Wavin QuickStream
Technical Manual

QuickStream

Polyethylene (PE)

Siphonic roof drainage systems

wavin
An Orbia business.

Foreword

There's no such thing as bad weather –

with the right roof drainage.

Statistically, a once-in-a-century weather event occurs once every hundred years – until recently. As a result of man-made climate change, we now experience such rare events almost every year. For example, heavy rainfall in Europe delivers between 60 and 80 liters of rain per square meter, per day. As a result of global warming, the atmosphere also stores more moisture, which then comes back as heavy rain.

With this in mind, including the Wavin QuickStream roof drainage system in your future plans or current builds is a strong decision. With its siphonic system, QuickStream is a robust solution for rapidly removing large quantities of rain from large roof areas. Its high drainage capacity is especially effective for halls, warehouses, airports, railway stations, and commercial or institutional buildings that need to manage roof drainage areas exceeding 1,000 m^2.

As a roof drainage system with pressurized flow, QuickStream is designed for a filling level of 1, i.e., full filling, constructed in accordance with EN 12056 and 1986-100.
On the other hand, a conventional gravity drainage system may only have a maximum filling level of 0.7 to aerate and ventilate properly.

The roof drains from the QuickStream range are true high-performance gullies; their slim, streamlined design swallows up to 24.0 liters of rainwater per second, even at a low accumulation height.

In this comprehensive technical manual, you'll gain a deep understanding of the design principles of QuickStream, the system layout and the typical construction of roof outlets. Each chapter covers an aspect of its simple installation and assembly, the emergency overflow system and the innovative Wavin fastening system. We'll also provide detailed information about the drainage conditions and introduce you to the Wavin software and its calculation tools, which are essential for planning, calculation and realization.

From initial planning and calculation to installation and handover, we hope you enjoy using QuickStream. We're confident that your customers will appreciate the system's safety, reliability and performance for every rain event.

PE Quickstream
This technical manual pertains to the PE Quickstream variant. For information regarding the PVC variant, please refer to the corresponding PVC Quickstream technical manual.

Contents

Introduction

Using the principles of full-bore flow to manage large amounts of rain.

Rainwater systems collect and transport water from roofs. The most used system is a combination of rainwater gutters installed along the eaves, which direct the flow into rainwater downpipes. These systems can be gravity-based or full-flow-based (siphonic systems). Wavin has a wide range of plastic gutter systems for houses that are aesthetically and technically fit for purpose.

However, a system composed of roof outlets in combination with gravity or siphonic pipe systems is used for large roof areas. Siphonic systems are usually preferred over gravity systems for roof areas of 1000 m² and above. The larger the roof area and the higher the roof, the more significant the advantages of siphonic systems. However, there is a height limitation for buildings. Typically, the Wavin QuickStream system is applied in buildings with a maximum height of 60 meters.

In this chapter, you'll learn more about the principles of full-bore flow and the special features and advantages of the Wavin siphonic system.

Principles of Full-Bore Flow

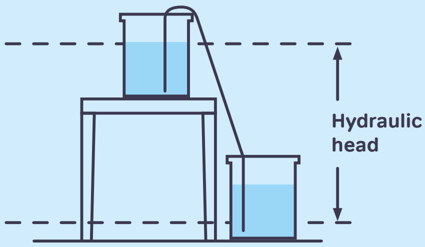
In roof drainage systems (gravity and siphonic) the energy required to overcome pressure loss caused by fittings, outlets, and pipe friction is obtained from the difference in water levels between the start and end points of the piping system (water column). In conventional roof drainage systems gravity is the only driving power for discharging as the difference in water levels results only from the specified pipe gradient. Whereas in siphonic systems the energy from the height of a water column between the roof outlets and the discharge level is used to boost the drainage function

The air within the pipe system is removed at the beginning of a storm by the flow of the water and new air is prevented from being sucked into the system via the action of the specially designed roof outlets. These roof outlets, having an air baffle and anti-vortex vane, only allow the intake of water and prevent the ingress of air. At low rainfall, the siphonic system works as a conventional gravity system. As the rain intensifies the water level around the outlets rises above the air baffle and the pipe system fills with water. Once the system is fully primed, it achieves its maximum capacity.

When the system is fully primed, the difference in height between the roof outlets and the rainwater discharge level is utilized to gain the energy that will enforce a negative pressure in the pipework. The high driving head at full-bore flow will increase the flow velocity of the water in the pipework. The combination of eliminating air in the pipework and the increased flow velocities result in a considerable increase in discharge capacity. This in turn leads to a significant reduction of the pipe dimensions compared to a gravity system.

Climate Change
Since 1901, global precipitation has increased at an average rate of 1.016 mm per decade.

Syphon effect



The difference of the height between the recipients and the high velocity of the flow that produce in the pipe, cause a negative pressure in it. That means that there is a suction in the highest recipient in addition with the effect of atmospheric pressure that push off the liquid and produce the transport of the water among them. It is necessary that the pipe is complete full and there isn´t air in it.

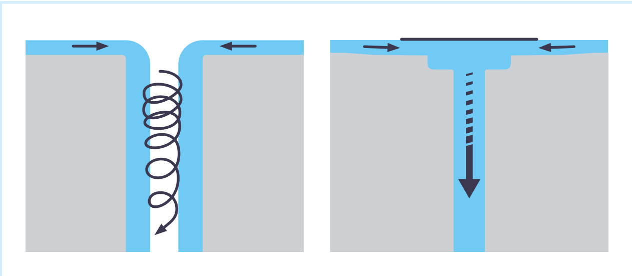


Figure 1: Gravity vs Siphonic

Weight of water in clouds

>1,000,000 t

can weigh thunderclouds

QuickStream ensures that the roof is not overloaded.
The water within a good weather cloud can weigh up to 1,000 tonnes. Thunderclouds even carry several million tonnes of water.

Introduction

System Components

In a typical siphonic system we have roof outlets, tail pipes which connect the outlet to the collector pipe, horizontal collector pipes, a vertical downpipe and the discharge where the transition to the gravity system takes place. The detailed description of each component is described below:

Pipes

The components of the QuickStream system are made of PE; QuickStream pipes are plain ended and should be connected to PE fittings via fusion or mirror welding.

Tail pipe

Also referred to as “roof outlet connecting pipe”. Section of vertical and possibly horizontal pipework connecting roof outlet to horizontal collector pipe. Includes: roof outlet connector, the vertical and horizontal part of the tail pipe and sometimes also a parallel connecting pipe.

Roof Outlet Connector

This accessory is made up of a threaded end, which connects with the outlet; and a plain end, to which a pipe or fitting can be welded. The threaded end contains a rubber seal that avoids leaks in the PE joint

Electrofusion coupler

socketed fitting that allows the connection between pipes and/or fitting of equal diameter by use of electrofusion welding.

Bend

Reduce local (or minor) losses, only 45° bends are used in the QuickStream system. It is possible to make orthogonal changes of direction, using two 45° Elbows. 90° elbows are permitted only in the tail pipe.

45° Branch

Fitting that allows the connection between the tail pipe and the horizontal collector pipes; between horizontal pipes and/or between horizontal collectors and downpipe. Like the bends, the 45° angle minimizes the minor losses in the siphonic network.

Access Fitting

Although QuickStream´s high speed flows and its siphonic pipes guarantee that the system is Self-cleaning. The access fitting allows inspection of the system. They are installed at the end of the vertical pipes, near here the transition from the siphonic system to the underground sewer occurs.

Eccentric Reducer

This fitting allows making connections between pipes and/or fittings of different diameters.

Expansion socket

Element that is installed in the downpipes of the system, to allow the effects of thermal expansion/contraction in this section of the system, and partially absorb the movements generated by the impact of the water in the lower elbow of the downpipe.

Roof Outlet

Element of the system that allows the collection of rainwater on the roof. These roof outlets, having an air baffle and anti-vortex vane, only allow the intake of water and prevent the ingress of air as the intensity of rain increases. There are various types of roof outlets, depending on the type of roof on which it will be installed.

Electrical Heating Element

The QuickStream siphonic system has an antifreeze system, located under the outlet fixing plate. The function of the heating element is to avoid obstruction of the outlet body due to the freezing of the water. If temperatures are below 4°C, the element is activated, generating a positive temperature delta that fulfills the function for which it is specified. It is not the function of the electrical heating to control or to melt the ice deposited along the gutter or roof during hail and snow events. Its effect is localized and is exerted on the outlet connector of the QuickStream drain.

Fastening system

The Wavin QuickStream includes a dedicated (suspended) fastening system that can be used in any installation and is adaptable to construction requirements. Some of the main components are brackets, suspension elements, rails and fixations In Chapter 6 the full system will be explained.

Advantages of a Siphonic System

The combination of the elimination of air from the system and the high water speed, results in a significant increase of the evacuation capacity, which means a reduction in the number and diameter of collectors and downpipes, compared to a traditional gravity system. Therefore, the key benefits of a siphonic system compared to a conventional gravity system are:

- Underground drainage piping within the building footprint can be virtually eliminated.
- External underground drainage pipes and pipe trenches can be reduced significantly.
- A reduction on the total pipe length.
- Less discharge points in the system.
- No slope required in the pipework, allowing an optimum usage of the available space in the building and making coordination with other building services and the building structure easier.Resulting in a simpler installation.
- A reduction of the number of roof outlets due to higher drainage capacities of the siphonic outlets. Less roof outlets means less roof penetrations and hence a low leak risk.
- Reduced installation time and costs.
- Self-cleaning system due to high velocities.
- More architectural flexibility due to smaller diameters and horizontal pipework.
- Reduced pipe dimensions can allow installation of horizontal pipework through steel beams. The same applies for vertical pipework in concrete pillars making even better use of the available space and reducing vulnerability to external damage.
- The higher a down pipe the more efficient a siphonic system, making siphonic systems ideal for high buildings.
- No weathering or damage due to vandalism because of the number of downpipes is lower than gravity systems.
- Lower insulation costs if required. Smaller pipes also mean lower costs for insulation at the same time.

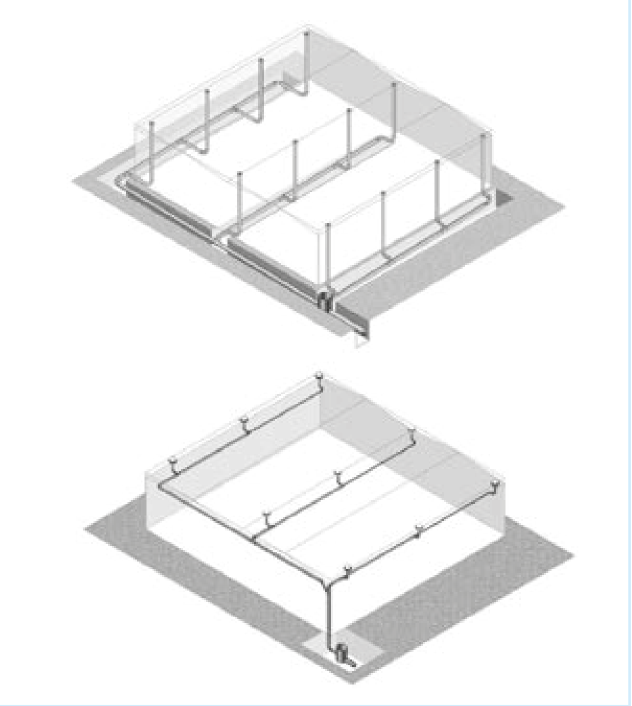


Figure 2: Gravity vs Siphonic system

Using a plastic siphonic system also brings specific benefits:

- Plastic pipe system is lower in weight, easier to install and reduces load on roof.
- Low friction values result in less energy losses, higher flow velocities and smaller pipe diameters.
- Smooth inner surface results in optimized self-cleaning of system.

However, there are some specific key considerations to take into account:

- Only a dedicated software system will make it possible to design a well-functioning system. Wavin has designed an AutoCAD compatible calculation system that automatically checks on the most important calculation values to secure a well-functioning system.
- A deviation in the proposed layout or dimensions of the system is only possible after consulting the designer of the siphonic system, which might lead to changes being required to the existing installation.
- The Wavin Helpdesk (or that of Wavin's locally authorized representative) can always be contacted during office hours for consultation and a possible recalculation of the system.
- Due to the positive and negative pressures, the pipework needs to be resistant against buckling and installed as a tensile resistant system. Pipes and fittings of the Wavin QuickStream system can resist the maximum negative pressures which might take place during a rainfall.

Drops of water in rainwater

up to 20,000 drops/l

One litre of rainwater consists of approx. 15,000-20,000 drops

QuickStream is reliable down to the last drop.
In heavy rain, the pipes are completely filled with water – there is no air in the system. For more speed when transporting water.

Customer benefits of Wavin's Quickstream System

Next to the advantages of any siphonic system over a standard gravity system, choosing a Wavin QuickStream siphonic system gives the designer and installer several additional benefits:

Safety
A siphonic system will only operate well when many requirements are being fulfilled. All major requirements are checked automatically in the Wavin QuickStream software, and no outputs can be generated if all requirements are not fully met. This secures an optimized operation of all Wavin QuickStream systems. The software will generate a comprehensive calculation overview enabling an easy and time saving check on the calculated system values

Technical support
With a proven track record in the design and supply of siphonic systems for over 30 years, Wavin is able to not only support standard technical requirements, but also offer tailor made technical support for specific technical issues.

Leading design and calculation software
Wavin has developed its own dedicated software program to design and calculate QuickStream siphonic systems. The development was based on three principles: Safety, AutoCAD compatibility and market leading installation drawings.

AutoCAD and BIM compatibility
The Wavin QuickStream software is AutoCAD and BIM compatible and thus allows easy incorporation of the Wavin QuickStream system into AutoCAD drawings of the building. This allows optimum communication via AutoCAD drawings between the designer and Wavin.

Market leading installation drawings
Furthermore, the software enables an easy and fool-proof installation by generating 3-D prints of the layout of the system. Installation drawings are supplied with actual pipe lengths instead of center line distance lengths which minimizes the risk of installation errors.

100% full bore flow
In some siphonic roof drainage systems a mixture of water and air is being transported through the pipe system even when the design capacity is achieved. Since the pressure in a siphonic system varies, the air will expand and will result in irregular velocities of the water. The Wavin QuickStream outlets and system secure a stable 100% fullbore flow resulting in smaller pipe dimensions and a safer situation.

High-capacity roof outlets
Wavin offers a comprehensive range of roof outlets in metal or plastic which can discharge high capacities of water. This results in a reduction of the number of roof outlets leading to fewer roof penetrations and a further reduction of the pipework. All Wavin roof outlets have been thoroughly tested by an accredited independent institute (LGA) in accordance with EN 1253 standards. These outlets are suitable for designing systems in compliance with EN 12056.

Optimized bracketing system
Wavin has developed a bracketing system especially dedicated to the Wavin QuickStream system. The bracketing system enables the fastest installation time and secures a fool proof mounting of the brackets with minimal tooling required.

System Guarantee
Wavin offer 10 years guarantee for Wavin designed QuickStream projects using the full range of pipes, fittings, outlets and bracketing. But this may vary in different countries.

Extensive product portfolio
Wavin has the most comprehensive product range in plastic pipe systems and can supply complementary product ranges alongside its siphonic systems. These include infiltration, attenuation and re-use systems, inspection chambers and gravity drainage systems. Besides, Wavin is a leading supplier of gravity rainwater systems, soil & waste systems (including low noise) and hot & cold systems. One contact to assist you in a wide variety of systems, optimizing solutions and securing effective communications. As a leading innovator in the plastic pipe industry, you always have access to the latest technology.

Riyadh Air Metropolitano Madrid, Spain

Is Quickstream Useful For Your Project?

QuickStream siphonic drainage advantages are more notorious in roofs areas bigger than 1000 m².
Most applications include:

Warehouses

Sports and Cultural Scenarios

Airports

Industrial halls

Malls

Buildings (Residential, Commercial, Institutional)

Other kind of infrastructure with large roof areas

Design principles

The roof as the foundation of all planning and calculations.

When implementing the Wavin QuickStream system, we differentiate between various types of flat and pitched roofs. Green roofs installed on a modified conventional roof system are a QuickStream specialty and are eminently suitable for this sustainable roof design.

Intelligent water storage on flat roofs is becoming increasingly important in areas experiencing a mix of long, dry spells and occasional heavy rainfall events. Wavin PolderRoof is the basis of a solution here, with weather forecast-based control units for water retention, controlled drainage or fresh water supply. Like all the roof types mentioned above, the PolderRoof can also be equipped with a pressurized drainage system.

QuickStream deploys its full potential when all roof drains handle the amount of water they are designed for or when they all drain equal parts of water. To create such a well-balanced system, it's first necessary to calculate how much rain can hit the roof and with what intensity.

In this chapter, you'll learn more about how QuickStream differentiates between roof types and all relevant information on calculating required flow values.

Roof and Gutter Types

There are three different types of roofs: flat roofs, sloped roofs and green roofs. Each roof type has different properties that need to be considered when designing a rainwater system:

Flat Roofs

Flat roofs are normally associated with apartment buildings and industrial buildings. Such roofs are seldom truly “flat”, but simply fall below the minimum gradient associated with sloped roofs. Minimum gradients are usually specified to avoid any unwanted ponding and to help prevent the development of any adverse gradient due to differential settlement. Flat roofs are often preferred as they reduce the amount of dead space within the building and have a larger buffering capacity for rainwater.

However, in a broader sense, flat roofs can also be designed as accessible surfaces to be used e.g. for green roofs, roof gardens, or solar energy generation, for example. In this case, roofs are then actually usually designed without slopes and truly flat.

Sloped Roofs

Most residential, commercial and warehouse properties have sloped roofs. Such roofs can drain naturally, which means there is less risk of leakage. In climates with sub-zero temperatures, snow loading is less critical. For the Wavin QuickStream system, we distinguish three different types of sloped roofs: sloped roofs without gutters, sloped roofs with gutters and envelope roofs.

- Sloped Roofs Without Gutters: For sloped roofs without gutters, the roofing membrane covers the whole roof, and the roof outlets are positioned at the lowest roof line of the roof.
- Sloped Roofs with Gutters: The roof outlets will usually be positioned in a metal or fiberglass type of gutter.

Usually there is no 100% watertight seal between the roof surface and the gutter. It is important to keep this in mind in order to prevent overflows inside the building.

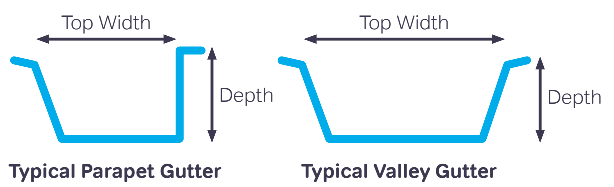
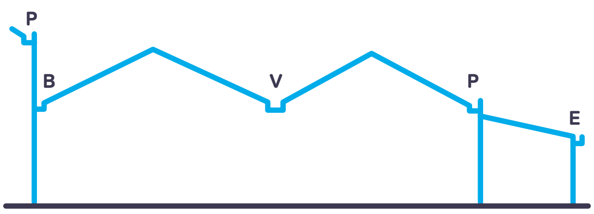


Figure 3: Typical gutter layout

The different types of gutters which can be found on a building are



Eaves gutters (E) are always fixed externally to a building and can overflow along its length away from the face of the building.

Parapet gutters (P) are located around the perimeter of a building either with a higher outer edge or located behind a parapet or fascia that prevents it from overflowing along its length clear from the building.

Boundary-wall gutters (B) are geometrically like parapet gutters but typically located across the width of a wall.

Valley gutters (V) are internal gutters located along the valley of multi-gabled buildings formed by two roofs or catchment areas.

Figure 4: Different types of gutters

QuickStream roof outlets are suitable for installation in gutters with a minimum width of 21 cm.

Envelope Roofs

Envelope roofs are a special type of sloped roof consisting of mostly equally sized roof parts which all drain water to the lowest point in the middle of that roof section. Since water is not able to flow from one envelope to another, blockage or partial blockage of an outlet will lead to overflow of the water to adjacent envelopes. Due to these obstructions between the outlets, This particular roof shape demands careful and detailed planning when designing the siphonic system to ensure optimal performance and efficiency (See figure 5).

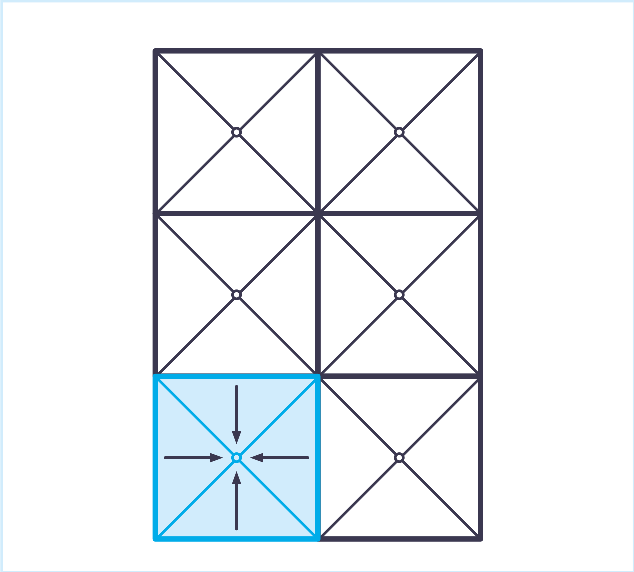


Figure 5: Design of an envelope roof

Green Roofs

Green roof, eco-roof, nature roof or green roofing system are general terms referring to vegetated roof coverings consisting of a thin layer of living vegetation installed on top of a modified conventional roof system. Green roofs are arguably the oldest type of permanent roofs. These involve the planting of roof areas to attenuate rainfall and can take the form of a roof top garden with trees or a lightweight carpet of grass lawn. Two main types of green roof exist:

- Extensive: incorporating close to nature vegetation types such as mosses, herbs and grasses.
- Intensive: Includes perennials, shrubs and lawns

Advantages of a green roof are that it reduces temperature extremes inside the building. Furthermore, a green roof intercepts and delays rainfall runoff by capturing and holding precipitation in the plant foliage, absorbing water in the root zone and slowing runoff as it infiltrates through the layers of vegetated cover. This delay is reflected in rainfall capacity calculations by means of a runoff delay coefficient ©.

Figure 6: Extensive greening

Figure 7: Intensive greening

Wavin PolderRoof ® – The smart retention-roof solution

In the building industry the growing set of requirements tends to make the building design process more and more complex. As there is a lot of attention going into energy systems, the water related subjects got little and late attention. But Wavin has the vision to treat rainwater as a resource and not as waste by storage and reuse of valuable rainwater on the city's many flat roofs. At the same time, we want to help making the city more climate-adapted and protected from heavy rains and peak runoff. By turning the purest rainwater into a resource instead of wasting it through drainage we want to support urban climate resilience, water circularity and better water balances for construction projects.

The PolderRoof transforms a flat roof into a smart water reservoir.

To enable intelligent water storage on flat roofs, the PolderRoof concept was developed. The PolderRoof transforms roofs into intelligent, controlled water reservoirs. In this way, the system is able to store all the rain that falls on the roof and drain it off or reuse it at a later date. The PolderRoof serves as a foundation for a green roof, a roof garden or a solar or photovoltaic system. The PolderRoof also enables solutions for irrigation, infiltration or connection to retention systems.

How does a PolderRoof work?

The PolderRoof consists of

- a flat, but shallow retention system,
- weather forecast-based control units for water retention, controlled drainage, or fresh water supply,
- and an intelligent online platform including a dashboard.

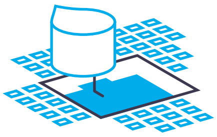
The roof surface is actively protected by a protective fleece and the retention layer, and thus on the one hand provides space for water storage, but at the same time forms the solid foundation for any application on the roof: from solar panels to roof gardens, from paving stones to colorful flower mixes.

Application

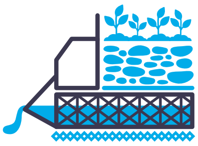
A PolderRoof can be applied to flat roofs on new and existing buildings (static requirements to be checked) and can be combined with gravity or siphonic roof drainage systems. It is intended to allow and strives to meet the requirements for a water-neutral building site and to comply with stormwater drainage standards. It can be applied as a basis for:

- Green roofs (extensive, semi-intensive, intensive, biodiverse, climate-roofs, etcetera)
- Roof gardens or roof parks
- Solar and Energy roofs
- Retention Roof for water regulations
- Protection of roofing membranes against UV and cooling

Design principles



The perfect foundation for any application
The water buffer serves as a solid, flat foundation for a wide range of applications like any type of green roof, rooftop garden, solar park, or other types of use. While doing so, it transforms a typical flat draining roof into a smart, controlled, and multifunctional water storage space. And it does not only allow for controlled water storage and regulatory compliant discharge but also integrated capillary irrigation for the greenery - making use of rainwater as a resource and supporting local cooling effects through evaporation.



