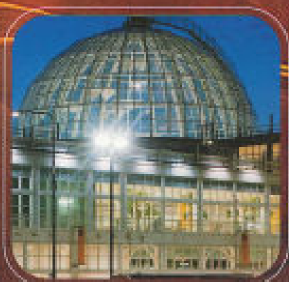
MIFAB HydroMax

Leaders In Siphonic Drainage

The World is Awakening to

A New Dawn in Drainage

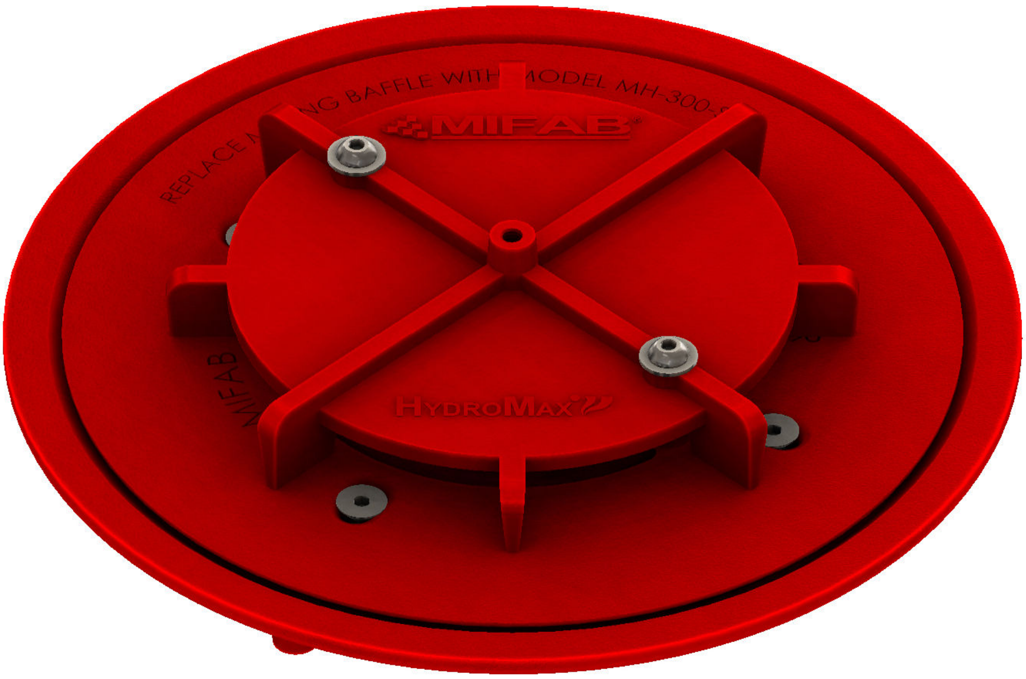


The Engineered Rainwater Solution

Understanding HydroMax Siphonic Drainage

MIFAB HYDROMAX
Leaders In Siphonic Drainage

Understanding the *MIFAB* HydroMax™ Siphonic Roof Drainage System



Contents

Understanding the *MIFAB* HydroMax™ Siphonic Roof Drainage Offering

1. Introduction – Tomorrow's Technology Today

The world is awakening to a new dawn in drainage.

From the days when our forefathers began draining roofs, gravity has been the driving force to move the rainwater from the roof to the ground. However, our 21st century technology offers a superior alternative to cater for the storm profiles that today's changing climate brings us. It's available now and it's ***MIFAB* HydroMax™**.

(It also provides 25% to 45% cost savings!)

In the late 1960's Ovali Ebling's, an Engineer from Finland, conceived plans to utilize negative pressures generated by the building height to draw rainwater from the roofs of buildings.

University and Governmental Research, together with developments by leading industry figures such as HydroMax™, have seen the technology advance. Although the technology base has largely remained in Europe, the market for siphonic roof drainage has strikingly grown in many countries throughout Europe the Far East and Australasia.

IPC and UPC codes to allow Alternative Engineered Design (IPC 105.4) have now opened siphonic drainage to the US market. IPC 2012 Chapter 11 Section 1107 includes Siphonic Roof Drainage.

