roof drainage system can discharge water from large buildings at more than five times the rate of conventional drainage systems
- Downpipes are considerably smaller in diameter and fewer are required
- Piping networks are generally smaller and can be laid level requiring less headroom and assisting with services coordination
- Minimizing in-ground works (especially below the building) normally giving considerable savings in cost and time
- Systems are designed to be self-cleansing and are normally trouble-free if maintained correctly on a regular basis – refer to ARC Recommendations.

  Note: if a component, such as a baffle plate, has been removed, the siphonic system is reduced to a conventional drainage system with a much smaller cross section, so will perform very poorly.

However, siphonic roof drainage systems are not recommended for roofs prone to debris accumulation, such as roofs with nearby or overhanging trees or other vegetation, or roofs covered with gravel, stone ballast or vegetation (green roofs).

Siphonic systems are also more complex than conventional systems, so maintenance staff needs to be informed that they must not remove any design elements such as baffle (anti-vortex) plates.

Siphonic roof drainage systems have been known to implode due to excessive negative pipe pressures, but this is rare. More likely there is an air gap in the down pipes which will prevent the system from operating correctly.

ARC Recommendations

The failure mechanism for roof drainage systems is normally inadequate maintenance, such as drains, gutters or downpipes blocked by debris. While not all inclusive, the following basic maintenance can greatly reduce the potential for property damage and resulting business interruption:

1. Inspect roofs, roof drains, debris guards, baffle plates, gutters, downpipes and discharge outlets for accumulated debris before the start of the rainy or tropical cyclone seasons, following storms, after roof construction, or at least quarterly. Clear obstructions or accumulated debris as necessary.

   Note: Inspections and cleaning may need to be carried out more frequently where there is a high density of trees or other sources of airborne debris.

2. Inspect roof drainage system components for damaged or missing components. Make repairs or replace missing components as necessary.

3. Inspect for any excessive accumulation of water on the roof (ponding) as this could be due to inadequate roof drainage. The excessive weight from water accumulation could lead to roof collapse.

4. For conventional drainage systems, inspect gutters to ensure they are properly sealed at the underside of roofing to prevent rainwater from entering the building.

References

British Standard 8490:2007, Guide to siphonic roof drainage systems

Siphonic Roof Drainage Association website (www.siphonic-roof-drainage.co.uk)

Questions or comments?

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