Automatic storage control
The level of rainwater in the retention system is controlled by an intelligent water barrier, also known as a weir. The weir backs up the water in the system for as long as is reasonable. In this way, it provides needed water to plantings, promotes evaporation, and actively contributes to ambient cooling and building insulation. However, as soon as rainfall is foreseeable or there is a risk that the storage capacity will be exceeded, a defined discharge rate and the right time of discharge are selected intelligently and according to specifications.
In times of drought, plants have longer water reserves available, and the system can also control the supply of freshwater intake in the event of a persistent water shortage, thus protecting your wonderful green investment.
Based on the control units and appropriate sensors, the system can always ensure proper operation and allows intelligent dynamic water storage on the flat roof.

The Platform
Through the platform the roof performance is being measured, reported and dashboarded - showing everything that needs to be known to safely store water (temporarily) on the roof. All information about the roof and the operating system can be accessed and viewed in a personal project-based dashboard.
The PolderRoof represents a new dimension in urban water management!

Knowledge and Research
Since new buildings are more and more driven towards water harvesting and reusing, integrating these solutions is becoming important for developers and architects. Rooftops offer opportunities to make a community, region, or development area climate adaptable. Many communities see these opportunities but wonder where and how best to start.
Together with cities and universities, we work to transform urban centers into a smart water-grids.

Figure 8: Roof park, Vivaldistraat

Figure 9: Rooftop, The Hague

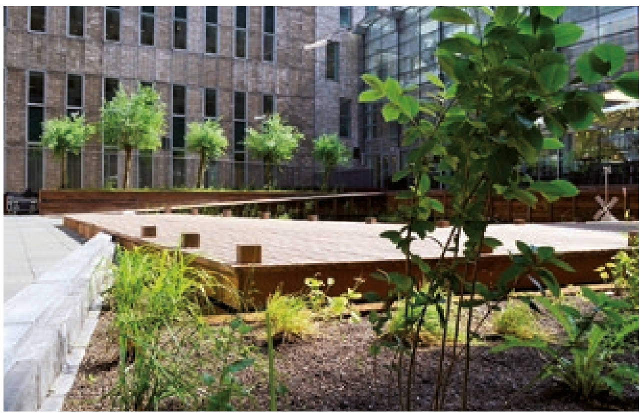


Figure 10: Rooftop, The Hague

Implications of the roof shape on the design of the roof drainage system

During rainfall, a siphonic system works optimally when all roof outlets are discharging the amount of water they have been designed to discharge, or all are discharging an equal proportion of their designed capacity. In these situations, the system will be well balanced. The amount of water flowing to roof outlets can however be disturbed by several elements:

- Bending of the roof (sagging).
- Clogging of outlets.
- Deviations from design (such as distances between outlets, pipe layout and/or pipe diameters).
- Wind effects.

To minimize these disturbing factors, it is important that there is always the possibility for "communication" between the roof outlets: when one outlet receives too much water, it should be possible for the water to flow to other outlets. Outlets which are connected to the same collector pipe must be at the same level in the roof to provide communication. Obstacles between roof outlets should be avoided.
If wind influences the amount of water falling on different roofs, these roofs are not allowed to be connected to a single common downpipe at the top of the building as the negative pressures could be too high.
Outlets in area A should not be connected to the same downpipe as outlets in area B. This is shown in in figure 7.

If a connection to one downpipe is desired, Wavin advises to connect the pipes discharging water from the roof surfaces just above floor level where the pressure in the pipe system is close to zero.

To avoid an excessive rain load variation caused by wind, on roof areas with different slopes, Wavin advises not to connect sloped roof areas where the angle between the roof slopes is more than 15 degrees (see figure 13).

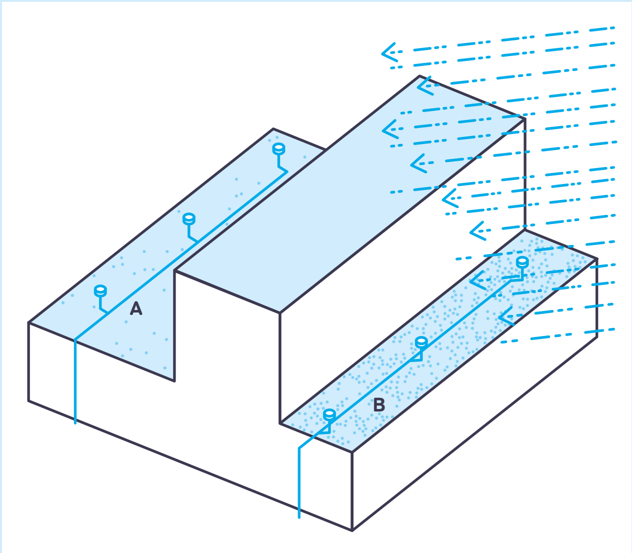


Figure 11: Wind influences may cause different loading on different roof areas

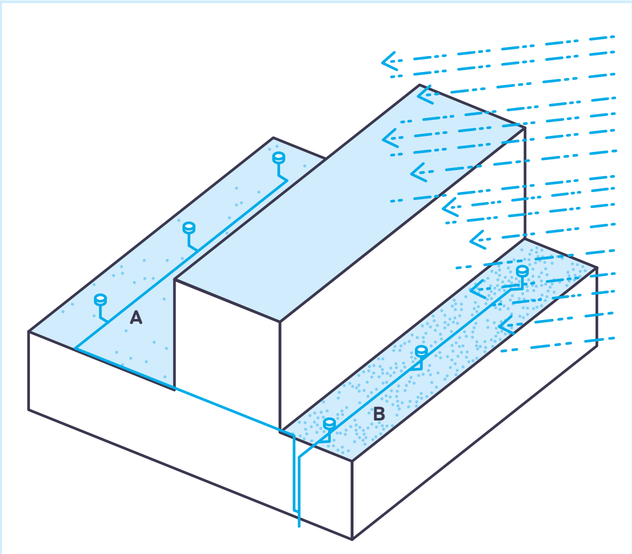


Figure 12: Wind influences may cause different loading on different roof areas

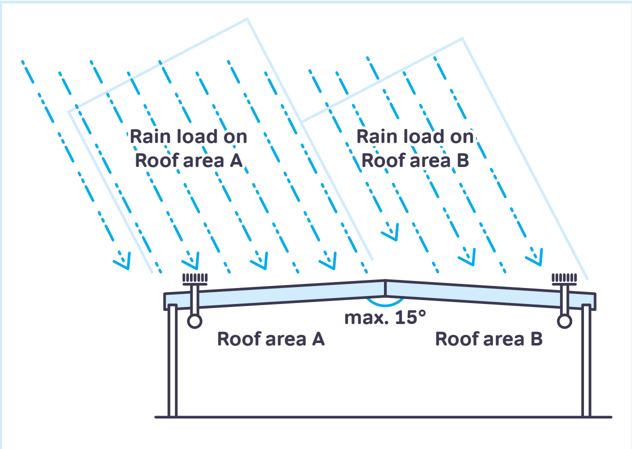


Figure 13: Not connection between sloped roof areas where the angle between the roof slopes is more than 15 degrees

Currently the world‘s rainiest city

11,871 l/m²

is the annual rainfall in Mawsynram, India

QuickStream is happy about so much work.
The strengths of the system are particularly evident in large amounts of rain, such as in India‘s record-breaking region, where 16 times as much rain falls as in Germany, for example.

Design Rainfall Calculation

In this chapter we describe the general guidelines for calculating the design rainfall and the flow values for the roof drainage. Some specific methods and values of coefficients could vary depends on the national or local regulations of the zone. We strongly recommend verifying these regulations in order to meet the standards in your country.

Design rainfall intensity

In most countries the design rainfall intensity is prescribed by national or local regulation and/or practice, e.g., 0.03 l/s/m². If so, all calculations for determining a QuickStream system will be based on these values. If it is not prescribed the design rainfall intensity can be calculated depending on the duration of the rainfall (D, in minutes), the geographical location of the building and the return period of the rainfall event (T, in years). Wavin advises to always install an emergency overflow system on a flat roof and in non-eaves gutters. For the emergency overflow a simple opening in the roof rim or a siphonic system can be used. The capacity of the overflow system should be designed according from national and local regulations. In cases where no regulations exist, common practice should be followed.

Roof Areas

To calculate the effective roof area, the roof area projected in the floor plan must be assumed.

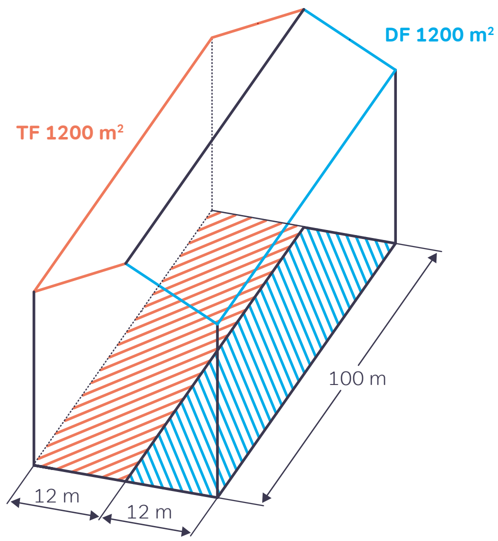


Figure 14: Effective roof area projected in the floor plan according to EN 12056

Effective catchment area

When there are adjacent walls next to a roof area, wind blowing against this wall might also intercept rain. When the catchment area "A" is composed of more than one area, the effective catchment area is the imaginary area which rainfall, under the most negative angle, can cover:
A = Length x Width.

If the angle of the actual or imaginary catchment area to the horizontal plane (α) is bigger than 45°, the following reduction factor R on the effective catchment area will be applied by Wavin:

ANGLE OF THE CATCHMENT AREA (DEGREES)	REDUCTION FACTOR R
45°	0.8
60°	0.6
85°	0.3

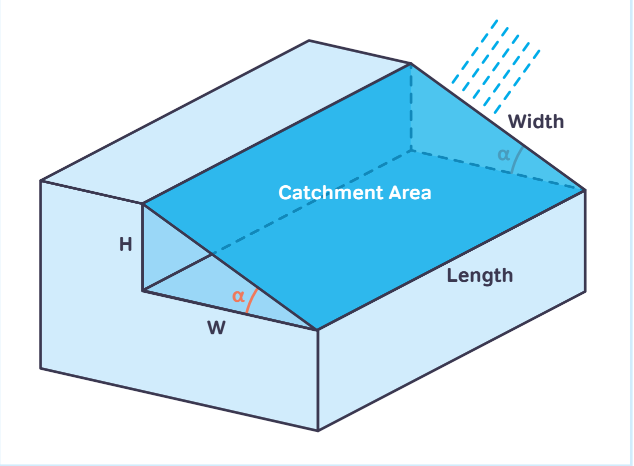


Figure 15: Effective catchment area

Run-off coefficient: C

Along with the duration of the rainfall event D it is also necessary to consider the time of concentration of the drainage system Tc. The time of concentration is the time taken for the rain falling on the most upstream part of the roof to reach the roof outlet. If due to:

- The distance between the most upstream part of the roof and the roof outlet
- The slope of the roof or
- The type of roof surface or
- A combination of these factors

The time of concentration, Tc, is greater than the design rainfall duration D, the flow rate at the outlet will not reach the maximum value. For design purposes the worst-case situation occurs when D is more or equal to Tc. In this situation the runoff coefficient of the roof will be 1. Wavin advice to use the following guidelines for the run-off coefficients "C" of various roof types:

TYPE OF ROOF	RUN OFF COEFFICIENT C
Sheet roof withslope > 3°	1
Gravel roof	0.8
Extemsive green roof < 10 cm	0.5
Extemsive green roof > 10 cm	0.4
Intensive green roof	0.2

Table 1: Runoff coefficients according to DIN 1968-100, unless otherwise specified by local regulations.

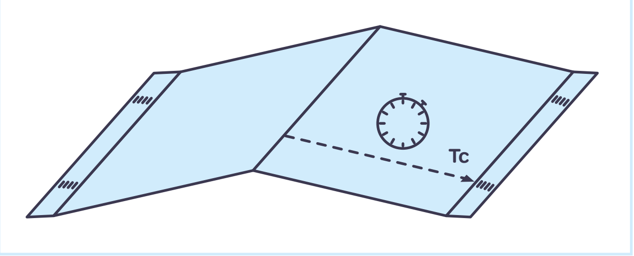


Figure 16: Rainfall time of concentration

Design rainfall quantity

The design rainfall quantity to be used for the hydraulic calculations is:

Q = r×A×C (or ×R)

In which:
Q: the rate of flow in [l/s]
r: rainfall intensity in [l/(s.m^2)]
A: Effective catchment area in [m^2]
C: run-off coefficient
R: Reduction coefficient due to the slope of the catchment area

Safety Factor

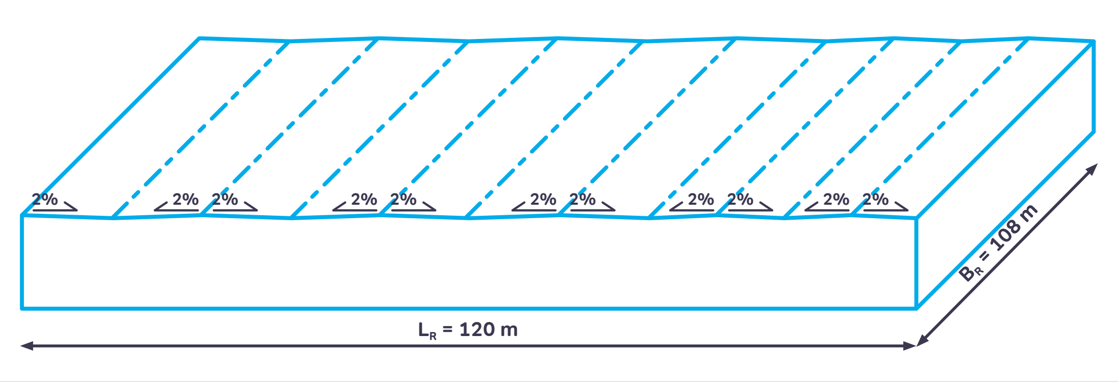
Safety factor is used in some regions depend on the type of gutter or roof in which the system will be installed. Again, Wavin advice to check the local or national regulations to see if this factor should be applied in the design rainfall quantity.
The safety factor commonly used are the follows:

TYPE OF ROOF AND GUTTERS*	SAFETY FACTOR
For flat roofs and eaves gutters	1
Eaves gutters where water overflowing will cause inconvenience	1.5
Parapet or valley gutters	2
Roofs where an exceptional degree of protection is required	3

*Based on EN 12056-3 Standard. May not apply in your country.

Examples

Place: Kąty Wrocławskie, Poland
Building application: Warehouse



Design rainfall quantity:
The design rainfall quantity to be used for the hydraulic calculations is:

$$Q = r \times A \times C_s$$

In which:
Q: the rate of flow in [l/s]
r: rainfall intensity in [l/(s×m2)]
A: effective catchment area in [m2]
C: run-off coefficient

According to PN EN 12056 roof drainage should be calculated for a rainfall showed in the table below.

RAINFALL INTENSITY IN [L/(S×M2)]
0,010
0,015
0,020
0,025
0,030
0,040
0,050
0,060

Table 2: Rainfall intensity

Calculating effective catchment area (without correction for wind influence):

$$A = L_R \times B_R$$

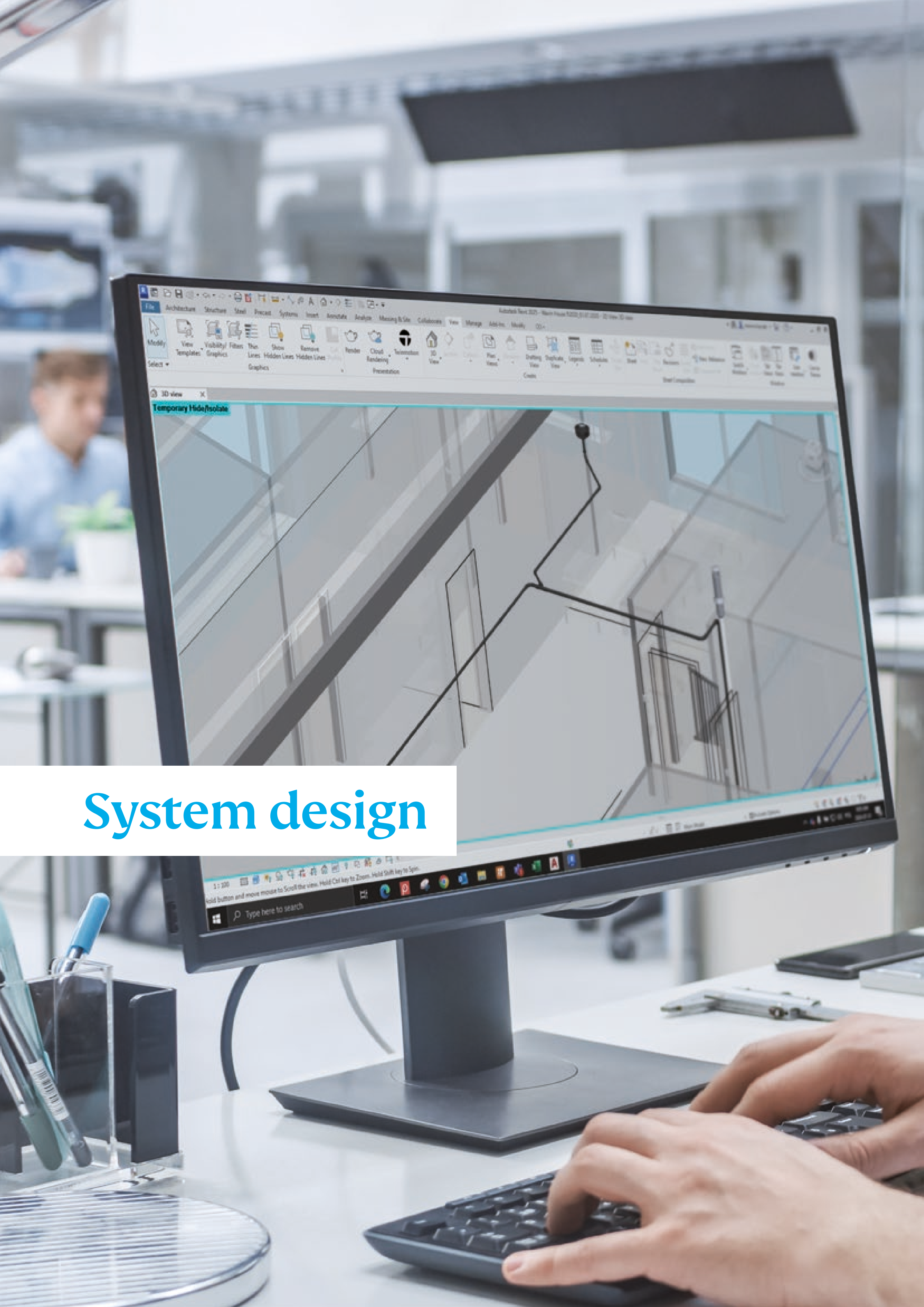
In which:
A: effective catchment area in [m2]
L_R: length of the roof [m]
B_R: width of the roof [m]

$A = 120m \times 108m = 12960\ m^2$
$C_s = 0{,}8$ (slop e= 2°)
$r = 0{,}03\ l/(s \times m^2)$

so:

$$Q = 0{,}03 \frac{l}{s \times m^2} \times 12960\ m^2 \times 0{,}8 = 311 \frac{l}{s}$$

System design



Count on Wavin – right from the planning phase.

Wavin uses state-of-the-art AutoCAD software to calculate the optimum system design. The design includes, among other things, roof drains, maximum negative pressure, minimum and maximum flow velocities, and negative pressure values. When you design your system with Wavin, we check all the relevant values to ensure everything works exactly as planned.

In this chapter, you'll learn everything important that influences system design:

- The maximum pressure losses and system equalization.
- Positive pressure, negative pressure and cavitation: This is how a fully vented system works with negative and positive pressure in the pipework. The largest part of the system operates (with negative pressure) at full flow. In most systems, the highest negative pressure is at the top of the vertical downpipe. With Wavin QuickStream systems, overpressure can also occur at the lower end of the pipework.
- Priming the downpipe: The QuickStream software checks whether the downpipes have a smaller diameter than the maximum diameter the upstream pipe system can fill. This means that the QuickStream system can always start up.
- Minimum and maximum flow velocities in the vertical and horizontal pipes.
- Transition to downpipe: The system will only start up reliably if the downpipe is primed, which will occur if its diameter is equal to or smaller than the horizontal collector pipe.

We'll also outline different types of rainfall intensity and the appropriate number of downpipes and roof drains to manage them. This chapter will explain why, with QuickStream, you can count on us - from the very first step.

Maximum head losses and system balancing

The available head for the design of a siphonic system is the vertical distance between the roof outlets to the cover level to which the siphonic system discharges or the level of the siphon break in the vertical downpipe. A siphon break is an increase in the diameter in the downpipe or in a horizontal pipe in flow direction.
For all flow paths of each roof outlet to the discharge point the dimensioning of the pipelines must be determined in such a way that the total friction losses in the pipes and fittings at the design rate match as closely as possible but do not exceed the available head. The equations that describe the head losses in the system are described in Chapter 8.
The maximum difference in calculated friction losses of all flow paths of each outlet to the discharge shall not be greater than 1 meter water pressure. If this occurs, the capacity of the different outlets will differ too much. This will result in water being drained from certain roof parts more quickly than other parts and consequently results in suction of air into these roof outlets and thus a breakage of the siphonic action. This will result in a reduction of the capacity of the whole system.
In practice, balancing is achieved by reducing the diameter of the tailpipes closest to the downpipe, and increasing the diameter of those further away.

Systems designed by Wavin always comply with this criterion for the maximum difference in head loss between all the outlets. This ensures good operation and is automatically checked by the Wavin QuickStream design software (See Table below). All outputs from the software are blocked if this requirement is not being fulfilled. An example is shown in table 3.

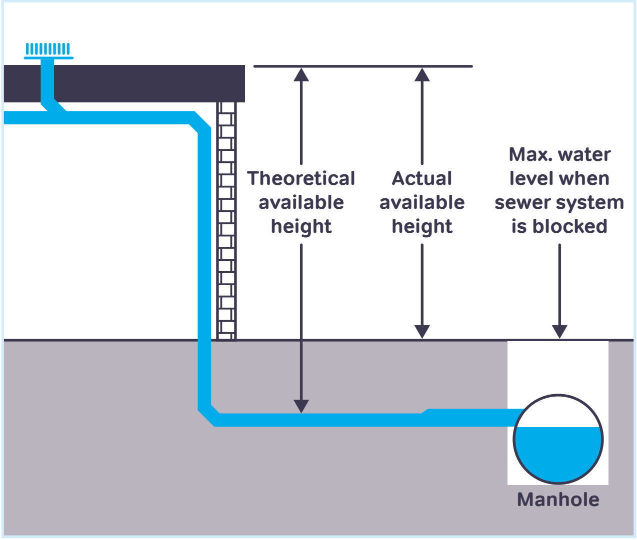


Figure 17: Estimating the available height

	(mm)
Maximum allowable system imbalance	1000
Maximum system imbalance	684
Maximum system imbalance < allowable imbalance	OK

Table 3: Example displaying the maximum allowable imbalance pressure and the actual imbalance.

Positive and negative pressures and cavitation

A fully primed system acts with negative and positive pressures in the pipework. Most of the system operates (at a negative pressure) at full bore flow. At the roof outlets and discharge point the pressure is atmospheric pressure. In most projects the highest negative pressure can be found at the top of the vertical downpipe. When the Wavin QuickStream system is extended horizontally outside the building and is connected to a manhole or is flowing into open water, positive pressures can also be found in that part of the pipe system. A schematic overview of the pressures in the pipe system can be found in Figure below.

