Syphonic Roof Drainage – How does it work?

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Originally developed in Scandinavia over 40 years ago, syphonic roof drainage systems have been in use in the UK since the early 1990’s. Since then, many large projects have used the syphonic system to overcome installation problems which would have been difficult to solve using a traditional gravity rainwater system.

Designing a Syphonic Rainwater System.

To make a syphonic rainwater system work correctly; several factors have to be considered:

1) Rainfall Intensity Rate
2) Use of specially designed roof outlets
3) Calculated method for sizing the pipework
4) Materials specification for the pipework
5) Designing the pipe configuration for optimum performance

Rainfall Intensity Rate

To ensure the building is adequately protected from water ingress, the rainwater system must be designed to remove all the water that falls on the roof quickly. BS EN 12056 part 3 provides both data and a method for calculating the highest expected rainfall intensity expected for all regions of the UK plus a method for deciding on the safety factor best suited for various scenario’s. The designer must decide how best to use this data; the initial calculation may give the designer a very high intensity rate if they input either a high safety factor or an excessively high return period, i.e. 100 years.
Using 100 years as the return period for a project in London would give the following results:

<table>
<thead>
<tr>
<th>Safety Factor Category</th>
<th>Rainfall Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>222mm/Hr</td>
</tr>
<tr>
<td>3</td>
<td>270mm/Hr</td>
</tr>
<tr>
<td>4</td>
<td>600mm/Hr</td>
</tr>
</tbody>
</table>

Using the highest intensity rate will result in the designer creating an oversized system rarely, if at all, going syphonic having a dramatic effect on the pipe diameters, however the chance that it will be utilised is extremely unlikely, plus in the normal life span of the property it will probably never operate syphonically but only as a gravity system loosing all of the advantages of a well designed syphonic system.

**What is the best approach to ensure all the benefits of a syphonic system are utilised?**

The first thing is not to use a higher safety factor then necessary, second to consider how to deal with the occasional high rainfall rate that generally will not last for more than 2 minutes (NOT 1 HOUR).

**Solutions:**
1) Design the primary system to a realistic return rate, 108mm/hr has proved to work well in most locations in the UK with several 2 minute occurrences annually.
2) If a high rainfall rate is the result of calculation, deal with the excess above 108mm/hr by some other means:
   a) Charge it via overflow weirs to the outside of the building
   b) Install an internal gravity overflow system
   c) Install a secondary syphonic system, which only operates when the water level builds up on the roof to a predetermined level.
   d) Allow the water to build-up on the roof for a short period; the high intensity rate will only last for 2 minutes, following which the system will remove the excess quickly.

**The Syphonic Outlet**

Syphonic outlets are designed to reduce the entry of air into the system, if air reaches more than 40% of the volume of the pipe the syphonic action will stop. To reduce the amount of air entering the system a baffle plate is usually fitted over the orifice of the outlet, this not only reduces the amount of air being pulled into the outlet opening, it also stop a vortices forming that will draw air into the system.
rapidly. The best outlets have been tested and approved by the British Board of Agreement. Outlets should also be designed to easily accommodate the water membrane of the roof, which comes in many forms.

**Calculated method for sizing the pipework**

These days’ manual calculations are rarely done; software is now available to speedup the process and removes human error. The primary aim of the software is to size the pipework to ensure it runs full of water as quickly as possible to induce a syphonic action as the water column drops in the main vertical section of the pipe system. On buildings of several stories negative pressure of –800 mbar frequently occurs providing a high level of suction at the outlets. Calculation software is frequently linked to a drawing package, which provides a diagram of the proposed installation, together with the hydraulic calculations.

**Materials specification for the pipework**

Due to the high negative pressures that can occur in the systems, it is important that a resilient material is used with high resistance to implosion. Good quality HDPE pipe and fittings provide a good solution and ideally they should be made to EN 1519 the product standard for this material. Another useful property of HDPE is that it can be fusion welded together removing the need for seal ring joints that may fail causing flooding of the building if the internal pressures force the joints apart.

In addition the system must be securely fixed with strong brackets especially if the pipework is hung horizontally some distance from the soffit of the slab. Systems are available which combine a steel rail and pipe brackets that restrain the pipework, which leaves the drop rod to deal only with carrying the dead weight of the pipework.

**Designing the pipe configuration for optimum performance**

One of the major benefits of a syphonic system is that the horizontal pipe runs do not have any fall, minimising the space required to accommodate the system. This provides the designer with freedom to route the pipes to any location at high level, before dropping to ground level. The high suction in the system reduces the pipe
diameters and number of vertical drops needed compared to a gravity system, providing a reduction in cost for most installations. The major advantage of a syphonic system is that drainage can be taken to the end of the building, removing the need for almost all under slab drains.

Components of a multi-outlet siphonic system

To ensure an efficient system is created the following design criteria must be followed:

a) Prime time – All roof drainage design in the UK is based on a 2-minute storm, so if the system does not operate fully in less than 1 minute, there is a risk the building will flood. As buildings have got larger, so have syphonic systems, and unless the prime time is considered, systems can be created which will not function properly.

b) Balance - Syphonic systems should be carefully balanced, usually by changing pipe sizes, to ensure the correct amount of water enters each outlet. The balance is achieved by trading off the available suction pressure against the pipe and fitting energy losses. Also try to balance the flow rate into each outlet, although it is not critical for them to be exactly equal but large difference will result in air being pulled into the low flow rate outlets.

What is happening in syphonic drainage?

2004 was an important year for the syphonic drainage industry, with the publication of a Dti funded draft standard for Syphonic Roof Drainage, and the formation of the Syphonic Roof Drainage Association.

The draft standard is awaiting passage through the BSI process, but when published will give a real benefit to designers and specifiers, who for so long have not had a source of information and guidance as to correct design and installation procedures.

The SRDA was formed this year with the intention of:

- Raising the profile and status of the syphonic industry
- Providing clear, informative and impartial information to specifiers
- Giving specifiers the reassurance that member companies have signed up to a wide range of regularly monitored standards

For more information on the SRDA visit www.siphonic.org or call 01204 701934.