Government of **Western Australia**
Department of **Finance**

Finance Technical Guideline

TG008 Siphonic Drainage Systems

1 Purpose

This guide sets out Finance's requirements for the specification and installation of siphonic drainage systems to minimise maintenance requirements and to limit damage caused by an overflow.

2 Background

Siphonic systems are a relatively recent innovation in roof and building drainage design. They have been used in public buildings; airport terminal buildings, sports stadia and commercial property developments throughout Australia, Asia and Europe.

Siphonic systems may be used on any building over approximately 4.5m in height above ground as the advantages of siphonic systems become evident where roofs are above this height. Siphonic systems utilize the height of the building to create negative pressure in the pipe work allowing the system to suck water out of the gutters at high velocities and flow rates.

Siphonic systems are designed to be water filled (primed) to exclude air from the pipe work and cause the pipes to flow under pressure. The greatly increased driving head of water results in a reduced need for vertical pipe work and as the system operates under high pressure, pipe sizes may be reduced substantially in comparison to conventional drainage systems which rely on gravity.

Pipe work in siphonic systems is typically horizontal and can be incorporated in the space just below the roof surface with a minimal number of strategically placed downpipes.

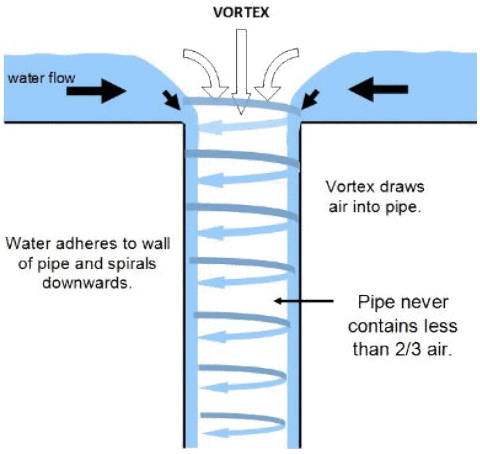

Figure 1 Conventional Gravity Fed down pipe.

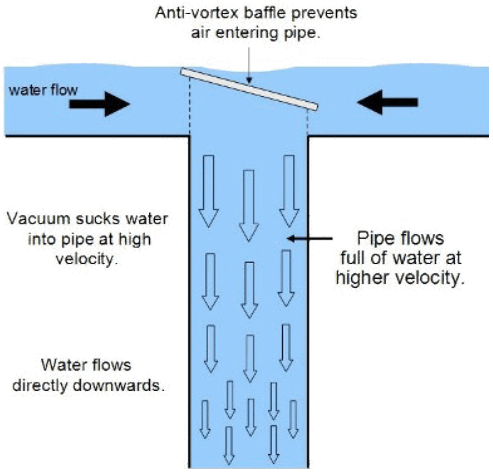

Figure 2 Siphonic down pipe.

2.1 Issues

A siphonic roof drainage system will only operate efficiently at its design condition for the specified rainfall criteria used for design purposes, which means the system will rarely operate optimally. It is noted that at lower rainfall intensities (<40% below system capacity) systems will act in a similar manner to conventional roof drainage systems.

Issues that may result in system failure include the following:

- Most common cause of operational problems and system failures is blockages in pipework and gutters - can be avoided with a regular maintenance program.
- Incorrect installation resulting in air being trapped in the system.
- Air traps in system during rainfall events of lower intensity than the design criteria with gutters overtopping before air is purged from the system.
- Inconsistent rainfall intensities may result in variations in gutter water level and system pressures which can lead to air being drawn into the system that results in noise generation and structural vibrations
- Cavitation (bubbles formed due to low pressure) may cause damage to pipes when pressure increases to the point where the bubbles collapse.

2.2 Recommendation

1. Where siphonic drainage systems are selected these need to be designed and documented by a hydraulic consultant experienced in the design of siphonic drainage.
2. An appropriate design rainfall intensity should selected with reference to *ARR 2016 Book 2: Rainfall Estimation* (http://arr.ga.gov.au) and based on data from the Bureau of Meteorology.
3. Include clauses in the specification requiring the following:
    a. Siphonic drainage systems must be supplied and installed by a specialist siphonic drainage contractor.

b. The siphonic drainage contractor must provide shop drawings of the siphonic drainage system for review and approval by the hydraulic consultant.
c. A hold point must be incorporated to enable the hydraulic consultant to inspect the installation of the siphonic drainage system.