Negative pressures have a more severe effect than equivalent positive pressures on the strength of the pipes because pipe walls tend to deform and buckle asymmetrically under negative pressures. It is therefore important to always use the SDR/pressure rating of pipework specified in the Wavin QuickStream design.

In tall buildings which exceed approximately 12 meters in height, it is possible for negative pressures in the pipes to approach the vapor pressure of water. When this occurs, the water will effectively boil, and form cavities filled with water vapor. This process is called cavitation and can result in serious turbulence and pressure fluctuations in the pipe work. When vapor cavities collapse, they can generate extremely high impact pressures that can cause serious damage to the strongest of materials including steel. At 20°C and at sea level, cavitation occurs in water at a negative pressure of 0.97 bars.

All Wavin QuickStream systems are designed not to exceed a negative pressure of 0.9 bars which offers a 10% safety factor against cavitation occurring (e.g. See Table below). If the location of the building is below sea level or if the expected rainwater temperature requires a lower safety pressure, the software will automatically adapt the maximum allowable negative pressure. The level of under pressure can be influenced by choosing alternative pipe diameters. The Wavin QuickStream software will automatically check the maximum allowable negative pressure in the system and block all outputs if the value does not meet the requirements. All Wavin pipes and fittings used for the Wavin QuickStream pipe system are designed to resist the maximum negative pressures at which cavitation takes place and can thus resist all negative pressures which might take place during rainfall.

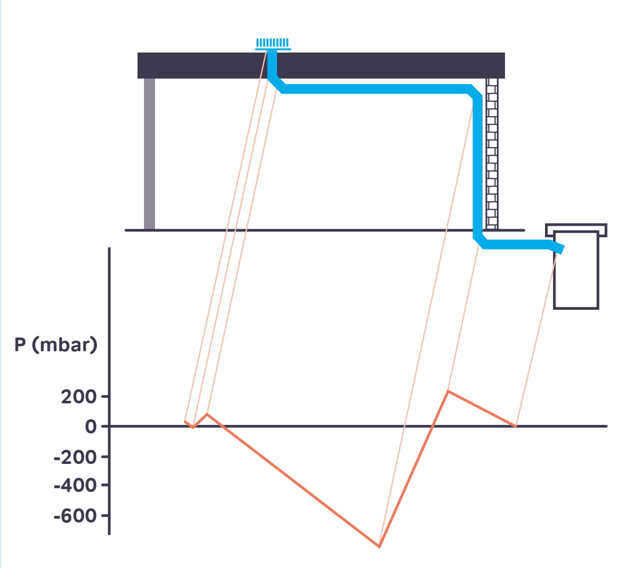


Figure 18: Typical example of the negative and positive pressures in a Wavin QuickStream system

	(mm)
Maximum allowable negative pressure	-9000
Maximum negative system pressure	-6448
Maximum pressure < allowable negative pressure	OK

Table 4: Example displaying the maximum allowable negative pressure and the actual negative pressure.

Priming of the system

A combination of the following:

- small vertical height difference between the roof outlets & the horizontal collector pipe,
- A long collector pipe with too high energy losses,
- A too large vertical downpipe,

Will result in insufficient water in the vertical downpipe for the system to prime (fill completely with water).
The vertical downpipe can be regarded as the main driver to achieve a negative pressure; therefore, it is essential to check whether priming of the downpipe will take place. The Wavin QuickStream software checks automatically whether all the chosen vertical downpipes have a smaller diameter than the maximum diameter that can be filled by the upstream pipe system. This will ensure that the Wavin QuickStream system is always able to start-up and consequently is able to discharge the design rain intensity from the roof area (See Table below).

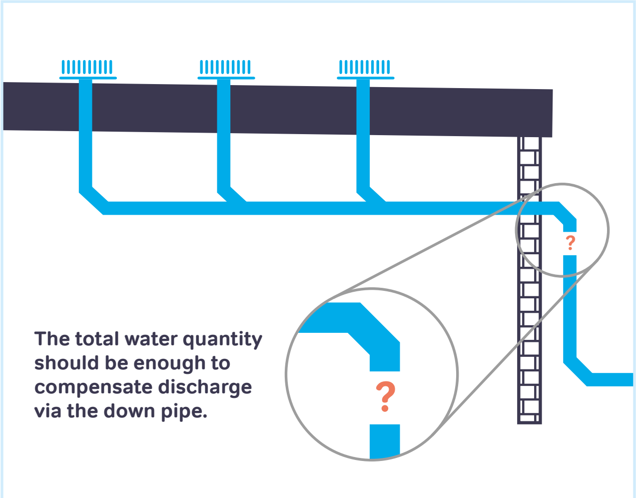


Figure 19: QuickStream software automatically checks that all vertical downpipes are smaller than the maximum allowed size. This ensures the priming of the system.

	(mm)
Maximum downpipe diameter for priming	157.9
Chosen internal downpipe diameter	115.4
Priming of vertical downpipe	OK

Table 5: Example displaying the maximum downpipe diameter for the priming and the actual diameter.

Minimum and maximum flow velocities

The system needs to be checked on minimum velocities at the design rate in the vertical and horizontal pipes. The velocity in horizontal pipes should be greater than 0.7m/s (and 0.5m/s for small pipe diameters) to secure the removal of air during priming and to provide a suitable degree of self-cleansing to prevent the build-up of sediment or other debris in the horizontal pipelines. Self-cleansing will start during the priming phase. The water-air mixture creates sufficient turbulence to loosen any deposits. The minimum flow velocity in tail pipes should be 1.7m/s to promote rapid priming. In all other vertical pipes, the minimum velocity should be at least 2.0m/s to ensure that air in the form of bubbles is transported downwardsto the point of discharge and to promote a rapid priming of the system. Self-cleaning of the pipeline in operation does not replace the normal require-ments for maintenance.

SECTION ROOF OUTLET NO. 2

SECTION PART NO.	ITEMS	DN (mm)	CAPACITY (l/s)	VELOCITY (m/s)	OUTFLOW PRESSURE (mm)
0	Discharge 125, Pipe Ø 125	125	40.0	3.8	396
1	Elbow 45°, Elbow 45°, Pipe Ø 125	125	40.0	3.8	1096
2	Elbow 45°, Elbow 45°, Pipe Ø 125	125	40.0	3.8	-5501
7	Tee 125 x 63	125	32.0	3.1	-4250
8	Pipe Ø 125	125	32.0	3.1	-4155
13	Tee 125 x 63	63	8.0	3.1	-2824
9	Reducer 63 x 50, Elbow 45°	63	8.0	3.1	-2556
10	Pipe Ø 50	50	8.0	5.3	-2928
11	Elbow 45°, Elbow 45°, Pipe Ø 50, Outlet connector 2.5" Ø 50	50	8.0	5.3	-2304
12	QSMP 75 outlet	75	8.0	2.1	-183

Table 6: Example displaying the calculation overview for each component of the system.

On the other hand, for the maximum velocity, it is necessary to check the discharge point to avoid damages in system outlets with high velocities. Due to the high velocity in the dis-charge point, is recommended to protect the manhole, channel or discharge structure to avoid possible damages. For more details in the discharge points and the maximum velocities **see the Chapter "Discharge conditions", p. 68.**

Transition to the downpipe

The maximum branch diameter into the downpipe must not ex-ceed the diameter of the collector pipe. Smaller diameters are possible. If the downpipe is implemented with a larger diameter than the collector pipe, the system will not start up reliably.

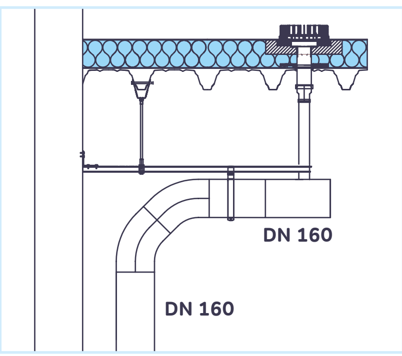


Figure 20: Downpipe of equal dimension

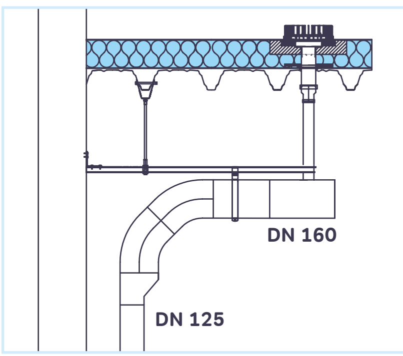


Figure 21: Downpipe reduced

Pre-calculating the system

The following tables show different scenarios of rain intensities, showing the required quantity of downpipes and number of outlets.

RAIN INTENSITY: 75 mm/h = 0.02085 lt/sec*m²

ROOF AREA (m^2)	RAINFALL QUANTITY (lt/sec)	ROOF OUTLETS NEEDED (UN)		NUMBER OF DOWNPIPES NEEDED (UN)							
		TYPE M-200	TYPE M-260	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm	Ø 160 mm	Ø 200 mm
1000	20.9	2	1	6	4	2	2	1	1	N.A.	N.A.
3000	62.6	4	3	16	10	6	4	3	2	1	1
5000	104.3	6	4	26	16	10	6	4	3	2	1
10000	208.5	11	7	51	32	19	12	8	5	3	2
50000	1042.5	53	35	255	156	95	58	37	24	15	10

RAIN INTENSITY: 100 mm/h = 0.0278 lt/sec*m²

ROOF AREA (m^2)	RAINFALL QUANTITY (lt/sec)	ROOF OUTLETS NEEDED (UN)		DOWNPIPES NEEDED (UN)							
		TYPE M-200	TYPE M-260	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm	Ø 160 mm	Ø 200 mm
1000	27.8	2	1*	7	5	3	2	1	1	N.A.	N.A.
3000	83.4	5	3	21	13	8	5	3	2	2	1
5000	139.0	7	5	34	21	13	8	5	4	2	2
10000	278.0	14	10	68	42	26	16	10	7	4	3
50000	1390.0	70	47	340	208	127	77	49	32	20	13

RAIN INTENSITY: 125 mm/h = 0.03475 lt/sec*m²

ROOF AREA (m^2)	RAINFALL QUANTITY (lt/sec)	ROOF OUTLETS NEEDED (UN)		DOWNPIPES NEEDED (UN)							
		TYPE M-200	TYPE M-260	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm	Ø 160 mm	Ø 200 mm
1000	34.8	2	2	9	6	4	2	2	1	N.A.	N.A.
3000	104.3	6	4	26	16	10	6	4	3	2	1
5000	173.8	9	6	43	26	16	10	7	4	3	2
10000	347.5	18	12	85	52	32	20	13	8	5	4
50000	1737.5	87	58	424	260	158	96	62	39	24	16

Roof Outlets

The right roof outlet in the right place: attracts rainwater like magic.

The most important function of our Wavin QuickStream roof outlets is preventing air from flowing into the pipe system with the rainwater. What QuickStream can do so convincingly begins at the roof outlet - it can drain large quantities of water in a short time and simultaneously clean the pipe system. Once again, we'll support you in your planning work, create a detailed layout proposal and perform hydraulic calculations.

We'll address key questions about planning roof outlets. It's generally accepted that roof outlets should be at the lowest point. But where should outlets connected to the same downpipe be placed? How far should roof outlets be from the roof edge? What other factors affect the best position for roof outlets, and how do they interact?

More and more buildings contain roof gardens, and QuickStream also has the right roof outlets for this option. The outlets allow unhindered access for inspections and prevent soil and dirt from entering the drainage system on green roofs.

Roof outlets in cold climate zones are another interesting special case - we also have a solution for this, where electric heating elements can be installed together with Quick-Stream.

In this chapter, you'll learn which types of roof drains from our product range are suitable for which types of roof and environment – and how, with the right selection and positioning of roof outlets, QuickStream can work its magic.

Number of roof outlets

The available head for the design of a siphonic system is the vertical distance between the roof outlets to the cover level to which the siphonic system discharges or the level of the siphon break in the vertical downpipe. A siphon break is an increase in the diameter in the downpipe or in a horizontal pipe in flow direction.
For all flow paths of each roof outlet to the discharge point the dimensioning of the pipelines must be determined in such a way that the total friction losses in the pipes and fittings at the design rate match as closely as possible but do not exceed the available head. The equations that describe the head losses in the system are described in Chapter 8.
The maximum difference in calculated friction losses of all flow paths of each outlet to the discharge shall not be greater than 1 meter water pressure. If this occurs, the capacity of the different outlets will differ too much. This will result in water being drained from certain roof parts more quickly than other parts and consequently results in suction of air into these roof outlets and thus a breakage of the siphonic action. This will result in a reduction of the capacity of the whole system.
In practice, balancing is achieved by reducing the diameter of the tailpipes closest to the downpipe, and increasing the diameter of those further away.

Systems designed by Wavin always comply with this criterion for the maximum difference in head loss between all the outlets. This ensures good operation and is automatically checked by the Wavin QuickStream design software. All outputs from the software are blocked if this requirement is not being fulfilled.

Location of the roof outlets

Water must be able to flow unhindered to the roof outlets. The locations of the roof outlets on the roof or in a gutter must be situated at the lowest point. Outlets connected to the same down pipe should be at the same level and preferably be in a suitable position to communicate with each other. Near the roof rim and near adjacent walls, dirt and leaves are usually deposited. Therefore, it is recommended to locate the roof outlets at a minimum distance of 0.5 meters from the roof rim (see Figure 22). If the roof rim is more than 0.5 meter high (e.g. a wall), a minimum distance of 1.5 meters is required.

The following factors are considered when deciding upon the locations of the roof outlets:

- Roof structure and low lines
- Intended use of the facility
- Emergency overflow feasibility
- Area to be drained

All the above factors must be considered together as they interact. Therefore, some general rules of practice should be observed during conceptual studies of the roof drainage solutions.

- Avoid locating the outlets or routing the pipework above rooms where condensation is likely to occur, or where a failure of the system could cause property damage or harm to the personnel. The prohibited premises include but are not limited to: hospital operation rooms, archives, or transformer rooms. If no other options are available, special measurements should be taken (insulation to prevent condensation, pipe system has to be tested thoroughly etc.).
- Locate all roof outlets at the low lines. Water from the roof will be transported to these low lines by a slope in the roof.

As a result, there are normally no roof outlets located in the slope. Keep the advised span between consecutive outlets to 20 meters.

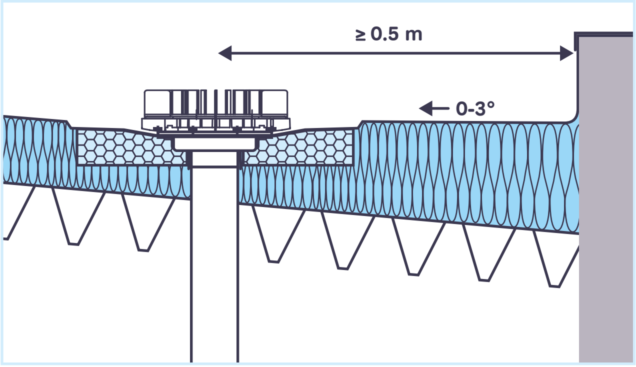


Figure 22: Location of the roof outlets

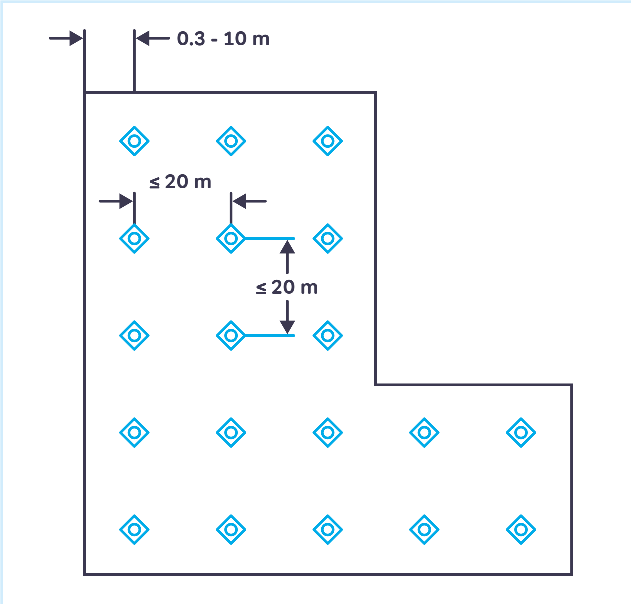
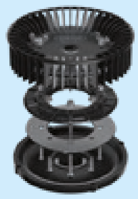
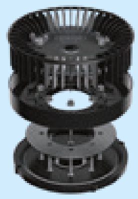
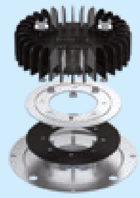


Figure 23: Location of the roof outlets

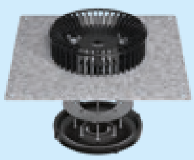
Type of roof outlets

Wavin QuickStream roof outlets are available in different dimensions and materials, and all comply with EN 1253 regulation. Additionally, there are three different constructions for sealing to roofing materials and gutters.


1. Clamping type roof outlet

Compressing the roofing membrane between two flanges performs the sealing. This outlet type can be directly installed on the most common roofing membranes as PVC, EPDM and Bitumen.



2. Bitumen type roof outlet

This type is supplied with a wide stainless-steel flange on which the bitumen roofing membrane can be directly heat bonded.

3. Gutter type roof outlet

These outlets are designed for installation in gutters. Sealing is performed by EPDM gaskets, with both surfaces of the gutter compressed between the clamping ring and the outlet part. Upon request a gutter type can also be supplied with a metal sheet of the same material as the gutter, so that the outlet can be welded/ soldered into the gutter. Take into account that the gutter outlets will be about 3 mm above the surface of the gutter. This means a residual amount of water remains after rainfall has ended. If this is to be avoided, the gutter has to be deformed in the area of the outlet to let the outlet sink about 3 mm.

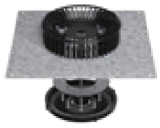
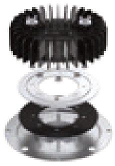
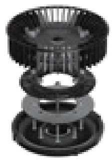
Strongest downpour – so far

38 l/min

of rainwater per square meter fell on Guadeloupe in 1970.

No great challenge for QuickStream.
Four times the average amount of water flowing through a shower is extreme. But business as usual for QuickStream and Orbia's commitment to climate-resilient cities.

Roof outlets application overview

ROOF TYPE	APPLICATION	FLOWRATE (lts/seg) (1)		
		22.5	23.5	24.5
Flat roofs	Bitumen			
	Bitumen + Gravel Guard			
	Membrane			
	Membrane + Gravel guard			
Gutters	Concrete			
	Metal/Plastic			

(1) Test according EN 1253-2 TUV 2024

Insulation of roof outlets

To prevent leakages inside the building due to condensation, roof outlets must be insulated. If there is a "cold" roof with a ventilated space under the roof, the pipe work in that space must also be insulated. Wavin can supply insulation blocks with the roof outlets.

As an indication, a plastic pipe installed in an area at room temperature, will reach an outside temperature that is approximate 3° to 5° higher than the inside water temperature. Note that a "cold" rainfall during any season might induce condensation.

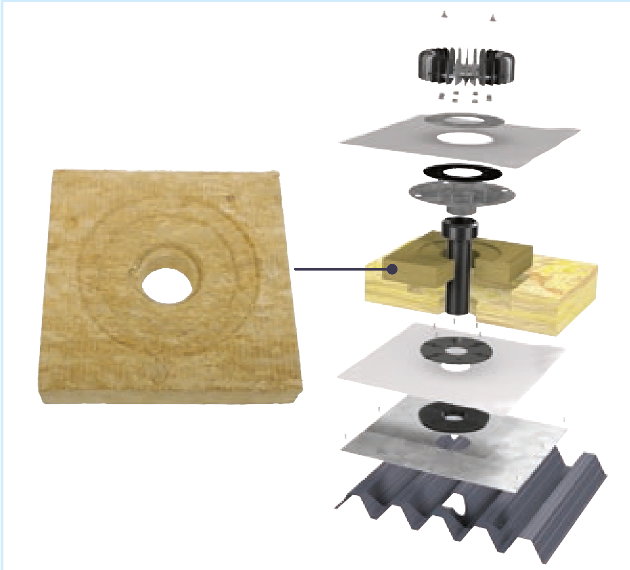


Figure 24: Build up of an insulated roof with vapour barrier

Roof outlet constructions for green roofs and parking decks

Drainage systems from roof gardens and parking decks should enable inspection and access to the outlet and in the case of green roofs, shall incorporate means of excluding soil and debris from entering the roof drainage system.

Furthermore any required loads varying from pedestrians to traffic loads should be transferred to the roof structure. Wavin has developed special covers and shafts that can be placed over the roof outlets and which are especially designed for green roofs and parking decks. Depending on the load situation various covers with gratings can be supplied.

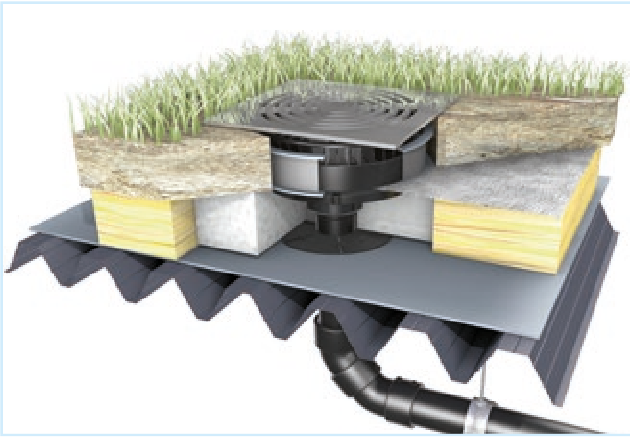


Figure 25: Example of a greenroof with vapour barrier

BMW Center Dingolfing, Germany

Electrical heating elements

In most circumstances the pipe system of a siphonic system runs through warm spaces. The warm air in the pipe system will rise in temperature and this also helps keep the outlet at an elevated temperature. In cold climate areas this might not be enough to keep the surroundings of the outlet in a thawed condition. Roof outlets might become blocked by freezing of melted snow or hail and cause water accumulation or flooding inside buildings. In this case, consideration should be given to the installation of electrical heating elements. Wavin QuickStream roof outlets can be provided with an automatic electric heating system. A heating system prevents blockage of the outlet in case e.g., hail, snow or freezing melt water from snow.
A built-in temperature probe will automatically switch-on the heating plate when ambient temperature drops below +4°C. The heating element (see figure) is placed between the external surface of the sump pan and the thermal insulation pack.

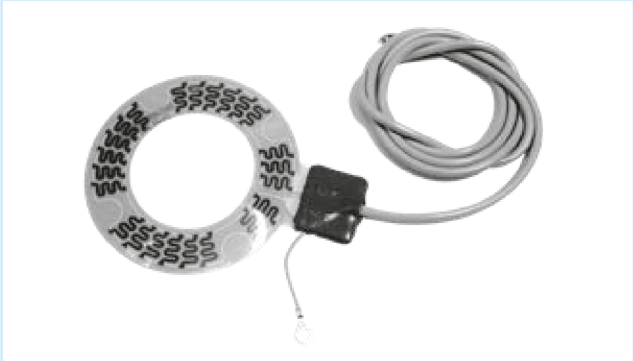


Figure 26: Electric heating element for Bitumen metal roof outlet

There are dedicated heating element versions for both metal and plastic roof outlets. For the metal version, the heating element should be grounded.

QS-M-75-260 Gutter

SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	(4) 1* Backing flange
(2) 1* Top part 260 (5) 2* Gasket	(6) 1* Base plate gutter
(3) 8* bolds M6*20mm	
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Aluminum coated
Base plates/ Clamping ring	Stainless steel (passivated)
Wing nuts / screws	Stainless steel
Gaskets	EPDM (40 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 23.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	
Salt spray test	

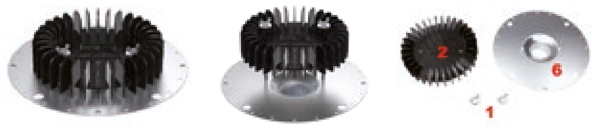
QS-M-75-260 Membrane

SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	(4) 1* clamping ring
(2) 1* Top part 260	(5) 1* Gasket
(3) 8* Nuts M6	(6) 1* Base plate
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Aluminum coated
Base plates/ Clamping ring	Stainless steel (passivated)
Wing nuts / screws	Stainless steel
Gaskets	EPDM (40 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 22.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	
Salt spray test	

QS-M-75-260 Membrane & gravel guard

SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	(4) 1* gravel guard
(2) 1* Top part 260 Gasket	(5) 1*
(3) 8* Nuts M8	(6) 1* Base plate
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Aluminum coated
Base plates/ Clamping ring	Stainless steel (passivated)
Wing nuts / screws	Stainless steel
Gaskets	EPDM (40 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 22.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	
Salt spray test	

QS-M-75-260 Bitumen



SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	
(2) 1* Top part 260	
(6) 1* Base plate	
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Aluminum coated
Base plates/ Clamping ring	Stainless steel (passivated)
Wing nuts / screws	Stainless steel
Gaskets	EPDM (40 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 23.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	
Salt spray test	

Higher risk of extreme rainfall

The heavier the rainfall, the better QuickStream.
Climate research is generally in agreement: the intensity of precipitation and the frequency of heavy rainfall events is increasing due to global warming caused by human activity.

QS-M-75-260 Bitumen & gravel guard

SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	(4) gravel guard
(2) 1* Top part 260	(6) 1* Base plate
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Aluminum coated
Base plates/ Clamping ring	Stainless steel (passivated)
Wing nuts / screws	Stainless steel
Gaskets	EPDM (40 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 23.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	
Salt spray test	

QS-M-60-200 Concrete gutter

SPARE PARTS	
(1) Wing nuts with washer and gasket	
(2) 200 mm top part (leaf-cath)	
(3) Baseplate (funnel)	
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Polypropylen - UV stabilized
Base plates/ Clamping ring	Stainless steel
Wing nuts / screws	Stainless steel
Gaskets	EPDM
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 23.5 l/s (head of water: 55mm) • Capacity Test according ASME A112.6.9-2005 > Capacity result: 30l/s	

QS - P+ Membrane & Bitumen series

SPARE PARTS	
(1) 2* Wing Nuts with SS ring and gasket	(4) 1* clamping ring
(2) 1* Top part 260	(5) 1* Gasket
(3) 8* Nuts M8	(6) 1* Base plate
MATERIALS **ALL MATERIALS ARE SEAWATER RESISTANT	
Top Part	Polypropylen with talcum
Base plates/ Clamping ring	Polyamid with glasfibre
Wing nuts / screws	Stainless steel
Gaskets	EPDM (50 Shore)
CERTIFICATIONS/TESTS	
• EN 1253 – TUV Test report (Date 13.12.2024) > Capacity result: 24.5 l/s (head of water: 55mm)	

The emergency overflow system

Why Wavin QuickStream is the system of choice in standard cases and also in emergencies.

Every roof drainage system can reach its limits, even a high-performance system like Wavin QuickStream. However, this isn't due to the siphonic system itself, but usually a result of blocked drains, a disrupted drainage system or roofs that buckle under the water load. This can happen especially with flexible roofs made of metal or wood constructions. The bending ultimately leads to a build-up of water in the resulting depression, which can't be reached by the main drainage system – and can, therefore, no longer be drained away.

Flat roofs with parapets and non-eaves gutters should always have an emergency overflow or a secondary drainage system. Other situations in which an emergency overflow system is appropriate include:

- blockage of roof drains due to leaves or other debris
- rare rain events that can't be handled by the economically dimensioned main drainage system alone.
- disturbed water flow due to other events, such as a blocked drainage system.
- When a rainfall event surpasses the design rainfall intensity specified for the primary system calculation

In this chapter, we'll explain why QuickStream is an extremely powerful roof drainage system and particularly suitable for an emergency overflow. We'll also show you how to calculate, plan and set up such an emergency overflow system.

Emergency overflow system

It is possible that a primary siphonic system does not function well, due to clogged outlets or a disturbed sewer system. Wavin therefore always advises installing an emergency overflow system, especially Flexible roofs (metal or wooden constructions) may bend under a load of water. This bending may cause a deformation which makes it impossible for water to reach the emergency system. This phenomenon is called water accumulation. The chance that water accumulation occurs can be limited by avoiding too-flat and too-weak roofs. Because these design parameters will be chosen by the designer of the building, the constructor of a building is responsible for the calculations referring to water accumulation. The constructor of a building has to prescribe the size, the number and the place of the overflows. Wavin strongly recommends always providing an emergency overflow or secondary system on flat roofs with parapets and in non-eaves gutters in order to reduce the risk of structural overloading or over-spilling of rainwater into a building.

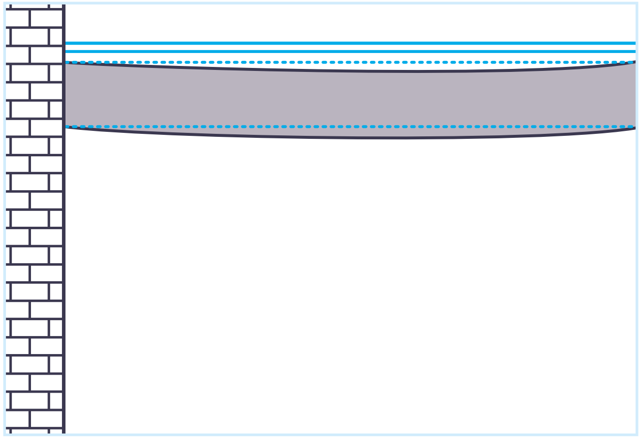


Figure 27: Water accumulation may cause bending of the roof

With eaves gutters and flat roofs with a low roof rim where these risks are not present, no additional safety system is required. Overflows may be used for different purposes, either singly or in combination:

- To provide a warning that one or more roof outlets have become wholly or partially blocked by leaves or other dirt and that maintenance is necessary.
- To cater for rare storm events so that the main rainwater system can be sized more economically for storms that occur more frequently.
- To increase the security of flat roofs and non eaves gutter systems.
- To drain water from the roof if the primary system is not functioning correctly.
- To drain water from the roof if the water cannot be discharged for whatever reason (sewer system is blocked or full of water and no emergency relief chamber has been installed, the holes in the grating of the emergency relief chamber cannot cope with the discharge capacity of the siphonic system, etc.)

Under normal conditions, an emergency overflow system should only discharge water when rainfall exceeds the design rainfall. In all other situations the working of the overflow system indicates that something is wrong

Operation of the Emergency Overflow system thus should be noticed by the building owners and the cause should be examined. There should be no transport to an underground pipe system.

Locating a square orifice or setting a pipe culvert at the roof parapet is the simplest solution. If it is not feasible to provide a weir overflow, due to technical reasons, a separate siphonic system can be installed to avoid excessive water accumulation.

Emergency system discharge should be visibly accessible to enable the building owner to promptly address the emergency.

Calculation of a rectangular overflow system

The dimensions of a rectangular emergency overflow can be calculated with the following formula:

$$Q_w = \frac{L_w \times h^{1.5}}{24000}$$

- Q_w = flow rate over weir in [l/s]
- L_w = Length or wetted perimeter in [mm]
- h = Water head over weir rim invert level in [mm]

The rectangular overflow may be an open weir or a closed one (mailbox). An open weir has the advantage of having no cover which could become a blockage for wood or branches. For that reason, it is advised in case of closed overflows (mailboxes) to build in extra room for potentially floating articles.

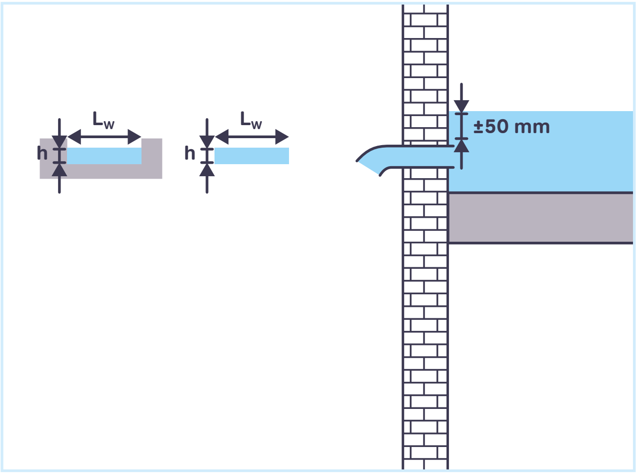
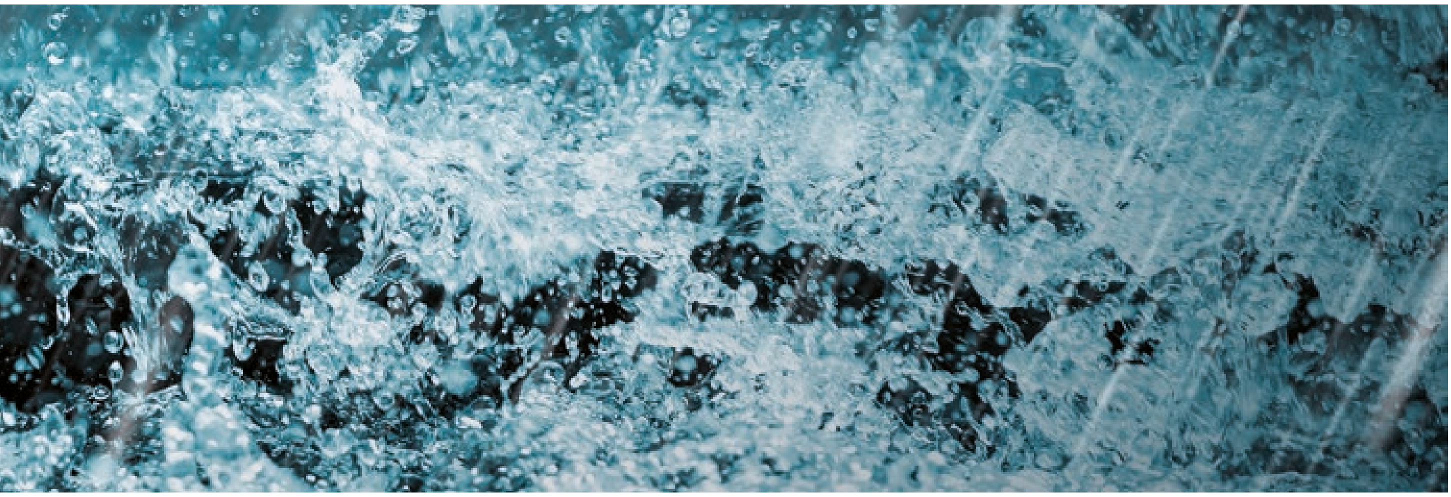


Figure 28: Calculation rectangular emergency overflow

The following table gives the calculated values for various combinations of width of overflows and water head

WATER HEAD h (mm)	CAPACITY OF THE A RECTANGULAR OVERFLOW Qw IN (l/s) OVERFLOW WITH Lw (mm)							
	100	200	300	400	500	600	700	800
30	0.7	1.4	2.1	2.7	3.4	4.1	5.5	6.8
40	1.1	2.1	3.2	4.2	5.3	6.3	8.4	10.5
50	1.5	2.9	4.4	5.9	7.4	8.8	11.8	14.7
60	1.0	3.9	5.8	7.7	9.7	11.6	15.5	19.4
80	3.0	6.0	8.9	11.9	14.9	17.9	23.9	29.9
100	4.2	8.3	12.5	16.7	20.8	25.0	33.3	41.7
120	5.5	11.0	16.4	21.9	27.4	32.9	43.8	54.8
150	7.7	15.3	23.0	30.6	38.3	45.9	61.2	67.5
200	11.8	23.6	35.4	47.1	58.9	70.7	94.3	117.9
250	16.5	32.9	49.4	65.9	82.4	98.8	131.8	164.7

Table 7: Capacity overview of a rectangular overflow system



The capacity of a piped overflow system at a water height of 50mm above the top of the pipe in [l/s], see Figure and table below.

Pipe diameter (mm)	Overflow capacity (l/s)
50	1.4
70	2.8
100	7.2
125	12.2
150	18.2
200	37.5

Table 8: Capacity overview of a piped overflow system

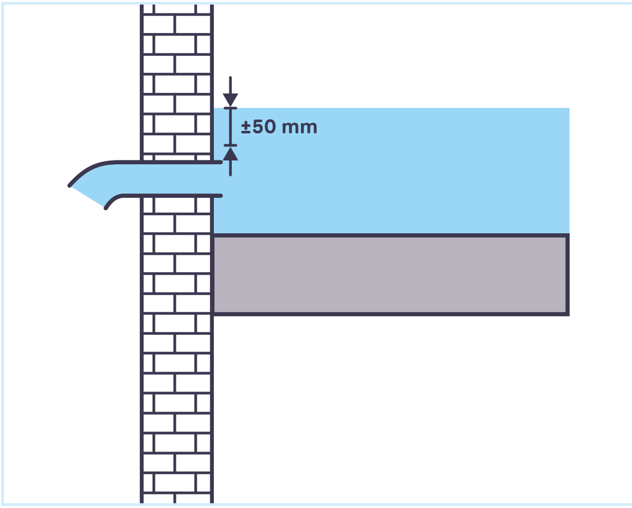


Figure 29: Pipe overflow

Wavin quickstream siphonic overflow system

The Wavin QuickStream system can also be used for emergency overflows. In situations with very large roof surfaces, or where a low roof line is situated between high buildings or when no overflow can be made in the parapet, a Wavin QuickStream siphonic system will be the most economical emergency overflow system. The discharge of the Wavin QuickStream emergency drainage should be led through the external wall above ground level. It is prohibited to connect the emergency drainage system to a gravity pipe system since the discharge of the emergency system should be visible and act as a warning system (see Figure below).

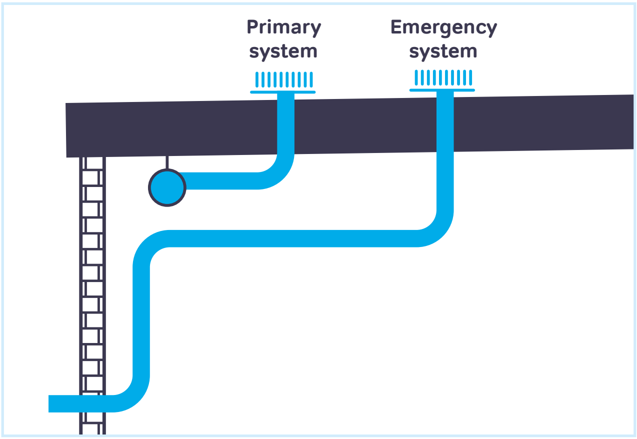


Figure 30: In a QuickStream emergency system each roof outlet has an exit above ground level.

Location of the emergency overflow

The entrance of water to the emergency outlet should be situated above the maximum water level for the main system. Wavin will notify the water level next to the roof outlets applying at the design capacity of system. To limit the maximum water load on the roof and for ease of calculation, the emergency outlets at the roof parapet should be placed near the Wavin QuickStream outlets of the primary system.

If several outlets are projected along a line routed across an inner roof area, parapet overflows are only possible at the ends of the line. A prerequisite is that the water level in the middle of the line will remain below the maximum allowable water level which can be borne by the roof structure. If the water level can become too high or the roof structure disturbs the flow between the outlets, Wavin QuickStream emergency outlets should be located close to the remaining inner outlets.

Emergency system regulations

The capacity of emergency overflow systems is either specified in local regulations or will follow from the safety factor when a parapet, boundary wall or valley gutter is being used. In some regions the capacity of an emergency overflow system is bigger than the capacity of the standard system.

Examples of the rainfall load calculation for emergency systems are shown in the table below:

Country	Primary System	Emergency Overflow System
Netherlands	300 l/s.ha x run-off coeff.	470 l/s.ha (no run-off coeff.)
Germany	300 l/s.ha x run-off coeff.	600 l/s.ha – (300 l/s.ha x run-off coeff.)
Belgium	500 l/s.ha x run-off coeff.	300 l/s.ha (no run-off coeff.)
France	500 l/s.ha x run-off coeff.	500 l/s.ha (no run-off coeff.).2
Poland	300 l/s.ha x run-off coeff.	300 l/s.ha (no run-off coeff.)
Hungary	depending on the region	200 l/s.ha (no run-off coeff.)
Colombia	300 l/s.ha x run-off coeff.	300 l/s.ha (no run-off coeff.)

Table 9: Examples of rainfall load for primary and emergency system in different countries

The fastening system

A bracketing system that's quickly assembled, error-free, and permanently safe in everyday use.

The Wavin QuickStream Bracketing System for horizontal pipework makes installation quick, easy and safe. It can be carried out by one person alone, and the fastening system has been designed to virtually eliminate installation errors.

Once the suspension has been installed, the pipe segments can simply be inserted into the brackets. Inserts can be placed in the clamps to secure the pipe against axial displacement. The clamps are designed to allow quick and easy insertion of the pipe segments and additional clamp locking.

Thanks to the tool-free assembly, you'll save time and work comfortably. The clever modular system will benefit you, and the fastening system will allow you to obtain structural verification during installation work.

After installation, the fastening system, in combination with the QuickStream siphonic system, is impressive. All forces (static, dynamic, thermal) that occur during the operation of a pressurized drainage system are safely absorbed by the fastening system.

QuickStream Bracketing System

Wavin is one of the leading suppliers of siphonic roof drainage systems and has over 30 years' experience in siphonic design and installation of siphonic systems.

Optimized bracketing system

Wavin has developed a bracketing system especially dedicated to the Wavin QuickStream system. The bracketing system enables fast installation time and secures a fool proof mounting of the brackets with minimal tooling required.
A controlled absorption of thermal axial pipe stresses in rigid suspension systems by making use of galvanized steel rails is most commonly applied in PE siphonic rainwater discharge systems. The benefits are ease of installation and no unexpected displacements. The thermally induced axial loads are completely absorbed by the suspension and bracketing system.
Once the suspension rails have been installed, pipe segments can then easily be placed in the brackets. In-lays can be placed in the brackets to create a strong and cost effective fix of the pipework against axial displacement. All Wavin QuickStream brackets are designed to enable fast and easy placing of pipe segments and additional closing of the bracket.

The Wavin dedicated bracketing system is simple to use:

- In a few steps the horizontal pipe work is installed in the easiest and safest way.
  - This bracketing system is designed for safe and quick installation by minimizing loose parts and required tools.
- Easy connection at height – clamp is designed to hold pipe in place for easy, quick and safe installation
  - Clamps are delivered in one piece – quick assembly and no loose parts to fall from height to the building floor
- All forces (static, dynamic and thermal induced forces) that occur in the operation of a pressure drainage are safely absorbed by the bracketing system.

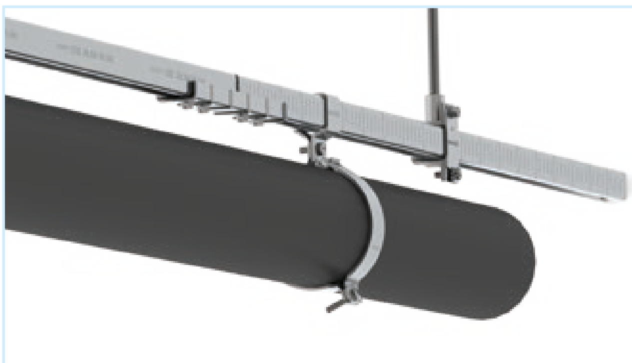
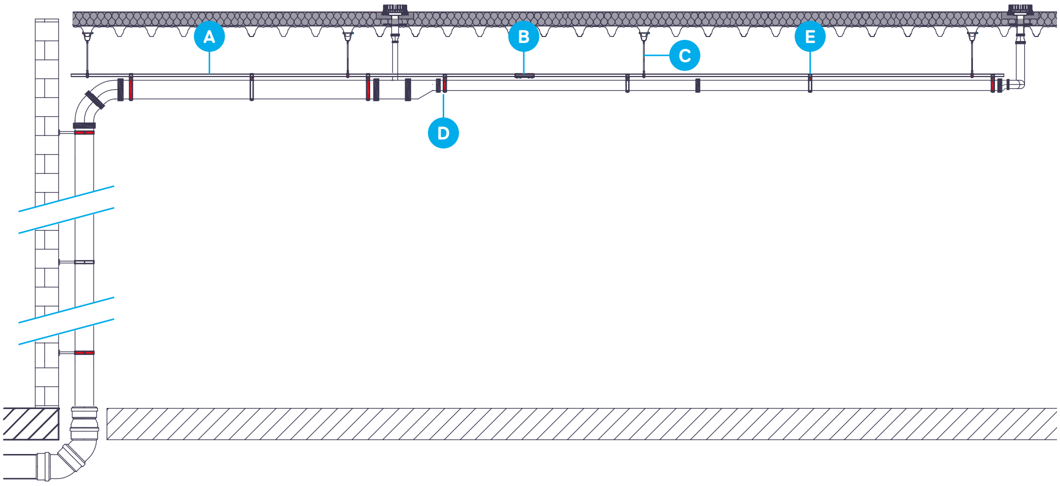
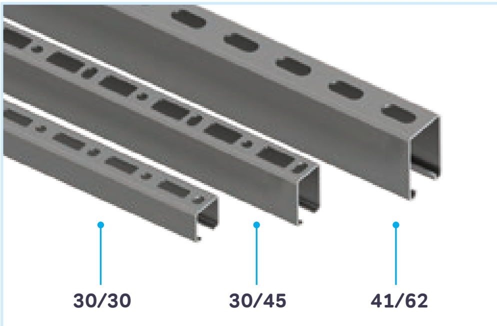


Figure 31: Fastening of pipe and rail system

System overview

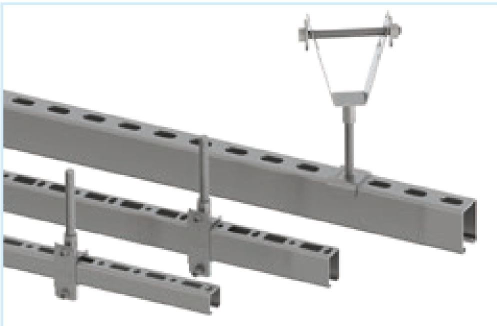


A Rail

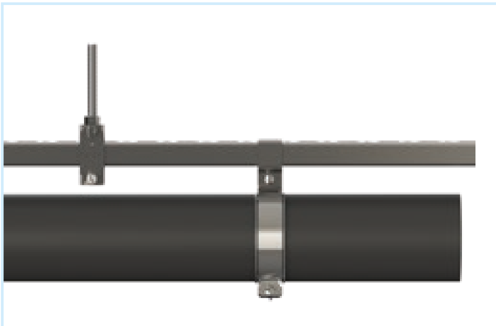


B Rail connector

C Suspension element



D Fixed-point bracket



E Sliding bracket

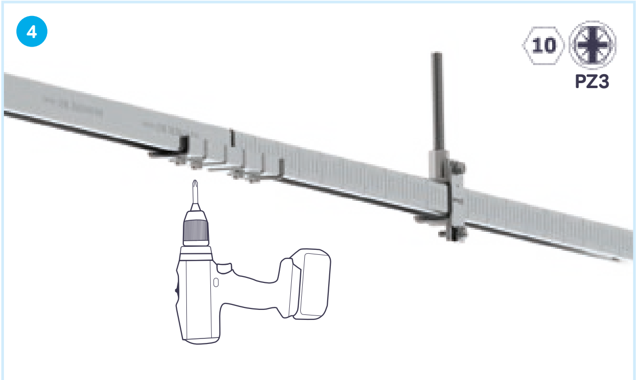
Installation instructions

Installation of the suspension element and fixation of the rail

Install the suspension element at the correct height using a M10 threaded rod.

Fix the rail into the suspension element and fasten the two bolts.

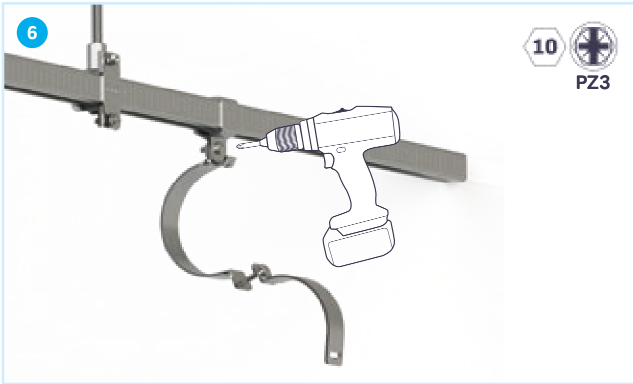
Insert the rail connector approximately halfway into the rail.



Fix the next rail to the rail connector and fasten the 4 bolts (it is not required to place the rails against the previous one).