2.3 Selection and Preparation of Materials

The calculations for the size and position of roof gutter siphonic inlets, horizontal and vertical pipes including bends, branches, junctions and connections to associated underground pipework should be prepared by a hydraulic consultant experienced in the design of siphonic systems and be based on detailed architectural and hydraulic engineering drawings and the design rainfall intensity. It is recommended that the hydraulic consultant also obtain design advice from a specialist supplier/installer of siphonic systems.

It is understood that: the minimum velocity should be 1.0 m/s for self-cleansing purposes; the suction pressures in the system should not exceed 8.0m in water head to avoid cavitation (bubbles formed due to low pressure in the system); and the system should incorporate a 100% overflow system.

Inlets

All siphonic roof inlets for the collection and discharge of the surface water from the roof should be fabricated from a durable and long lasting material. When selecting inlets materials take into account the corrosive effect of dissimilar metals and ensure plastic inlets have an appropriate UV resistance. Siphonic inlets should incorporate leaf guards and be fitted with durable baffles designed to restrict the entry of air to the system. All inlets are required to be self-priming to avoid a build-up of water within the gutter system.

Support System

The pipework support system should take into account the weight of a full pipe, vibrations, thrust forces and requirement to maintain straight lines and prevent buckling from internal water forces. Pipe should be fixed to restrict the effects of thermal expansion and contraction and to allow for any water hammer that may occur. Extra restraints may be required at changes of direction in the main lines to prevent any movement of the pipe.

Installation

The siphonic system should be installed only by fully trained and qualified personnel employed directly by the siphonic roof drainage contractor and are required to be a registered plumber. Installation should be inspected by a hydraulic consultant experienced in the design of siphonic drainage systems to ensure the system is installed strictly in accordance with documentation.

If buildings are sited adjacent or below large trees the cost savings associated with a siphonic system may easily be outweighed by maintenance cost and should be

avoided in favour of traditional drainage systems with lower risk of system fail flooding.

2.4 Maintenance

Due to the high velocities generated within the siphonic roof drainage system the pipes are generally self-cleaning, which means they should require a minimum amount of maintenance under normal conditions. A routine maintenance schedule should be undertaken to ensure the system is working at optimum efficiency.

The frequency of the system maintenance and in particular gutter cleaning will depend on the site and seasonal conditions, and maintenance procedures should be timed to suit. It is recommended that the entire system be checked at the time when severe storm events are expected. Regular removal of leaf, sediment and other debris from roof and gutter systems is essential to maintain optimal performance of the system.

2.5 Applicable Standards

All siphonic systems should be designed to satisfy:

AS/NZS 3500.3 Plumbing and drainage Part 3: Stormwater drainage;

AS/NZS 4130 Polyethylene (PE) pipes for pressure applications;

AS/NZS 2033 Installation of polyethylene pipe systems;

AS/NZS 2179.1 Specifications for rainwater goods, accessories and fasteners – Part 1: Metal shape or sheet rainwater goods, and metal accessories and fasteners;

Permits and approvals required in Western Australia should be obtained prior to commencing installation.

3 References

Babister, M. and Retallick, M., 2016, *Rainfall Estimation, Book 2 in Australian Rainfall and Runoff - A Guide to Flood Estimation*, Commonwealth of Australia. (accessed from http://arr.ga.gov.au)

Department of Planning and Local Government, 2010, *Siphonic Roofwater Systems, Chapter 16 in Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region*, Government of South Australia, Government of South Australia, Adelaide. (accessed from https://www.sa.gov.au/__data/assets/pdf_file/0016/15208/WSUD_chapter_16.pdf)

Arthur, S., Wright, G., Swaffield, J., 2004, *Operational performance of siphonic roof drainage systems*, School of Built Environment, Heriot Watt University, Edinburgh.

Fig 1. (http://www.gutterpumper.com.au/images/gravity-flow-2a.png)

Fig 2. (http://www.supadiverta.com.au/images/full-flow-2a.png)

Finance Maintenance Minimisation Manual Section 4.4.1.7 Siphonic systems

(accessed from https://www.wa.gov.au/sites/default/files/2019-07/Maintenance%20Minimisation%20Manual.pdf)

4 Document Control

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1. Document Approval

This guideline was endorsed and approved for use on 6 July 2021 by:

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Department of Finance, Western Australia