Installation of brackets

Click the bracket at the right location on the rail (see table 2 for the bracketing distance).



Fix the bracket to the rail by clicking the front part into the rail and fasten the bolt.

Click one stainless steel inlay into the back part of the bracket.
Note: Inlay only required for fixed-point brackets.

Position the PE pipe into the bracket.

Position the front part of the bracket and fasten the bolt.

Bracket installed properly.

Special attention needs to be paid to the following 5 points

1. Wavin rail connector

The suspension rails must be connected using specific Wavin QuickStream rail connectors, which can transfer thermally induced axial loads from one rail to the next. The 30 x 30 mm rail connector can also be used for 30 x 45 mm rails. However, connections between 30 x 45 mm rails and 41 x 62 mm rails, or between 30 x 30 mm rails and 41 x 62 mm rails, are not possible. If a rail connector cannot be used, the end brackets on each rail must be fixed. This applies only at bends and when changing pipe diameters from 315 mm to 250 mm.

	30 x 30	30 x 45	41 x 62
30 x 30	✓	✓	✗
30 x 45	✓	✓	✗
41 x 62	✗	✗	✓

2. Install the bottom side of all rails on the same level

The bottom side of the different types of rail always needs to be installed on the same level. Special attention to the height of the rail needs to be paid when installation of the rail is started at the upstream side of the horizontal collector pipe and when the pipe size at the downstream side of the horizontal collector pipe is larger than 160 mm. In this situation, the 30 x 30 rail needs to be installed 15 or 30 mm lower to allow a bottom level connection to a 30 x 45 or a 41 x 62 mm rail. When the rail is fixed at the bottom side to e.g. steel beams, a 30 x 15 or a 30 x 30 rail can be fixed between the 30 x 30 rail and the steel beam to adjust the height of the 30 x 30 rail to the height of the 30 x 45 or 41 x 62 mm rail.

3. Maximum intermediate distances of the suspension elements

All Wavin QuickStream rail types 30 x 30, 30 x 45 and 41 x 62 should be suspended to the roof construction at a maximum distance T (see figure 35) of 2 meters between the suspension elements, taking into account the weight of a fully filled pipe, the weight of the suspension rail and the load ability of the roof construction.

4. Anchoring of the steel rails

All rails can be suspended relatively easily using threaded rods to the roof. The length of the threaded rods is of no importance as these only bear the weight of the pipe, pipe clamps and rail construction. Wavin recommends bracing the steel rails to the roof every 12 meters to prevent horizontal movement of the system. The anchors need to be fixed to the wall structure or alternatively installed lateral to the rails and approx. 45° to the roof.

5. Check weight limitations, which can be suspended to the (roof) construction

Care should be taken that the roof constructions have sufficient strength to bear the whole piping construction. The total weight per meter of a fully filled pipe and the suspension system can be taken from table 10. When the rail system is suspended every 2 meters, the design strength of each suspension point to the roof should be at least 2 times the total weight/m according to table 10.

World's largest roof area

20x **200.000 m^2**

is the size of the roof of the New Century Global Centre in Chengdu, China

From QuickStream's point of view: the perfect workplace.
The larger the flat roof, the more impressive QuickStream's Syphonic System.

Horizontal anchoring of the steel rails

Type of anchoring

In order to prevent the anchor from moving horizontally due to dynamic forces, a fixed connection of the anchor to the building structure (e.g. joists) is required. In addition, in case of interruptions (e.g. deflections) of the anchor, a firm connection should be made at both ends of the anchor to the building structure. The connection to the building structure is made with material provided by the customer (see figures 2, 3 and 4). If the pipe system (anchor rail with pipe) is subjected to temperature on one side (e.g. solar radiation or heat sources in the hall), we recommend additionally bracing the anchor laterally every 5 m in these areas. Our project team is at your disposal will gladly assist you with the realization.

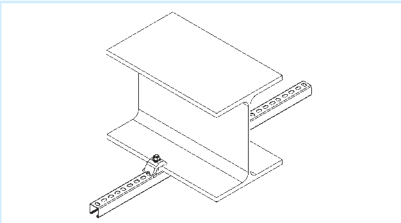


Figure 32: Steel

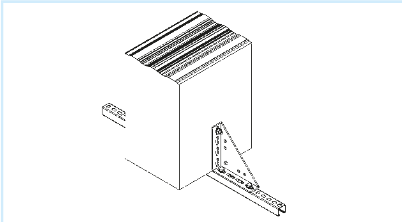


Figure 33: Concrete

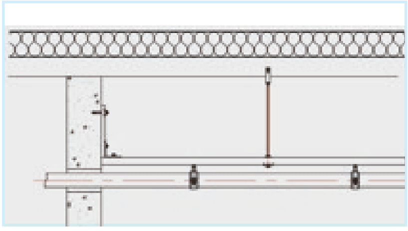


Figure 34: Mounting overview

Fixing of the anchor

The fixing of the anchor rail to the building structure consists of the rail suspension, a threaded rod and the connection to the load-bearing component. All Wavin QuickStream rail types should be suspended to the roof construction at a maximum distance T (see table 10 and Figure 35) of 2 meters between the suspension elements, taking into account the weight of a fully filled pipe, the weight of the suspension rail and the load ability of the roof construction. Figure 5 shows likewise the total weight of the individual pipe dimensions, including full filling and fastening material. The distance T of the rail suspension must not be exceeded according to table 10. Depending on the roof construction however, it may be necessary to reduce the distance between the mountings or use dual point suspension (see table 2).

ANCHORING	TYPE 1: 30x30									TYPE 2: 30x45		TYPE 3: 41x62
DN – PIPE DIAMETER [mm]	40	50	56	63	75	90	110	125	160	200	250	315
T – MAX. DISTANCE [m]	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
WEIGHT* [kg/m]	3,4	4,2	4,7	5,4	6,7	8,8	12,1	15,0	23,3	35,8	54,6	86,9
F – MAX. FORCE (kg/T)**	6,8	8,4	9,4	10,8	13,4	17,6	24,2	30,0	46,6	71,6	109,2	173,8

* Weight of the pipe including suspension and 100% filled with water. ** Resulting weight/point load per suspension with suspension distances

Table 10: Maximum distance anchoring.

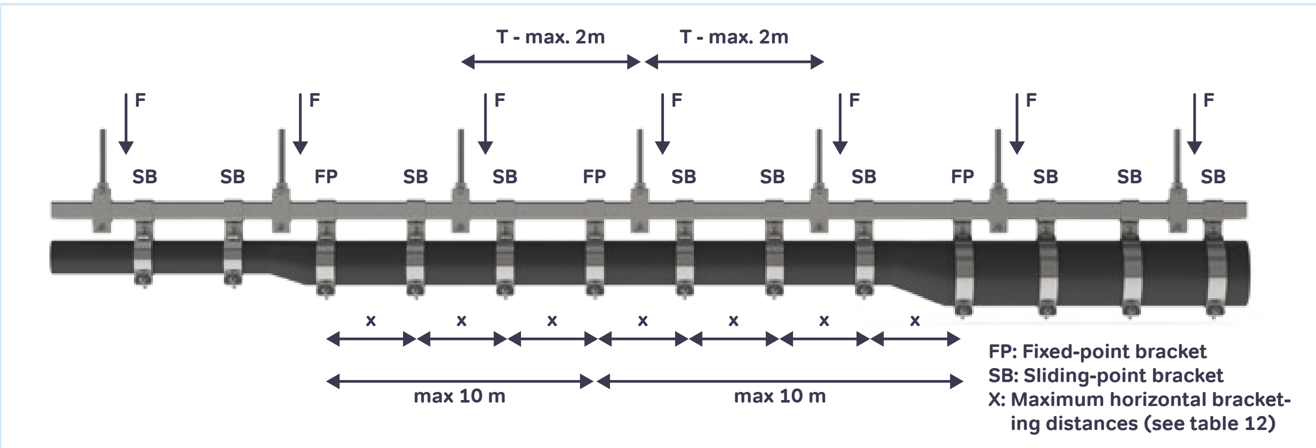


Figure 35: Mounting overview

Mounting options of the pipe system depending on the maximum suspension load

An important validation step is the assessment of the resulting loads on the trapezoidal sheet metal roof. Due to the weight of the pipelines in operation are subject to loads (weight loads on the trapezoidal sheet metal). The permissible load is determined by the responsible planning office. The values for suspension according to table 2 must be followed in different installation ways:

Single point suspension
The result of the pipe weight and mounting distance is the load. These resulting loads for maximum mounting distance (2 m) are shown in table 2, is specified.

If the loads exceed the maximum possible weight load of the trapezoidal sheet metal, e.g. the mounting distance (see figure 2 distance T). This reduces the weight load per suspension.

Dual point suspension
Analogous to the possible reduction of the mounting distances with two-point suspensions, the load is additionally transverse rail is divided into two points (suspensions).

The weight of the pipeline remains unchanged. The forces but are limited to twice the number of suspensions and are thus halved.

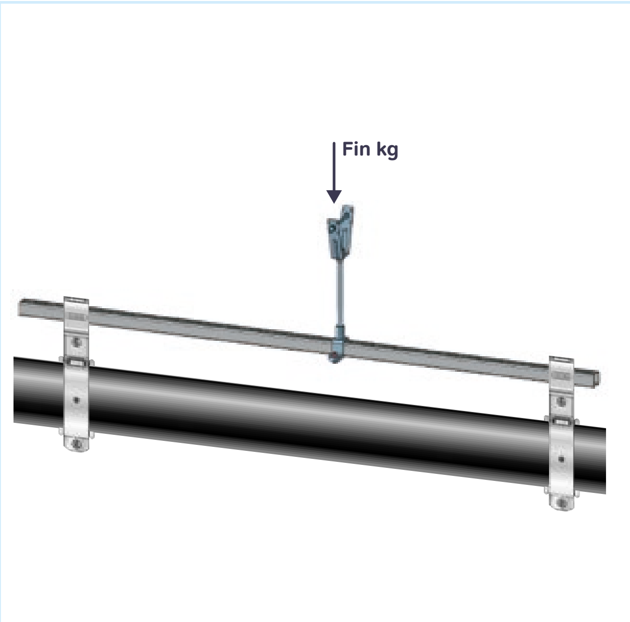


Figure 36: One point fixation

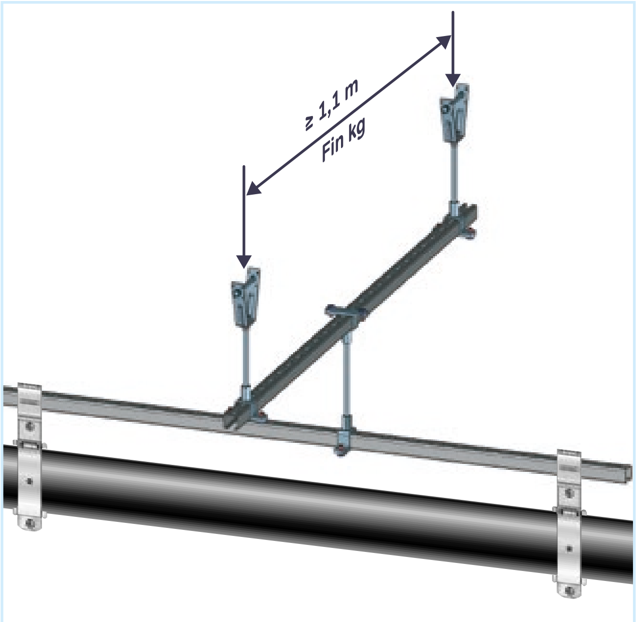


Figure 37: Two point fixation to reduce the weight loads on the fixation self

Note for single/two-point suspensions
The possible weight load of trapezoidal sheets is often expressed in kg/point or kg/m2. The fixing distances of the anchor
channels cannot be reduced at will. The roof is divided into so-called load squares (1 m - 1 m).

With mounting distances < 1 m, a load square attacked or loaded twice. The fixing distance and the distance of the load distribution (see figure "two-point suspension") should never be less than 1.1 meter and must in each case coordinated with the responsible calculating office as the weight loads are always taken into account in the calculation including for example heating and ventilation.

Fastening system

1	2	3	4	5	6	7	8	9	4	5	6	7	8	9
			15 kg/m² **T** - Distance		20 kg/m² **T** - Distance		25 kg/m² **T** - Distance		30 kg/m² **T** - Distance		35 kg/m² **T** - Distance		40 kg/m² **T** - Distance	
DN/OD [mm]	F [kg/m]	T_{max} [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]
40	3,4	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
50	4,2	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
56	4,7	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
63	5,4	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
75	6,7	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
90	8,8	2,0	1,70	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
110	12,1	2,0	1,24	2,0	1,65	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
125	15,0	2,0	X	2,0	1,29	2,0	1,67	2,0	2,0	2,0	2,0	2,0	2,0	2,0
160	23,3	2,0	X	1,29	X	1,72	X	2,0	1,29	2,0	1,50	2,0	1,72	2,0
200	35,8	2,0	X	X	X	1,12	X	1,40	X	1,68	X	1,96	1,12	2,0
250	54,6	2,0	X	X	X	X	X	X	X	X	X	1,28	X	1,47
315	86,9	2,0	X	X	X	X	X	X	X	X	X	X	X	X

1 DN/OD-Pipe diameter [mm]
2 Weight* [kg/m] Weight of the pipe including suspension and 100% filled with water
3 $T_{max.}$ Distance [m] maximum distance between the suspension elements

4,6,8 Mounting with a single point suspension
5,7,9 Mounting with a dual point suspension
X Standard assembly is not possible, in this case a special solution can be developed for specific projects

Table 11: Distance for single or dual suspension.

Example calculation

Given:

1 Pipe dimension: 110 mm
2 Maximum suspension load on the trapezoidal roof: 15 kg

Looking for:

Possible suspension type and mounting space.

Solution:

Fixing distances:

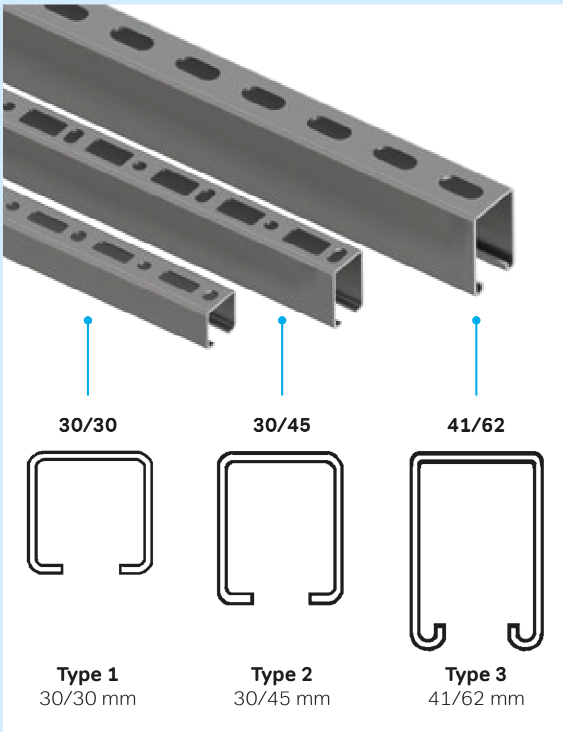
3 One point: 1.24 m
Two point: 2.00 m

1	2	3	4	5	6	7
			15 kg/m² **T** - Distance		20 kg/m² **T** - Distance	
DN [mm]	F [kg/m]	T_{max} [m]	1-point [m]	2-point [m]	1-point [m]	2-point [m]
40	3,4	2,0	2,0	2,0	2,0	2,0
50	4,2	2,0	2,0	2,0	2,0	2,0
56	4,7	2,0	2,0	2,0	2,0	2,0
63	5,4	2,0	2,0	2,0	2,0	2,0
75	6,7	2,0	2,0	2,0	2,0	2,0
90	8,8	2,0	1,70	2,0	2,0	2,0
110	12,1	2,0	1,24	2,0	1,65	2,0
125	15,0	2,0	X	2,0	1,29	2,0
160	23,3	2,0	X	1,29	X	1,72

Installation of the suspension element and fixation of the rail

The Wavin QuickStream system compromises three types of suspension rails:

1. Rail 30 x 30 mm for pipe diameters 40-160 mm
2. Rail 30 x 45 mm for pipe diameters 200 - 250 mm
3. Rail 41 x 62 mm for pipe diameter 315 mm



Installation of the rail connector

The suspension rails must be mutually connected with the specific Wavin QuickStream rail connectors that can transfer thermally induced axial loads from one rail to the next one. The rail connector 30 x 30 mm can also be used for rail 30 x 45 mm. The rail connector for the rail can also be used for connecting a 30 x 30 mm rail to a 30 x 45 mm rail. It is not possible to make a connection between a 30 x 45 mm rail and a 41 x 62 mm rail, or between a 30 x 30 mm rail and a 41 x 62 mm rail. In cases where it is not possible to use a rail connector, then the extreme brackets on each rail must be of the fixed type. This is only the case at bends and at a diameter change between 315 mm and 250 mm pipe size.

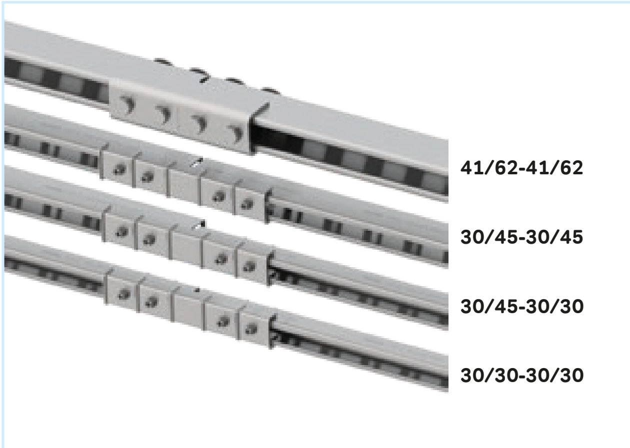


Figure 38: Types of rail connectors

Positioning of the horizontal brackets

A controlled absorption of thermal axial pipe stresses in rigid suspension systems by making use of galvanized steel rails is most commonly applied in PE siphonic rainwater discharge systems.

The benefits are ease of installation and no unexpected displacements. The thermally induced axial loads are completely absorbed by the suspension and bracketing system. Once the suspension rails have been installed, pipe segments can then easily be placed in the brackets. In-lays can be placed in the brackets to create a strong and cost effective fix of the pipework against axial displacement. All Wavin QuickStream brackets are designed to enable fast and easy placing of pipe segments and additional closing of the brackets.

To avoid potential sagging of the pipes, the horizontal maximum supporting bracketing distances from table 3 should be applied in a Wavin QuickStream system. Ensure that the maximum fixing distance according in is not exceeded. For horizontal pipelines < 0,8 m no fixture is required. Figure 35 provides a visual overview of the location of fixed-point brackets in the horizontal collector pipe. Table 12 shows the maximum temperature difference at 40°C (temperature difference between installation temperature of the PE material and the expected operating temperature).

For larger temperature differences, Wavin recommends the use of expansion sockets. In order to prevent the pipelines from bending between the pipe clamps, it is recommended to review and possibly reduce the horizontal mounting distances.
The vertical mounting distances do not have to be reduced.

DN/OD [mm]	X [m] ΔT <40°C	Y [m]	T [m]
40	0,8	0,9	2,00*
50	0,8	0,9	2,00*
56	0,8	0,9	2,00*
63	0,8	0,9	2,00*
75	0,8	1,20	2,00*
90	0,9	1,40	2,00*
110	1,10	1,70	2,00*
125	1,25	1,90	2,00*
160	1,60	2,40	2,00*
200	2,00	3,00	2,00*
250	2,00	3,00	2,00*
315	2,00	3,00	2,00*

X = Maximum horizontal bracketing distances in meters.

Y = Maximum bracketing distance (in meters) for the vertical downpipe.

T = max. Distance [m] maximum distance between the suspension elements.

*The fixed point within 0,3 meters from a suspension element.

Table 12: Bracketing distance.

Location of fixed points

In the event of a change in direction, there is a fixed point required. As a minimum, a fixed-point bracket must be placed on the largest side of every increaser / reducer. If a Tee piece is located at an increaser, then the fixed-point brackets can be situated directly next to the branch piece. Fixed-point brackets should also be installed directly before and after a change in direction, e.g. at a bend and at each interruption of the rails. The maximum distance between two fixed-point brackets may not exceed 10 meters. The fixed points need to be located within a maximum distance of 0.3 meters from a suspension element.

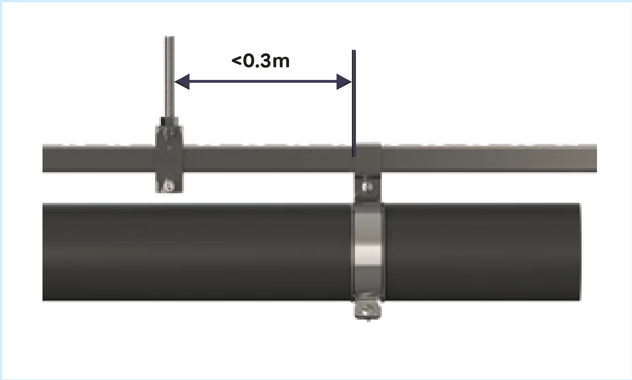


Figure 39: Maximum distance of a fixed point from a suspension element

Positioning of the vertical brackets without expansion sockets

The vertical downpipes can be fixed by the use of Wavin QuickStream rails in a similar way as with the horizontal collector pipes. Most commonly however, the pipework can be installed directly on the wall structure so that for this part of the system the suspension rails can be omitted. A fixed-point brackets needs to be positioned at the top end of the vertical downpipe, as close as possible to the elbows. See table 12 for vertical downpipe bracketing distances (Y).

Furthermore, fixed-points brackets also need to be installed at a maximum spacing of every 10 meters. Be aware of expansion and contractions loads transferred to the wall structure. In table 4 guidance is given for the thickness of the threaded metal pipe for the fixed-points in relation to the distance to the wall and Wavin QuickStream pipe diameter.

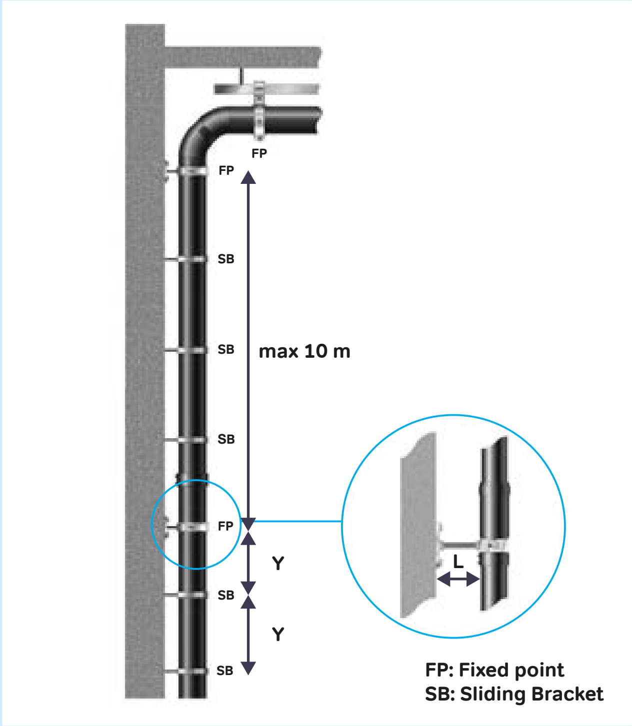


Figure 40: Positioning of vertical brackets

L - LENGTH OF THREADED ROD (MM)	40	50	56	63	75	90	110	125	160	200	250	315
50	½"	½"	½"	½"	½"	½"	½"	½"	1"	1"	1"	1"
100	½"	½"	½"	½"	½"	½"	½"	1"	1"	1"	1"	1"

Table 13: Minimum diameter of the threaded metal rods for fixed-points.

Positioning of the vertical brackets with expansion sockets

Most commonly in the vertical downpipes longer then 6m expansion sockets are used. As there will be always some friction in the sealing system of an expansion joint, it is absolute required to anchor the expansion socket (figure 41). At the top of a vertical downpipe, always a fixed-point bracket should be installed.

All other brackets should be "sliding brackets". Fixed-points can either be created by placing an electrofusion socket underneath the bracket fixing the expansion socket or by use of a stainless steel insert in the bracket.

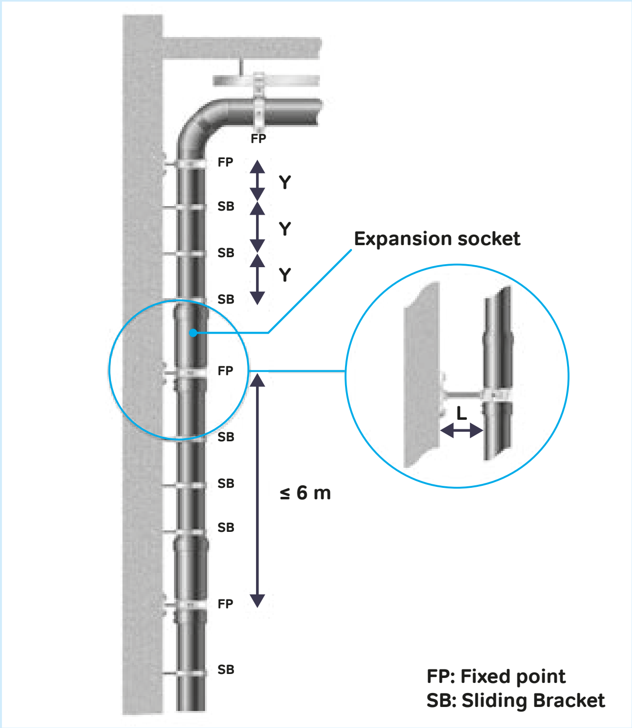


Figure 41: Expansion sockets.

L - LENGTH OF THREADED ROD (MM)	40	50	56	63	75	90	110	125	160	200	250	315
50	½"	½"	½"	½"	½"	½"	½"	½"	½"	1"	1"	1"
100	½"	½"	½"	½"	½"	½"	½"	1"	1"	1"	1"	1"

Table 14: Minimum diameter of the threaded metal rods for fixed-points.

Installation of roof outlet

To prevent the roof outlet being pushed out of the roof due to thermal expansion of the tail pipe, the first bracket should be positioned between 0.5 and 0.8 meters from the outlet. Under no circumstances should sagging be allowed in the horizontal part of the tail pipe. The vertical pipe length directly below the roof outlet is maximum 2 meters. Also in this pipe section, no bracket is allowed. The vertical pipe needs to be installed without tensions. Under no circumstances, bending of this part is allowed.

No horizontal support brackets needed if the horizontal pipe is less than 0.8 meters and no vertical brackets are needed if the vertical pipe is less than 2 meters (figure 42). Install horizontal support brackets if the horizontal distance between roof outlet and collector pipe is between 0.8 and 2.0 meters (figure 43). In the case the horizontal distance is longer then 2.0 meters (figure 44) always requires a steel rail with anchoring and at least two fixed-point brackets. Make sure that the maximum horizontal fixing distance is not exceeded according to table 12.

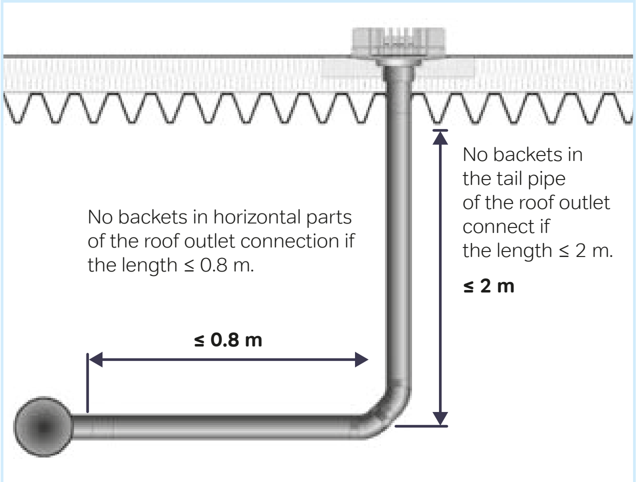


Figure 42: Outlet positioned < 0.8m.

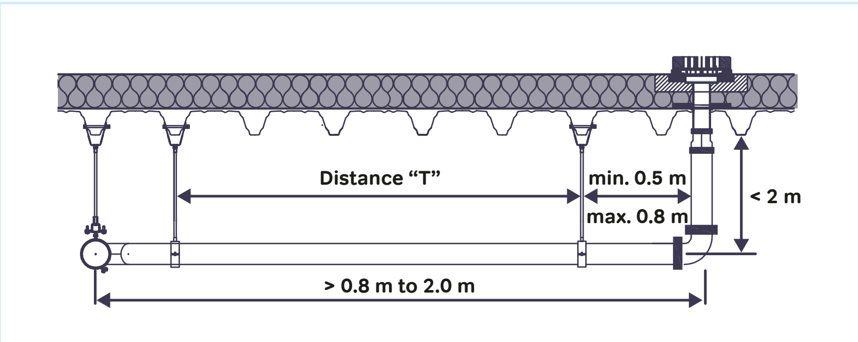


Figure 43: Outlet positioned between 0.8m and 2.0m.

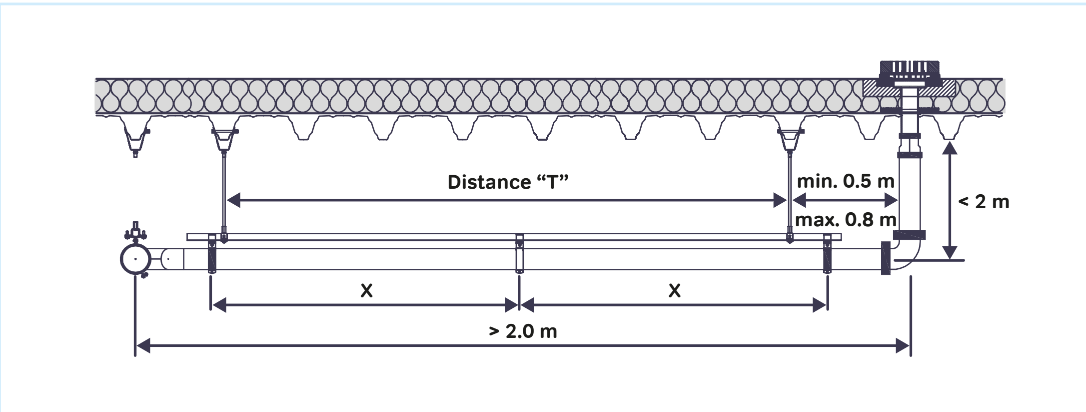


Figure 44: Outlet positioned > 2.0m.

Discharging conditions

Wavin QuickStream: also in charge of rainwater discharge.

Where can you put rainwater? This question is just as important as how to collect rainwater on a roof. Wavin QuickStream has solutions for both these areas of rainwater drainage. Discharge can occur at the downpipe above the building floor, at a horizontal section below the floor, underground or in an external shaft. With QuickStream, it's also possible to discharge rainwater directly into an open body of water.

The maximum discharge volume is specified in the roof drainage system's intended design, and the planner or project engineer must ensure that the receiving system is sufficiently dimensioned. To help with correct project planning, Wavin uses special calculation tools.

In this chapter, we'll discuss discharge and explain the calculation tools and components you can use to determine which type of discharge in the QuickStream system is the best fit.

Discharge conditions

The discharge of the Wavin QuickStream system into a gravity system can be provided at the downpipe above the structure floor level, at a horizontal section below the flooring or underground, or in an outside manhole. Furthermore, a direct disposal into open water is possible. The aim is to realize a break in the siphonic action by increasing the diameter and flow into a ventilated pipe.

Wavin QuickStream systems should always discharge above water level into a ventilated system in order to accommodate the removal of air. To guarantee that the evacuation of air in the pipe work and the attainment of siphonic action are not delayed, the discharge point should be installed at a higher level than the water in the gravity drainage system where the discharge takes place.

Options and requirements for receiving systems

The design provided for each Wavin QuickStream system indicates the maximum discharge flow. The designer or project engineer must ensure that the receiving system into which the rainwater system is discharging has sufficient capacity for all rainfall events. There are plenty of options in which a QuickStream System can discharge, some of them are showing next.

Level zero discharge
This type of discharge consists out of an increase of the diameter in the vertical downpipe at a floor level, to a ventilated horizontal pipe to ensure the siphonic break and a reduction in the discharge velocity.

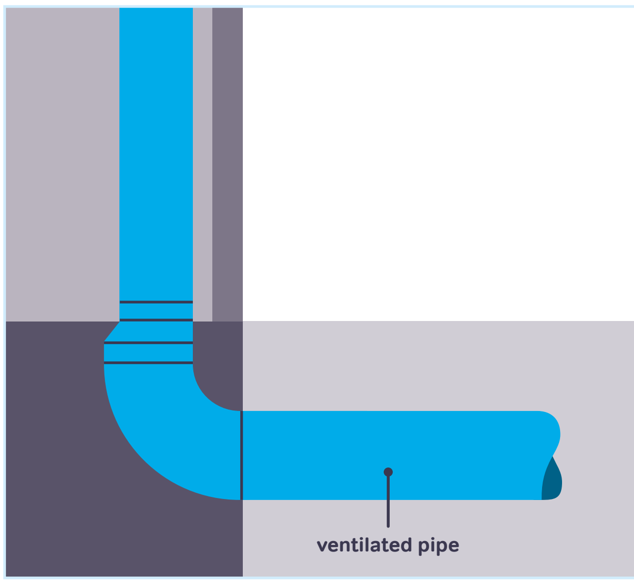


Figure 45: Discharge Level Zero

Discharge conditions

Level zero discharge with an access fitting
Approximately one meter above floor level the diameter is increased to reduce the flow velocity. At that point in the vertical downpipe an Access Fitting is located (see Figure below).

Meanwhile, at floor level a second increaser is located to connect the system to a ventilated pipe. The break of the siphonic action is at the increaser above the access fitting. This type of discharge is standard in some countries (e. g. Germany) so Wavin recommends reviewing the local regulations to ensure that it's applicable to use this type of discharge.

The system includes the possibility for an access fitting. With this fitting, there is the possibility to inspect the system.

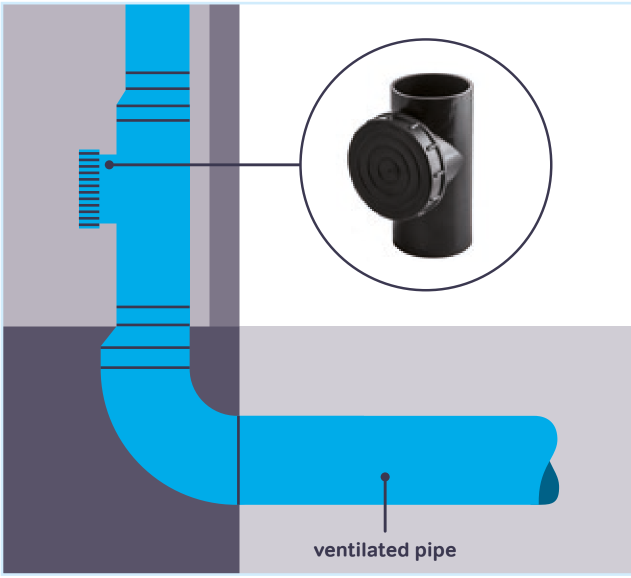


Figure 46: Discharge Access Fitting

Manhole or chamber discharge
It is probably the most common discharge in the QuickStream system, when the siphonic break takes place outside the building in a separate structure. The advantage of the smaller (or same) diameter is also used to transport the water over a long distance outside the building or the rainwater network near it.

There are some safety recommendations for this type of discharge. The first one, is to make no mistakes in connection of the wrong (same as siphonic system) diameter pipe by the civil contractor if the manhole with a bigger gravity connection has been supplied and installed. The second is to use a manhole with a grating to allow water to flow out of the system via the grating when the sewer or storm water system is filled.

If an emergency overflow relief chamber is used, the invert level of the discharge pipe should be at least 100 mm above the crown of the outlet pipe. The chamber should have sufficient volume and the cover must have ventilation holes as large quantities of air need to be released during priming of the system (see Figure 48).

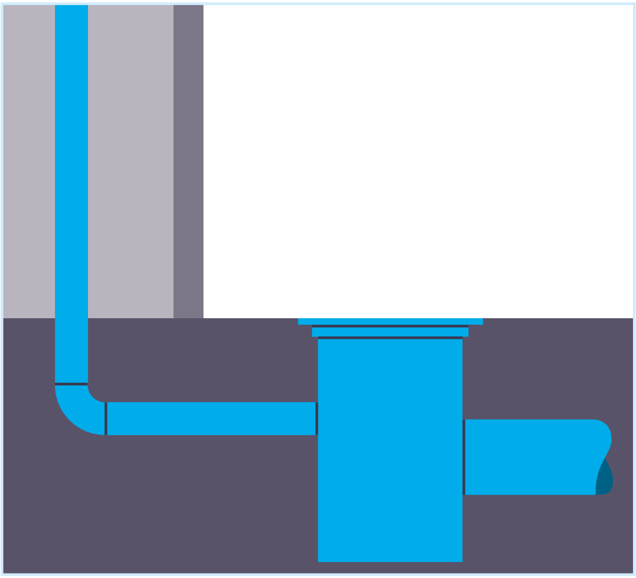


Figure 47: Manhole

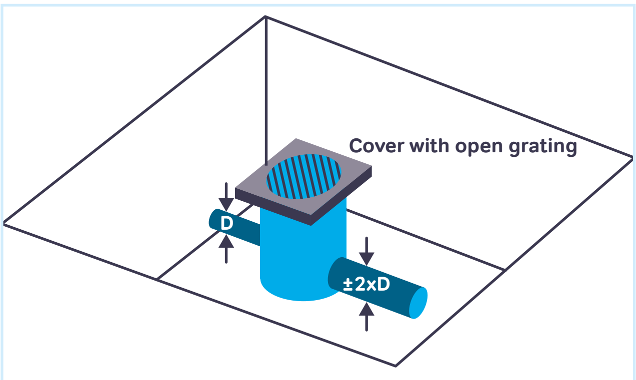


Figure 48: Manhole with an open grating cover

A manhole, acting as release chamber will also enable visual inspection during full operation.

Wavin has a comprehensive portfolio of plastic chambers called Tegra.

Discharge conditions

As guidance the table below presents the maximum flow in [l/s] of 100% filled pipes dependent on gradient. For a ventilated drainage system, a larger pipe diameter should be selected.

		Hydraulic gradient / slope				
	[mm/m]	**1**	**2.5**	**5**	**7.5**	**10**
	slope	**1:1000**	**1:400**	**1:200**	**1:133**	**1:100**
D_u	**D_i**					
	100	1.9	3.1	4.4	5.4	6.3
110		2.1	3.4	4.8	6.0	6.9
125		2.9	4.8	6.8	8.4	9.7
	150	5.5	9.1	13.0	16.1	18.6
160		5.8	9.3	13.2	16.2	18.7
200		10.6	16.8	23.9	29.4	34.0
	200	12.4	19.8	28.1	34.5	39.7
250		19.2	30.4	43.2	53.1	61.4
	250	22.6	35.7	50.7	62.3	72.0
315		35.5	56.1	79.6	97.7	113.0
	300	36.6	57.9	82.1	100.0	116.0
400		66.9	105.0	149.0	183.0	212.0
	400	78.5	123.0	175.0	215.0	248.0
450		91.3	144.0	203.0	250.0	289.0
	450	107.0	168.0	239.0	293.0	338.0
500		120.0	190.0	269.0	329.0	381.0
	500	141.0	222.0	315.0	386.0	446.0
630		221.0	348.0	493.0	605.0	699.0
	600	228.0	360.0	509.0	624.0	721.0
	800	487.0	765.0	1,082.0	1,326.0	1,532.0

Note: Above table is based on a friction factor kb = 0.40 suitable for plastic pipes and a water temperature of 10°C. The Du reflects a PVC SDR34 pipe class. Other pipe materials like e.g. concrete might have a higher friction factor and consequently above table cannot be used.

Wavin has a complete offer in plastic manholes, being the first to industrially produce plastic chambers and manholes

Plastic manholes have significant benefits over concrete:

- It has watertight and reliable connections, therefor 75% fewer leaks;
- It offers perfect hydraulics (smooth) leading to less cleaning and fewer blockages;
- It is corrosion resistant to sewer gases, therefore long lasting;
- It is light weight and therefore easy to install, plastic pipes are 30% faster to install;
- And materials are recyclable at end of life.

Figure 49: Wavin Tegra Manholes series

Discharge conditions

Discharge in a sewer (or storm water) pipe
This type of discharge is very similar to the manhole or chamber discharge explained above, when the siphonic break takes place outside the building. Also, this type of discharge has the same advantage to transport the water over a long distance outside if its required.

There is one difference at the final part of the outflow, where there is an increase of the diameter before the sewer pipe to reduce the velocity to avoid water flow into other inlets in the sewer pipe. In this type of discharges, it is also recommended to install an emergency relief chamber with open grating.

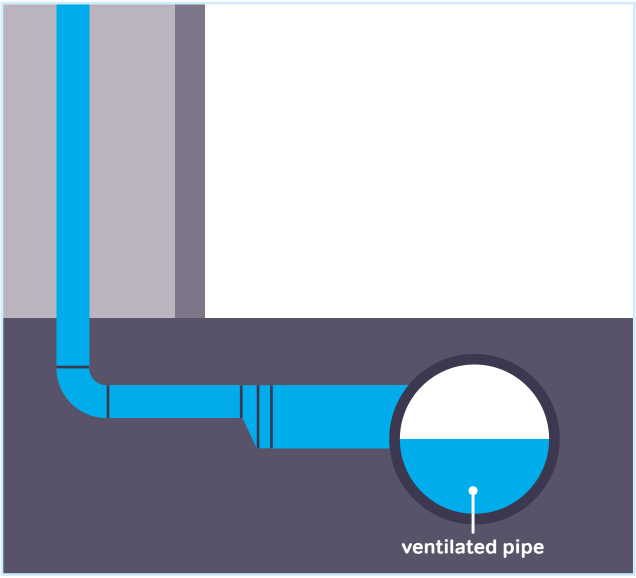


Figure 50: Discharge Sewer Pipe

Open water discharge
The open water has the same characteristics of a sewer pipe discharge. It is necessary to verify the implementation of an increase of the diameter before the outflow to reduce the velocity in order to avoid erosion of sand/vegetation or damages in concrete channels.

The discharge should be located above the maximum water level or an air release possibility should be installed.

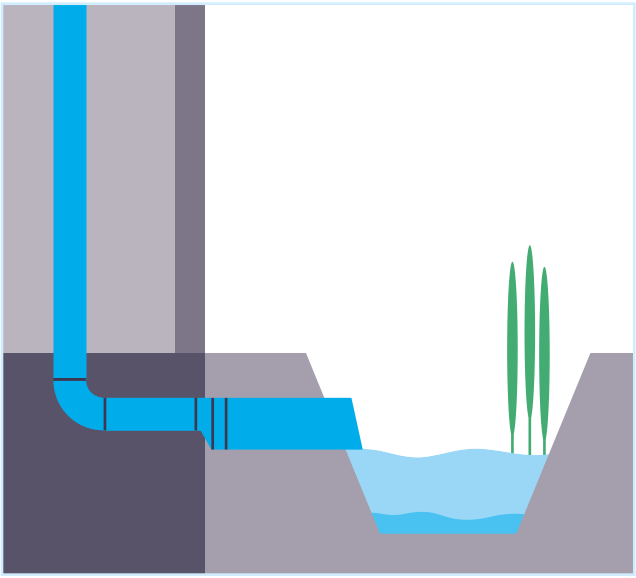


Figure 51: Discharge Open Water

Maximum velocities at the discharge point
The next table shows the maximum velocities recommended for all the types of discharges described. Again, Wavin suggest checking the local regulation to see if the values presented are applicable.

	Maximum velocity
Level Zero	no maximum
Access fitting	2.5 m/s at the location of the Access fitting
Manhole	5 m/s
Sewer Pipe	1.5 m/s
Open Water	2.5 m/s

Note: For the level zero discharge, theoretically there is no limit for the velocity. However, it is important to review the location of the outflow to prevent any kind of damages and inconveniences.

Most rainy days per year

335 days

a year it rains on Mount Wai‘ale‘ale on the island of Kauai, Hawaii.

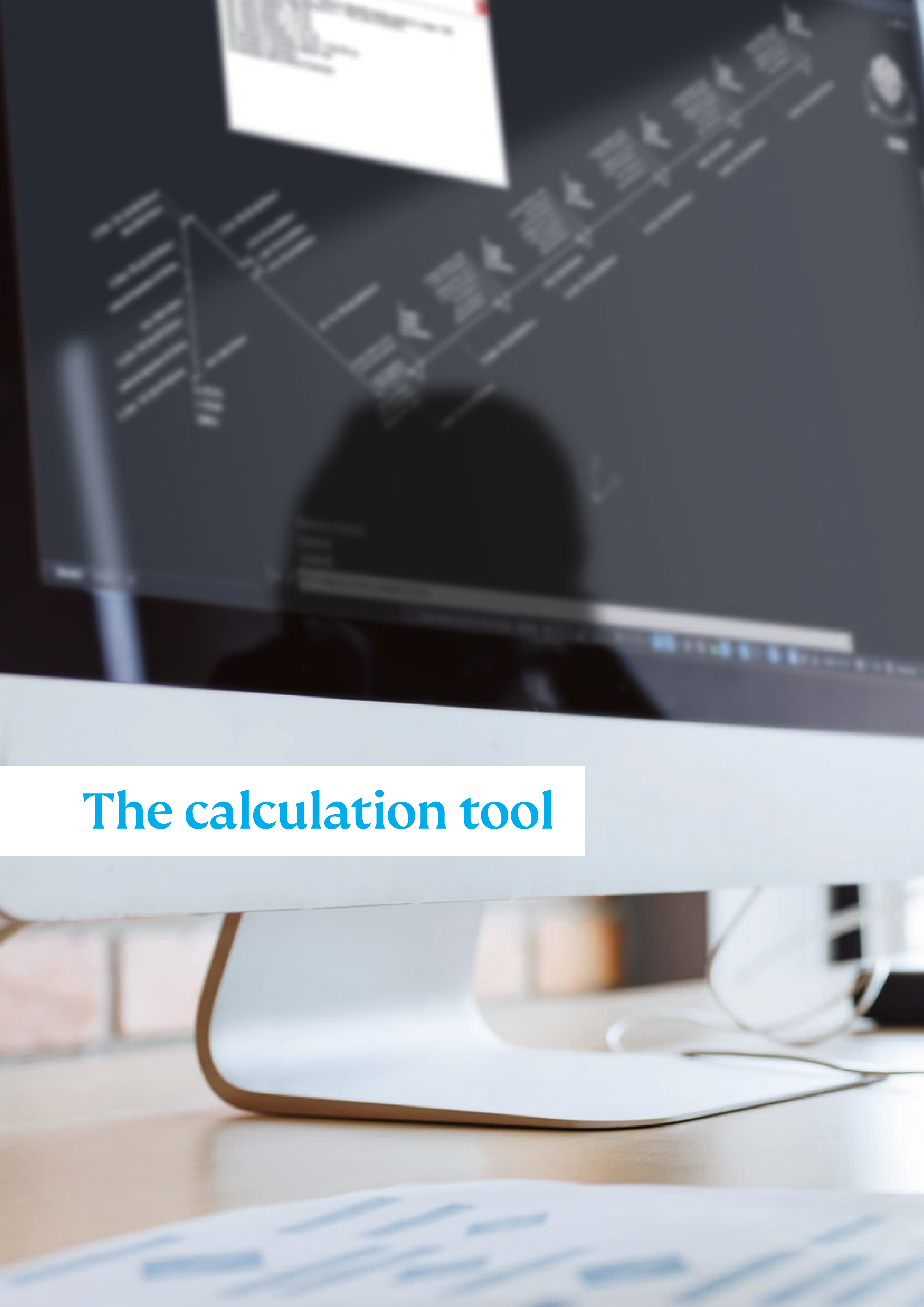
QuickStream would be in permanent use here.
The north-east trade winds batter the steep cliffs of the 1,569 metre high mountain all year round.

Discharge conditions

Underground pipe work
Wavin QuickStream can be installed under basement floors. If embedded in soil or concrete, no tensile resistant joints are required, as there is already sufficient fixing of the pipe. Special attention should be paid to the pipe construction crossing the basement wall.

Soil settlements along the outside wall might induce high local stresses and deformations. Either a flexible construction can be applied (for example a mechanic joint flexible pipe like PVC-O) or a more rigid pipe (e.g., PE SDR17 or SDR26) in combination with stable backfill against the wall.

Figure 52: PVC pipe installation



The calculation tool

The formula for success in planning and installation.

Calculating a roof drainage system in all dimensions is complex and error-prone. To help planners and installers, Wavin has developed its own calculation tool. The software calculates all the details of the installation and checks whether the previous planning was created correctly. A conversion tool can integrate the final design of the Wavin QuickStream system into a BIM model.

Safety tested
The software checks all requirements for the drainage system. A planning layout is only created if all requirements are met without errors.

AutoCAD compatibility
The software is AutoCAD-compatible, making it easy to integrate the QuickStream system into AutoCAD drawings of the building.

Installation aid
The software supports the simple and error-free installation of the roof drainage system by providing 3D views of the system layout.

BIM integration
Next to the above mentioned, the QuickStream design can be integrated in a BIM model via a conversion tool.

This chapter will expand on the capabilities of the Wavin calculation tool.

Hydraulic design principles

Application of bernoulli equation

Flow conditions within a siphonic roof drainage system can be calculated using the fundamental Bernoulli equation which relates changes between the potential, pressure and kinetic energies of the fluid and takes account of energy losses due to frictional resistance and turbulence in the pipes and fittings.

Most but not all proprietary siphonic systems are sized on the assumption that all the pipes in a system are flowing 100% full of water at the design flow rate, which is determined from the specified design rainfall intensity for the building and the catchment area drained by the system. This assumption implies that the system will be able to self-prime, i.e. the flow entering the system will be able to remove all the air that is initially within the pipes at the start of a design storm event. (See the Glossary at the beginning of this report for definitions of terms relating to siphonic roof drainage systems).

Applying the Bernoulli equation to the flow of a fluid of constant density under steady- state conditions between two points in a siphonic system gives:

$$\left(p_1 + \frac{1}{2}\rho V_1^2\right) - \left(p_2 + \frac{1}{2}\rho V_2^2\right) = \Delta E_{12} - \rho g \Delta z_{12}$$

where:

p = static pressure at a point in the fluid (in N/m²)
ρ = density of fluid (in kg/m³)
V = velocity of fluid at point (in m/s)
ΔE_{12} = loss of specific energy of fluid between points 1 and 2 (in J/kg)
g = acceleration due to gravity (=9.81 m/s²)
Δz_{12} = vertical height of point 1 above point 2 (in m)

Static pressure is the ambient pressure within the flow, which in the case of a straight section of pipe might be measured by means of a pressure tapping installed flush with the wall.

Equation (2.1) can be expressed in terms of pressure head as follows:

$$\left(h_1 + \frac{V_1^2}{2g}\right) - \left(h_2 + \frac{V_2^2}{2g}\right) = \Delta h_{12} - \Delta z_{12}$$

where:

h = static pressure head at a point in the fluid (in m)
Δh_{12} = loss of energy head between points 1 and 2 (in m)

Equation (2.2) is the basis of most current computer design packages for siphonic roof drainage systems. Application to each section of pipe or fitting in turn enables the variation in static pressure head along a system to be determined.

Assuming that a siphonic system is flowing at its maximum capacity without any water surcharging the roof outlets, application of Equation (2.2) between an individual outlet and the downstream point of discharge from the siphonic system gives:

$$H_T = \Delta Z + h_1 + h_E - \frac{V_E^2}{2g}$$

where:

H_T = total head lasses in pipes and fittings along flow path between inlet to siphonic system and the downstream end point of the system (in m)
ΔZ = difference in vertical Level between the inlet and end point of system (in m)
h_1 = pressure head at inlet to system (in m)
h_E = pressure head at end point of system (in m)
V_E = velocity of flow discharging from end point of system (in m/s)

The depth of water above a siphonic outlet in a gutter or flat roof is normally very small compared with the height of the building and can be neglected when applying the Bernoulli equation to determine flow conditions within a system. On this basis, hl can effectively be assumed to be equal to the value of atmospheric pressure head; if for convenience, the pressure heads in the system are calculated using atmospheric pressure as the datum, the value of hl can then be put equal to zero.

The pressure head acting at the downstream end of a siphonic system may not necessarily be equal to atmospheric pressure. Site drainage systems are usually sized to cater for storms of lower rainfall intensity than roof drainage systems. Surcharging of a site system during a high intensity storm may therefore exert a positive pressure head at the end point of the siphonic system and reduce its capacity below that achievable if it were able to discharge freely. If the first access chamber or manhole into which a siphonic system discharges is fitted with a suitable ventilated cover, it can be assumed that the surcharge head will not exceed the difference in level between the cover of the chamber and the center of the pipe cross-section at the point where the flow discharges into the chamber. For these reasons, it is convenient to define the head difference acting on a siphonic system as the available head, HA (in m), given by:

$$H_A = \Delta Z - (h_E - h_0)$$

where h0 (in m) is the value of atmospheric pressure head and (hE – h0) is the amount of surcharge head. If it is certain that the site drainage system cannot surcharge the end point of the siphonic system, or if a satisfactorily ventilated siphon break is installed at that point, the surcharge head can be assumed to be zero.

It is important to note that the Bernoulli equation as expressed in Equations (2.1) and (2.2) gives only an averaged description of flow conditions within a siphonic system. It does not provide any information about the magnitude of turbulent pressure fluctuations within the flow. Also, it does not take account of the effects of flow curvature on values of local pressure within pipe fittings. The centripetal acceleration experienced by flow within a bend produces a pressure gradient across the flow, with the pressure being lower on the inside of the bend than on the outside. The pressure calculated from the Bernoulli equation is likely to be a reasonable estimate of the mean pressure along the centreline of the bend but higher and lower pressures will occur at other points in the

flow. Similarly, flow separation at irregularities such as pipe joints or in expansion sections (i.e. pipe increasers) will produce fast rotating eddies within which the pressure can be much lower than in the surrounding flow.

Another reason why values of pressure calculated using the Bernoulli equation may not be completely reliable is that it is normal practice to assume that pipe fittings (such as bends, junctions, reducers, increasers) produce point losses of head, while the losses due to friction at the pipe walls are considered to be distributed uniformly along the length of the pipes. Even though the total head loss within a system may still be assessed satisfactorily, the local pressure values and the location of the points where the losses occur may not correspond precisely with predictions. This is particularly the case where the distance between fittings is small since the local flow conditions can then become very complex (see for example Miller, 1990).

Estimation of head losses

Frictional head losses in pipes can be calculated using any formula that is suitable for the type of pipe being considered. The Colebrook-White equation (HR Wallingford and Barr, 1998) is particularly suitable because it has been validated for a wide range of flow conditions and pipe materials, and BS EN 12056-3 (BSI, 2000) states that it shall be used if there is a dispute concerning appropriate values of head loss for design.

The Colebrook-White equation for frictional losses in pipes flowing 100% full of water can be written in the form:

$$i_F = \left(\frac{V^2}{8gd_P}\right)\left\{\log_{10}\left[\frac{k_p}{3710d_P} + \frac{1.775v}{\sqrt{(g\,i_F\,d^3_P)}}\right]\right\}^{-2}$$

where:

i_F = frictional head loss gradient (m loss of head per m length of pipe)
V = velocity of tlow (in m/s)
g = acceleration due to gravity (= 9.81 m/s^2)
d_P = internal diameter ofpipe (in m)
k_P = roughness value ofpipe (in mm)
v = kinematic viscosity of water (= 1.14x10^{-6} m^2/s at 15° C)

The value of the roughness parameter, kP, depends on the surface texture of the pipe walls, the effects of any irregularities or beads at joints, and the distance between successive joints relative to the pipe diameter. When they are new, plastic pipes such as polyethylene are intrinsically very smooth and can be expected to have values of the order of kP = 0.006 mm to 0.06 mm (see HR Wallingford and Barr, 1998). However, over the design life of a building (typically 20 years or longer), the pipes in a system are likely to become hydraulically rougher due to ageing of the pipe material, roughening of the walls due to grit or silt carried by the flow, and deposition of fine sediment or organic material washed into the system and accumulating in the horizontal pipes during periods of low flow. For these reasons, use of a minimum roughness value of kP = 0.15 mm is suggested when determining the design flow capacity of a siphonic system.

[In a parallel context, it may be noted that UK surface water sewers intended for adoption by sewerage undertakers must be designed for a roughness value of kP = 0.6 mm (see Sewers for Adoption, Water UK / WRc, 2001). This value applies irrespective of the pipe material used and is significantly higher than the pipes would have when new. A somewhat lower design value of kP is appropriate for siphonic systems because the size and quantity of sediment entering them is likely to be less than in sewers, even though the latter are laid at gradients that are intended to avoid sediment deposition].

When a siphonic system is flowing 100% full of water, the local head loss, Δh_L (in m), at a pipe fitting can be determined from the formula:

$$\Delta h_L = \varsigma \frac{V^2}{2g}$$

where ς is a non-dimensional head loss coefficient. Values of this coefficient for bends, junctions, reducers and increasers are given in standard references such as Idelchik (1986) and Miller (1990) and can also be established from suitable tests.

Since proprietary designs of siphonic outlet differ in geometry, the draft Standard recommends that the appropriate value of ς for each design should be determined using a test procedure given in Annex B of the draft. This procedure differs from the one currently described in UK National Annex NF of BS EN 12056-3 and has been checked experimentally for its suitability. Since existing Annex NF is only advisory, the UK will be able to withdraw it on publication of a separate British Standard on siphonic systems.

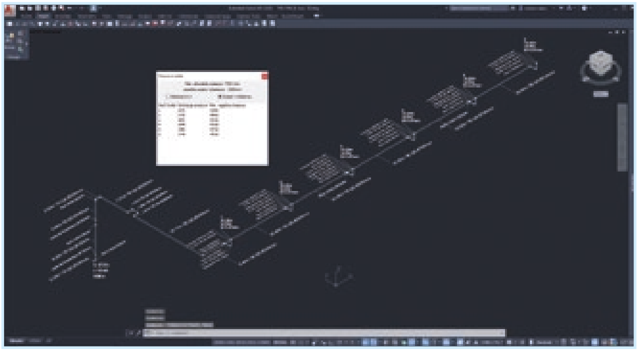


Figure 53: Example of QuickStream software calculations

Calculation procedure

The usual procedure for designing a siphonic system is as follows:

1. Determine a suitable layout for the pipework and select/estimate likely pipe sizes
2. Based on the design rainfall conditions and roof catchment areas, calculate the required flow rate through each component of the system
3. Calculate the head losses in the various components of the system
4. Find the total head loss along each flow path through the system, i.e. from a siphonic outlet at roof level to the downstream point of discharge from the system
5. Check that the total head loss for each flow path does not exceed the available head and is also close enough to this value to allow balanced operation of the system. Also, check that allowable limits on minimum velocity and pressure within the system are not exceeded
6. If these design criteria are not met, revise the layout and/or sizes of the pipes and repeat the above procedure.

When applying the Bernoulli equation to calculate the flow conditions within the system, it is recommended to start the calculations at the downstream end and work in the upstream direction to the siphonic outlets at roof level. The reason for doing this is to avoid the possibility of obtaining an unsafe estimate of the minimum pressure in the system. Most systems are designed so that the total head loss along each flow path is somewhat less than the available head (partly because standard pipe sizes make it impossible to obtain an exact match). The unused portion of the available head is termed the residual head for that flow path. If the calculations were to start from the outlet and work in the downstream direction, the pressure head predicted at the point of discharge would exceed the true value by the amount of the residual head. This causes all the calculated values of pressure within the system to appear higher than they actually are. The recommended procedure of calculating from the downstream end will cause the pressure values to be underestimated (i.e. made more negative), but this errs on the safe side when checking that the limit on minimum pressure is satisfied.

Another point that should be noted when applying the Bernoulli equation concerns the way in which the kinetic energy of the flow (i.e. the velocity head, V2/2g) is taken into account. Although some of the available head is used to accelerate flow as it enters and travels through a siphonic system, the kinetic energy only becomes a loss if and when it is dissipated in turbulence downstream of the exit point from the system. An exit loss coefficient should not therefore be included in the analysis when determining flow conditions within a siphonic system. Thus, applying Equation (2.2) to the most downstream section of the system (with point 2 being the point of discharge), gives:

$$\left(h_1 + \frac{V_1^2}{2g}\right) - \left(H_E + \frac{V_E^2}{2g}\right) = \Delta h_{12} - \Delta z_{12}$$

where hE is the pressure head acting at the end point of the system, and V 2 / 2g allows for the kinetic energy of the flow prior to any losses farther downstream.

Performance of systems with air/ water flow mixtures

In order to fulfil its function, a siphonic system needs to be able to perform satisfactorily at all rates of flow up to its maximum design capacity. This requires that the system should not cause the depth of flow in a gutter or on a roof to be greater at an intermediate flow rate than at its design capacity.

At low flow rates, a siphonic system will behave in the same way as a conventional one, with the pipes flowing only partly full of water and at atmospheric pressure. At higher rates of flow, some of the pipes in the system will transition to flowing full bore while others will still be flowing partly full, with local or continuous air pockets remaining in some pipe lengths. During this transitional condition, pressures within parts of the system may start to become sub-atmospheric. A further increase in flow rate will cause the whole system to flow effectively full bore but with some air still being drawn in through the siphonic outlets and transported along the system in the form of bubbles. At this point, the system can be said to have primed, with a continuous column of bubbly liquid connecting the outlets to the downstream discharge point at or below ground level. The system is then acting siphonically with the ability to generate significant sub- atmospheric pressures within the pipes. Further increases in flow rate entering the system cause a corresponding reduction in the amount of air transported through the system until at a certain point the pipes are flowing 100% full of water. The system cannot accept any more flow without causing significant surcharging above the outlets. As an indication, if a system is flowing 100% full of water with an available head of 10 m, an increase of 1% in the flow rate would ultimately cause water to surcharge above the outlets to a depth of about 200 mm (assuming that the flow rate is maintained constant for a long enough period and overtopping of the gutter or roof does not occur first).

Laboratory testing of siphonic systems indicates that some layouts are able to operate with a partial air/water mixture in an approximately steady condition of full-bore flow. Other layouts behave in a cyclical manner with the system first priming and flowing nearly 100% full of water; if the flow rate drawn by the outlets then exceeds the rate of supply, the water depth in the gutter or roof will decrease and allow more air to be sucked in through the outlets. This partially de-primes the system, causing a loss of flow capacity and a consequent increase in water depth in the gutter or roof. Beyond a certain point the increased depth cuts off the intake of air and allows the siphonic system to prime again. The reasons why different systems can behave in different ways are not yet properly understood but may be linked to the detailed layout of the pipework and the internal geometry of the siphonic outlets. There is an interesting analogy with siphon spillways used in dams and river control structures, where “blackwater” siphons can exhibit a cyclical behavior while “whitewater” or air-regulated siphons can operate in a more stable way with varying proportions of air and water (see, for example, Webber, 1965, and Novak et al, 2001).

Some siphonic systems are sized on the basis of allowing a mixture of air and water to occur at the design rate of flow. This is a feasible option because siphonic systems have to be able to operate satisfactorily in this condition since the great majority of storm events experienced by an installed system will produce flow rates below the maximum design capacity. However, sizing a siphonic system so that it operates full bore at its design flow rate with an air/water mixture is more complex than designing it assuming the system is 100% full of water. It is possible to apply the Bernoulli equation in Equation (2.1) if the air/water mixture is effectively homogeneous so that it can be considered to behave as a single fluid with a density less than that of water. However, the following factors need to be satisfactorily taken into account in the design process:

- Effect of air on the flow resistance of pipes and fittings. On the one hand, the presence of air may reduce the effective viscosity of the fluid, but on the other hand the air will reduce the flow area of the water and thus increase the velocity of the water in contact with the walls of the pipe.
- Effect of changes in pressure on the volumes of air bubbles in the pipes. If, for example, the volumetric flow rate of air entering a system at atmospheric pressure is equal to 10% of the water flow rate, and the absolute pressure at a point within the system reduces to 30% of atmospheric pressure, the air bubbles will become larger and cause the volumetric flow rate of air to increase to about 27% of the water flow rate (assuming rapid adiabatic expansion of the air without transfer of heat).
- Ability of different outlets in a system to draw different amounts of air. This will give rise to a variation of density of the bubbly liquid along the length of the system, with changes in pressure producing additional variations in its average density.

Generalized design procedures for sizing the pipework in such systems should be based on physical principles governing the behavior of air/water mixtures and should be checked against data from experimental tests to ensure that the various assumptions are valid.

Installation and maintenance

Clear rules and practical steps for a successful installation.

After successfully planning, calculating and checking the desired roof drainage, the installation of the Wavin QuickStream system should now be successful. All system components and the fastening elements are designed to be installed as easily and error-free as possible.

Nevertheless, certain guidance should be observed to ensure that everything works flawlessly. This guidance includes installing the system according to Wavin's planning, fixing the roof drains and the pipe system according to Wavin's instructions, avoiding slopes in horizontal pipes and avoiding blockages in the pipe system.

The following pages contain all the rules and a detailed description of the individual installation steps. You'll also find valuable information on maintaining the QuickStream system at specific intervals.

We wish you every success with your installation and a smooth working experience with the QuickStream components.

General installation principles

Basic Rules

To ensure proper functioning of the Wavin QuickStream siphonic roof drainage system, some general requirements related to the design and installation of the system must be met. Therefore, please note the following important rules:

1. Installation to Wavin system design
2. Install roof outlets and pipe system according to Wavin´s instructions
3. No slope in horizontal pipes
4. No siphons in the system
5. No obstructions in the pipe system
6. Only use 45° Bends and 45° branch unless specified differently
7. Only use Eccentric Reducers / Increasers (no centric allowed)
8. Only install expansion joints where provided in the design
9. Do not connect gravity pipelines to the Wavin QuickStream system
10. Use prescribed pipe materials and pipe classes

Installation to Wavin System Design

For each Wavin QuickStream system, Wavin will make a site-specific hydraulic design. Deviations from design might impair design criteria and discharge capacities.
Wavin uses dedicated software to design Wavin QuickStream systems. This means that the installation should be made exactly according to the drawings supplied by Wavin. Every deviation from design in the installation might lead to an imbalance of the system, resulting in incorrect functioning of the system. All deviations from the supplied drawings should therefore be discussed in advance with Wavin's design department. Wavin will always send a written reply to such a request

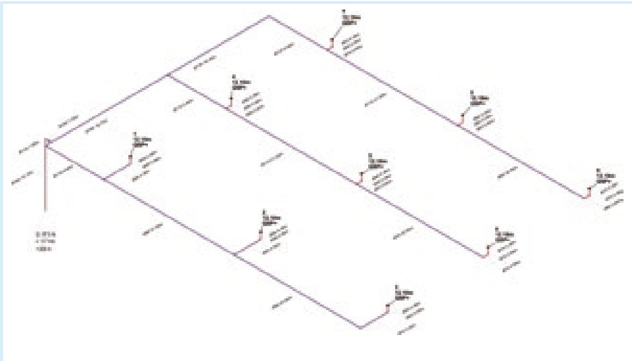


Figure 54: Hydraulic drawing

Install Roof Outlets and Pipe System According to Wavin's Instructions

One of the key elements in a Wavin QuickStream system is the roof outlet. Improper or incomplete installation might cause condensation and/or leakages. In most Wavin QuickStream systems, long horizontal pipes will be installed below the roof.

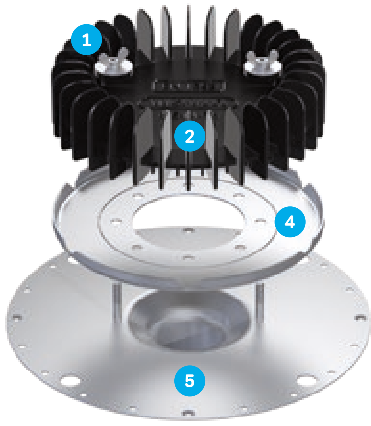
For this part of the installation please follow Wavin's installation recommendations mentioned in section 3. Wavin has developed special brackets for an easy and secure installation of the horizontal collector pipes.

Installation of roof outlets in metal or plastic gutters

Roof outlet components:

1. Two wing nuts with gasket
2. Top piece
3. 8 bolts with gasket for flange
4. Bottom of the outlet
5. Rubber seal top
6. Gutter; not included
7. Rubber seal bottom
8. Flange

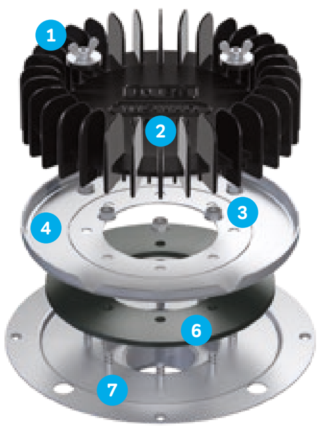
Installation of roof outlets in concrete roofs with bituminous waterproofing



Roof outlet components:

1. Two wing nuts with gasket
2. Top piece
3. Bituminous film under the roof; not included
4. Optional: emergency spillway ring
5. Bottom of the outlet

Installation of roof outlets in concrete roofs with waterproofing film with gravel guard



Roof outlet components:

1. Two wing nuts with gasket
2. Top piece
3. 8 bolts with gasket for flange
4. Flange with gravel guard
5. Film under roof; not included
6. Rubber gasket
7. Bottom of the outlet

No Slope in Horizontal Pipes

In horizontal pipes, no slope is required to transport the water to the downpipe since the system operates at high velocities due to the energy head, which is equal to the height of the building. A small slope is neither beneficial nor disadvantageous for the operation of the system. For ease of installation, we recommend to use no slope in the horizontal pipes. If a slope in the horizontal pipe is desirable to improve emptying of the system after a rainfall, Wavin advises to keep the slope below 1:200

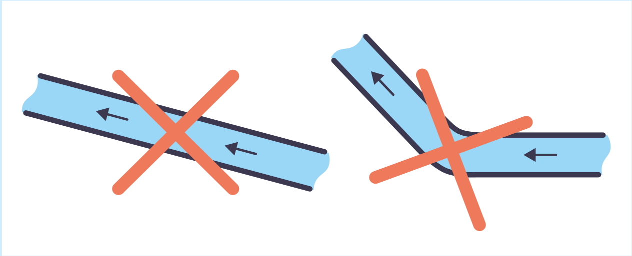


Figure 55: Example of an incorrect installation

No Siphons in The System

A negative slope or an upward placed bend into the flow direction will create a siphon. In siphonic systems this is not allowed since during the start-up of the system air might be entrapped, preventing a full-bore flow.

No Obstructions in The Pipe System

All pipe ends should be checked and freed from burrs. Burrs, dirt and other obstructions might influence the proper functioning of the system. Preferably, electro-fusion couplers should be applied. However, butt welds are also allowed in the Wavin QuickStream polyethylene pipe system.

Figure 56: Before installation, pipes must be checked for damage and contamination

Only Use 45° Bends and 45° Tees

90° bends cause more flow resistance than two 45° bends. So, the system uses two 45° bends instead of one 90° bend. The only exception is the first bend after the roof outlet, which can be a 90° bend (see page 10). For the rest of the installation, 90° bends are not allowed unless specified by Wavin. Similarly, only 45° branches are allowed instead of 90° branches unless specified by Wavin.

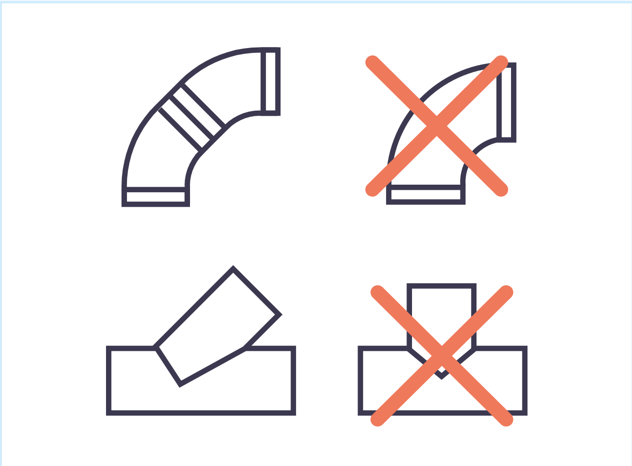


Figure 57: Execution examples

Use Only Eccentric Reducers/ Increasers

Diameter changes in horizontal collecting pipes must be made with eccentric reducers. In order to accelerate the evacuation of air, the topside of the collector must remain on the same level when a reducer / increaser is installed in the flow direction.

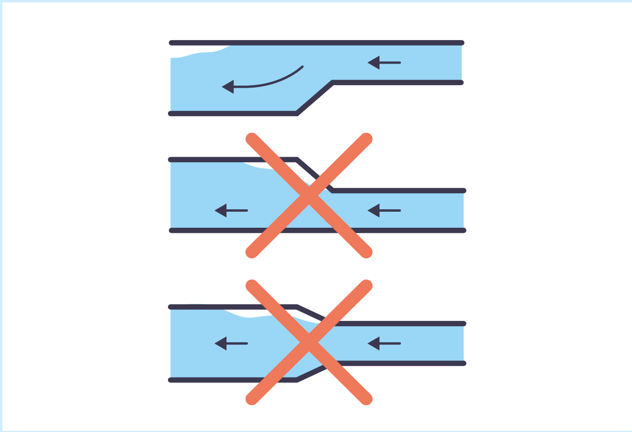


Figure 58: Example of correct installation of eccentric reducer

Pipe diameter must never reduce in the flow direction in horizontal pipes.

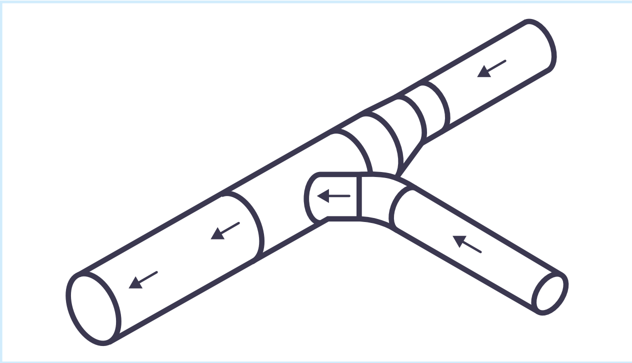


Figure 59: Example of correct installation

Installation of eccentric reducers in vertical pipes should be positioned with the level side facing the wall. This allows for ease of installation, particularly when fixing rails and clamps are used. Furthermore, it is more effective during priming of the system.

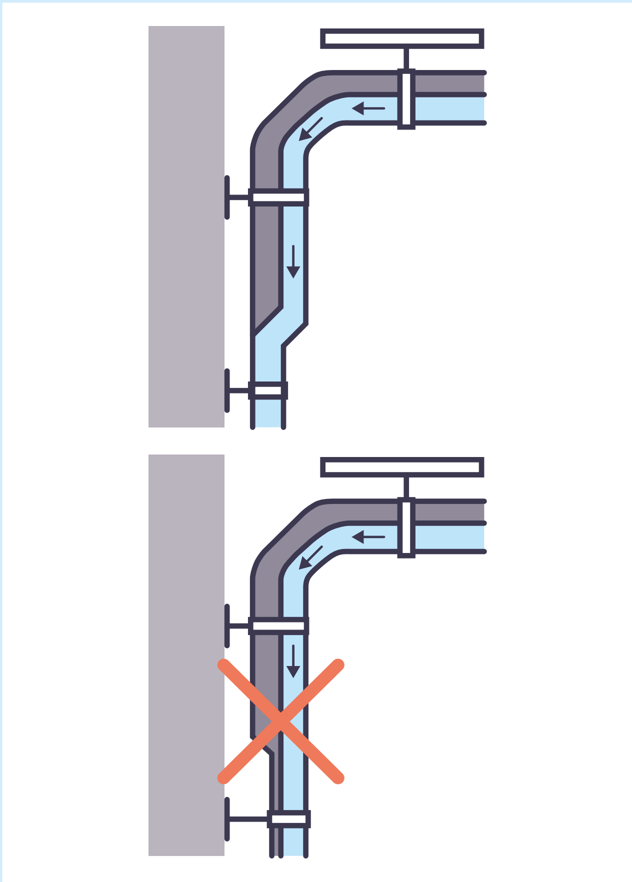


Figure 60: Example of correct installation in the downpipe with reducer

Largest amount of rain within one day

1.870 l/m²

fell on the island of La Réunion in one day in 1952.

A hard day‘s work for QuickStream.
In Europe, 60 to 80 litres of rain per day and square metre is already considered a once-in-a-century event. But these heavy rainfall days will increase.

Only Install Expansion Joints Where Provided in The Design

Once installed, the Wavin QuickStream system is subjected to temperature changes and dynamic loads. Any oscillation or vibration, originating from partly filled pipes, must be effectively damped. Wherever possible it is strongly recommended to make all joints tensile resistant. In some countries, it is common practice to provide each 6-meter pipe-length in the vertical downpipe with an expansion joint, while in other countries no expansion joints are used and fixing clamps are directly installed to the wall. It is not good practice to install an expansion joint in horizontal collector pipes. In those cases where expansion joints are applied, appropriate fixing is required.
In general, Wavin does not advise the practice of absorbing axial displacements by expansion loops or flexible legs in a Wavin QuickStream PE system, unless provided in the design proposal.

Do Not Connect Gravity Pipelines to The Wavin QuickStream System

Any open (gravity) connection to a Wavin QuickStream system will allow the intake of air and thus can severely impair the siphonic function. Therefore, such connections cannot be allowed in the design. Also, attention should be paid on not allowing extensions at a later date. Extensions to the building will require its own dedicated rainwater discharge system.

Use Prescribed Pipe Materials and Pipe Classes

As Wavin QuickStream siphonic systems are subjected to both positive and negative pressures, as well as axial loadings, only Wavin's recommended and quoted pipework materials, fixing materials and ancillaries should be used. In case of deviations, advice must be sought from Wavin's technical team.

General Installation Recommendations

Until the Wavin QuickStream system is required to deal with any water discharges, it is recommended to close the roof outlets on the roof. Otherwise, contamination of various kinds could penetrate into the pipe system.

It is strictly prohibited to sweep dirt from the roof into the roof outlets. Particular caution must be applied to remove all the cement waste. Once mixed with water cement could set permanently in the pipework, thereby severely reducing the discharge capacity.

If it is suspected that the system has become contaminated during the building process, it is strongly recommended to clean the system before completion.

If it is required to discharge water from the roof during installation, the roof should be free from dirt. The already installed horizontal collector pipes can be extended using temporary pipes to outside the building. The pipes outside the building should be extended to a minimum height between the roof and the outflow as shown in Figure below.

Sequence of Installation

In most cases the horizontal collector pipe will be installed underneath the roof. In this situation the following sequence is advised:

1. Installation of the emergency overflow systems to prevent potential problems of water on the roof and inside the building.
2. Installation of the Wavin QuickStream roof outlets in the roof construction at the positions according to the design. Follow the installation instructions as supplied with each product.
3. Plug off the outlet to prevent contamination of the system and water entering the system during the construction works.
4. Installation of the roofing material and fixing the outlet in the roofing material.
5. Installation of the hanging rails and brackets according to the design (see chapter 3).
6. Installation of the horizontal collector pipe and the roof outlet connecting pipes and then the vertical pipework top-down according to the supplied drawings. Use fix point brackets according to the instructions in chapter 6: The fastening system.
7. Check the bracketing system for fixing and/or sliding brackets.
8. Install discharge points.
9. Check if discharge can take place unhindered and with sufficient capacity.
10. Commission pipework by water tightness testing.
11. Clean roof surface.
12. Un-plug Wavin QuickStream roof outlets.
13. Dismantle temporary emergency overflows.

Pipe sections located in either floor and/or walls must be pressure tested prior to the casting of concrete. In order to prevent any ingress of mortar into the system, these pipe sections must be capped-off thoroughly. Open pipe ends must be well protected against possible damage by using PE caps.

Transportation and storage

Special Handling and Safety Measures

Roof outlets
Until Wavin QuickStream System is up and running, it is recommended to keep the roof outlets closed, avoiding several types of contaminants to get in the piping system.

Once the installation of the roofing materials has been completed and the roof outlets are clean and free from rubble, make sure the top part of the outlet is properly positioned and securely attached to the base plate of the roof outlet.

Never sweep dirt from the roof and inside roof outlets. Special attention should be taken to remove all cement residues, which can permanently block the piping system and reduce discharge capacity.

If there is any suspicion of blocked pipe in the system during the construction process, it should be cleaned before completion.

Fittings
- Store all items protected from sunlight, in fresh and ventilated environment.
- Unpack items only before using it

Pipes
- Store and transport the pipes packed on the original provided packaging.
- Do not slide or drag the pipes on the ground, or other surfaces during unloading process, as this may damage their ends.
- Avoid concentrated loads on storage or on any lifting.
- When storing and transporting loose pipes longer than 5 meters, there shall be used at least three supports for ≤ 90 mm pipe diameter and two supports for ≥ 110 mm diameter.
- Use lifting belts to protect the pipes in case of great heights lifts.
- To avoid excessive bending when the pipe is placed at some elevation, use a strap around the products at least in three points (both ends and middle).
- Do not store loose pipes in a place higher than 1.5 meters.
- Keep the pipes protected from aggressive substances and high temperatures.
- Pipes stored during a long time must be covered.

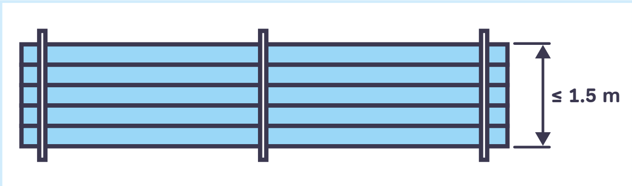


Figure 61: Maximum storage height

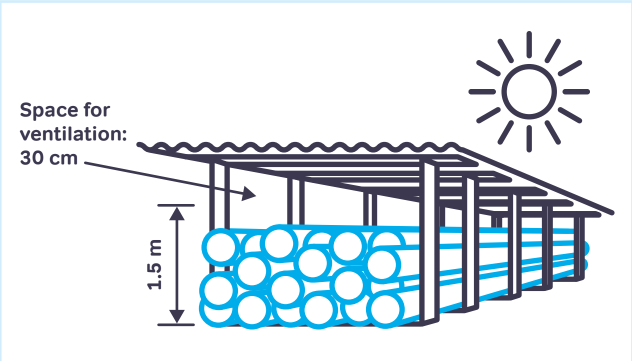


Figure 62: A suitable storage location for PE pipes

Note:
Do not use damaged products that may forfeit the quality and functionality of the system. Ensure you inspect the products for each installation.

Commissioning and maintenance

Commissioning

As a Wavin QuickStream roof drainage system operates at both positive and negative pressures, it is necessary to carry out a leak tightness test:

- Close the discharge of Wavin QuickStream system and fill up the system with water to roof level
- Check all the connections for leakages
- Unplug the discharge on completion of the inspection
- If the building is over 40m high, the pipe system needs to be split up in to sections no higher than 40m

The following steps are also recommended for commissioning the system:
- Check the installed system (pipe dimensions, roof drain numbers and positions). It must be ensured that the system was implemented as per the current state of planning (dimensions, pipe guide)
- Based on the planning requirements check that all fasteners (anchor points, building shell connections, fastening distances) have been implemented as per the installation guidelines.
- Check the emergency run-off system. Number, positions and dimensions of rectangular overflow in the wall.
- In the case of emergency drainage through a separate piping system, verify that the piping system is routed to an area that can be flooded without any damage. (The emergency drainage system must not be connected to the sewer system)
- The roof and roof outlets must be cleaned before commissioning. While doing so, check the roof outlets for completeness. If any components are missing, you must replace them
- In case of roof outlets for emergency drainage, check whether the overflow back-up ring has been assembled as per the plans.

Note: After initial commissioning of the building, a further inspection should be performed as part of the total commissioning after the first heavy rainfall, or at the latest within the first half year of use.

Maintenance

The roof maintenance is mandatory, both for gravity and for siphonic systems. It must be ensured that the roof remains free of dirt, which can be washed away by water and block the outlets.
The building owner must store the technical documentation related to the QuickStream System, which is handled on at the completion of the construction and must be part of the building documents.

QuickStream System

The water speed in the collector pipes together with the special design of the roof outlets make it easy for the system to loosen and wash away any deposits that could block the flow, so it can be said that it is a self-cleaning system.
However, a correct maintenance of the roof will avoid the possibility of obstructions of the outlets that would decrease in the capacity of the system.
The system must not be modified without prior authorization from the designer, installer and supplier.
It is recommended to make the first inspection of the roof 3 months after the system starts to run. The roof should be inspected when odd behaviors are found in the operation of the water discharge, such as overflows or water outflow through the emergency system, but in addition, at least twice a year.
When the building is in wooded areas, the required frequency can be weekly.

Outlets Maintenance

Each of the roof outlets must be carefully inspected, verifying that:
- All parts are in place.
- The leaf guard is clean enough to ensure the passage of water to the collector pipe. The baffle is essential to ensure priming.
- The leaf guard fixing screws are in good condition and tight. Failure of these elements causes imbalances in the water discharge.

Inspections and verifications should be reported in the periodic maintenance sheets.

Collector Pipes and Downpipes Maintenance

Maintenance program according to the table below.

Discharge of the siphonic system

The reception chamber or first inspection chamber / manhole downstream of the discharge of the siphonic system must be inspected at least once a year, and if necessary, all deposits must be removed.

Figure 63: Periodically maintenance to roof outlets

Roof Maintenance

Some important recommendations are given according to the type of roof. In the table below are presenting the important points to be considered during the maintenance process. The maintenance program for each type of roof is described in the table below.

Roof type	Use and conservation
Flat roofs	The limit load should not be exceeded. Do not change its use without prior consultation with a specialist. ⊙ Do not store any materials on the rooftop. ⊙ Do not damage the rooftop waterproofing. ⊙ Keep the roof clean and free of parasitic vegetation. ⊙ Do not put obstacles that may prevent the normal water discharge.
Walkable flat roofs	The use should be limited to that conceived in the design. Only authorized personnel should access it. Do not place obstacles in the path of the water to the outlets.
Non-walkable flat roofs	Authorized personnel must know which areas to step on and must wear soft-soled safety shoes.
Flat green roofs	Frequently inspect the roof waterproofing as this type of roof stores water for the plants and its poor conditions can affect the upper floors of the building. The installation of the soil should be done manually and take special care in the use of gardening tools, which must not damage the rooftop waterproofing. Select the right plants for this type of garden. Also take special care with fertilizers, which must not harm the waterproof sheet.
Sloping/pitched tile roofs	⊙ Only maintenance personnel can access it, and safety measures must be taken by wearing non-slip shoes, safety belts, etc. ⊙ Prevent access when the roof is wet. ⊙ Avoid the accumulation of leaves, soil or fungi that can block the channels or outlets.
Sloping/pitched plate roofs	⊙ Only maintenance personnel can access it, and safety measures must be taken by wearing non-slip shoes, safety belts, etc. ⊙ Prevent access when the roof is wet. ⊙ Avoid the accumulation of leaves, soil or fungi that can block the channels or outlets.

Important: In case of any unexpected events, such as hailstorm, strong winds, storms, high temperature variations, or other external influences that can affect the piping system and the building structure itself, it is strongly recommended to perform an inspection to the QuickStream system.

Maintenance program for each type of roof

Application	Frequency	Action
Flat roofs Walkable flat roofs Non-walkable flat roofs	After some unexpected event (1)	⊙ General inspection of the roof
	Monthly	⊙ Sweep and clean the roof.
	Annually	⊙ Clean the outlets, downpipes, and collector pipes. ⊙ Review fittings, rooftop waterproofing and fixing conditions. If you have rooftop protection with gravel, ensure the gravel is seated well.
	Every 3 years	⊙ Check the condition of tiles and plates fixed by nails or screws, to guarantee there is not any oxidation that could affect the roof tightness
	Every 5 years	⊙ Run a leak tightness test, filling the roof with water, not exceeding the limit of the rooftop waterproofing and leave it this way for 24 hours, checking for leakages during this time.
	Every 10 years	⊙ Restore the rooftop waterproofing layer if it is degraded, keeping the joints and the coating in perfect condition. ⊙ The waterproof blanket should be replaced if damaged, keeping the roof and joints in perfect conditions
Flat green roofs	Weekly	⊙ Keep the garden vegetation under control.
	Annually	⊙ Review the vegetal mantle and fittings.
	Every 5 years	⊙ Completely review the roof conditions and all its layers.
Sloping/pitched tile roofs	Annually	⊙ Completely review the roof conditions and clean the channels and outlets. ⊙ Review the conditions of the tiles and replace it, if necessary, to guarantee the roof tightness
	Every 3 years	⊙ Check nails, staples or hooks that hold the tiles and change them if necessary. ⊙ Check the conditions of tiles and plates fixed by nails or screws to guarantee there is no oxidation that could affect the roof tightness
	Every 5 years	⊙ Review the roof tightness
Sloping/pitched plate roofs Sloping/pitched asbestos cement plate roofs	Annually	⊙ Completely review the roof conditions and clean the channels and outlets ⊙ Review the conditions of the plates and replace it, if necessary, to guarantee the roof tightness
	Every 3 years	⊙ Check nails, staples or hooks that hold the tiles and change them if necessary. ⊙ Check the conditions of the plates fixed by nails or screws to guarantee there is not any oxidation that could affect the roof tightness
	Every 5 years	⊙ Review the roof tightness ⊙ Check if there is any leakage on the plates ⊙ In case of any cracks, detachment, oxidation, or other damages, it needs to be fixed to guarantee the roof tightness
Skylights and windows	Annually	⊙ Review the joints conditions
	Every 6 years	⊙ Review the frames conditions and its operation
Collector pipes and downpipes	Weekly	⊙ General review of the whole system ⊙ Review the bracketing and fastening system ⊙ Check presence of moisture, corrosion, detachment of material, deformations, breaks, cracks, and accumulation of residues
	Twice a year	⊙ Collector pipes and downpipes general conditions should be checked, as well as the racks and fasteners.
	Every 5 years	⊙ Check leak tightness of collector pipes and downpipes

(1) Unexpected event: such as hailstorm, strong winds, storms, high temperature variations, or other external influences that can affect the piping system and the building structure itself

Important: In case of any unexpected events, such as hailstorm, strong winds, storms, high temperature variations, or other than can affect the piping system and the building structure itself, it is strongly recommended to perform an inspection to the QuickStream system.

World‘s wettest place

26.461 l/year

were measured in Cherrapunji, India.

A feel-good environment for QuickStream.
The average annual rainfall in Germany is around 750 litres per square meter. In the wettest place in the world, it is almost 35 times as much.

FAQ, Warranty, Terms & Conditions

FAQ

If after commissioning, water is observed to regularly discharge through the emergency overflows it can be concluded that the system is not functioning according to design. Possible causes for this are listed below.

Solutions related to improper installation and/or maintenance:

- Accumulated dirt can hinder the flow towards the roof outlets...
  Solution: clean the roof and the roof outlets.

- Construction debris in the system reduces the flow capacity...
  Solution: clean the pipe system.

- There has been a violation with the design, e.g. a wrong pipe diameter (too big or too small), wrong pipe lengths (e.g. tail pipes or distances from outlet to collector pipe) or the pipe layout is changed...
  Solution: change the pipe layout to the design made by Wavin or contact Wavin to make a new design.

- In violation of the design, an additional small roof or soil and waste discharge is connected to the system, through which air is sucked into the system...
  Solution: change the pipe layout to the design made by Wavin or contact Wavin to make a new design.

Solutions to problems caused by operating outside the prescribed design parameters or design criteria:

- The main gravity sewer to which the roof drainage system discharges is over-loaded or blocked and no emergency overflow chamber with sediment catchments has been installed...
  Solution: install an emergency overflow chamber between the discharge point of the Wavin QuickStream system and the main gravity sewer system.

- The water level in the discharge chamber is too high at the start-up of the rainwater flow from Wavin QuickStream, preventing the escape of air...
  Solution: reinstall the gravity sewer pipe to a lower level or contact Wavin to discuss the implications of installing the discharge point of the Wavin QuickStream system at a higher level.

- High surrounding buildings might cause an uneven distribution of rainfall over the roof. Wind turbulence around a building might also cause under pressures at roof outlets...
  Solution: this problem should only occur during a combination of heavy rainfall and strong winds. Usually, the problem is caused by one of the other described issues.

- Due to high negative pressure cavities may occur, reducing the maximum flow capacity...
  Solution: Wavin verifies all design on the maximum allowable negative pressure and adapts the design to such an extent that cavitation will not occur. Compare the installed system to the installation drawings made by Wavin and correct any differences.

- The emergency overflows have been constructed too low, preventing the build-up of a sufficient water level on the roof to enable good priming of the system. The system cannot reach its design drainage capacity while water is flushed away through the emergency overflows...
  Solution: increase the heights of the emergency overflows in consultation with the building designer and Wavin.

- Free communications between roof outlets are hindered by obstacles...
  Solution: remove obstacles or place them higher, so water can flow freely under the obstacles.

Limited Warranty and Limitations of Liability

Limited Warranty

The Products are warranted to be free from defects in materials and workmanship under normal use in QuickStream siphonic system installations only, for a period of ten years from the date of purchase (the "Warranty"). In order for this Warranty to apply, the Products must be handled, stored, and installed in accordance with the instructions provided in this product booklet. As set forth more fully in Section 7.5 of our Terms and Conditions of Sale (which is incorporated by reference), this Warranty does not cover any damage caused by improper handling, storage, shipping, or installation of the Products (including installation in any applications other than QuickStream siphonic system).

Claims under this Warranty must be made in writing and submitted to Seller promptly after the defect is discovered and, in any event, within ten years of the date of purchase. In order to make a claim under this Warranty, any Product alleged to be defective must be made available to Seller for inspection, verification, and testing.

If Seller confirms that the Product is defective, the exclusive remedy for breach of this Warranty is limited to (1) replacement of the defective product, or (2) refund of the purchase price. Seller shall have no liability for the cost of removal or reinstallation with respect to any replaced Product. The election of said remedies will be determined by Seller in its sole discretion and shall be considered final disposition.
To the extent that this Warranty conflicts with our Terms and Conditions of Sale, the terms of this Warranty shall prevail. This Warranty may only be modified or altered in a writing signed by Seller's representative.

LIMITATION OF LIABILITY

FOR THE AVOIDANCE OF DOUBT, SELLER'S LIABILITY FOR ANY AND ALL LOSS OR DAMAGE, HOWSOEVER ARISING AND UNDER ANY LEGAL OR EQUITABLE THEORY (INCLUDING WITHOUT LIMITATION BREACH OF CONTRACT; BREACH OF WARRANTY; COMMON LAW, EQUITABLE, OR CONTRACT INDEMNITY; NEGLIGENCE; OR TORT) SHALL BE STRICTLY LIMITED TO THE PURCHASE PRICE OF THE PRODUCT.

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Choice of Law and Venue

This Warranty shall be governed by and construed in accordance with the laws of the jurisdiction in which the Seller is incorporated, excluding in any case conflict of law rules. The Parties acknowledge and agree that the applicability of the United Nations Convention on Contracts for the International Sale of Goods (often referred to as the Vienna Sales Convention) is expressly excluded.

Any disputes related to the Products, or this Warranty will be resolved exclusively by the competent courts of the state in which Seller is incorporated, and you and Seller consent to personal jurisdiction in those courts.

Discover our broad portfolio at wavin.com

- Drinking water distribution
- Waste water drainage
- Indoor climate solutions
- Urban climate resilience solutions

Building & Infrastructure

Wavin is part of Orbia, a community of companies working together to tackle some of the world's most complex challenges. We are bound by a common purpose: To Advance Life Around the World.

Orbia's Building and Infrastructure business Wavin is an innovative solutions provider for the global building and infrastructure industry. Backed by more than 60 years of product development experience, Wavin is advancing life around the world by building healthy, sustainable environments for global citizens. Whether it's to improve the distribution of clean drinking water, to make sanitation accessible for everyone, to create climate resilient cities, or to design comfortable living spaces, Wavin collaborates with municipal leaders, engineers, contractors, and installers to help future-proof communities, buildings and homes. Wavin has 12,000+ employees around 65 production sites worldwide, serving over 80 countries through a global sales and distribution network.

Wavin Türkiye Girne Bulvarı 294 | 01285 | Yüreğir/Adana Türkiye. Tel: (+90) 322 999 10 00 | Faks: (+90) 322 346 70 10
Internet www.wavin.com | E-mail wavin.tr.info@orbia.com

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