The siphonic roof drain product test standard is ASME A112.6.9-2005 and ASPE/ANSI 45:2013 is the latest Plumbing & Engineering Design Standard for Siphonic Roof Drainage (published and available from ASPE.)

With drains tested to ASME 112.6.9:2005, ***MIFAB* HydroMax™** is the new drainage system to take North America by storm.

***MIFAB* HydroMax™** was developed to advance the siphonic principles to create a powerful means of literally sucking the rainwater from the roof. Using small diameter pipework running at full-bore flow, ***MIFAB* HydroMax™** provides **ten** times more flow capacity than an equivalently sized gravity system on a single storey building.

***MIFAB* HydroMax™ -** bringing tomorrow's technology today.

To enable ***MIFAB* HydroMax™** to drain with such high performance, the system designer utilizes our advanced **HydroTechnic™** analytical pipe sizing design software program to optimize an Engineered Drainage Solution. Our program is proven through independent testing by HR Wallingford (probably the world's leading Hydraulic Research Establishment) for compliance with the performance requirements of BSEN12056-3:2000. **HydroTechnic™ enables USA Engineers to design in FULL compliance with the ASPE/ANSI 45:2013 siphonic drainage design standard.** Additionally, ***MIFAB* HydroMax™** can provide support together with training packages tailored to your requirements.

The key to the functionality of any siphonic roof drainage system is the sizing of the pipe system to balance flow rates and pressures within the piping system. The ***MIFAB* HydroTechnic™** software is the most technically advanced in the industry, allowing fast and accurate calculations to be carried out on the most complex systems. ***MIFAB* HydroTechnic™** is available as a web-based application specifically for US professional plumbing engineers with calculations being produced in both US Customary Units and SI (metric) Units.

Some Key Benefits of the HydroMax™ Siphonic System

- **Cost effective with typical savings of 25% to 45%**
  (resulting from reduced pipe diameters, significantly less below grade drainage and reduced trenching requirements)
- **Horizontal pipes are installed flat level - without grade**
  (eases co-ordination with other services)
- **Small bore pipework reduces space taken up and imposes less load on the structure**
- **High velocity flow ensures that systems are self-scouring**
- **Independently tested design software.**
- **MIFAB HydroMax™ roof drains tested to ASME A112.6.9:2005**
- **Designs in FULL accordance with ASPE/ANSI Technical Standard 45:2013**
- **1000's of HydroMax systems with 100% success**
- **Fewer collector pipes can convey water to the perimeter of the building or other preferred locations which frees up valuable building space**
- **Fewer internal downpipes (less restrictions on building space usage).**
- **Drainage below the floor of the building can be eliminated**
- **Engineered solution that allows controlled flow and or controlled discharge**
- **Reduced Construction build-program due to less ground works, less pipework, etc.**
- **Fewer Roof penetrations due to high performance roof drains**
- **Environmental benefits as routing to Harvesting/Retention/Reclamation Systems is simplified with HydroMax™. Less ground disturbance, fewer Raw materials, etc.**

2. The Principles of Siphonic Roof Drainage

2.1 Gravity Drainage

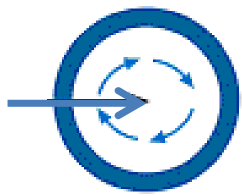
To understand the benefits from using ***MIFAB*** HydroMax™ siphonic drainage, it is necessary to know a little about how a gravity drainage system functions. Roofs are laid to slopes so that as rain falls on a roof, it makes its way under gravity to a collection point where a roof drain will be sited.

In gravity systems the flow rate is controlled by the ability of water to enter the roof drain. This is a function of allowable water depths on the roof or gutter.

Once into the vertical downpipes, water will adhere to the pipes inner surface, flowing down the walls in an annular motion with a large air core in the centre. When an appreciable quantity of water builds up in the gutter or on the roof, this motion will be accentuated by a vortex that will form above the roof drain drawing air into the pipe. This type of pipe entry flow can be readily visualised by watching water flowing down a plughole from a bathtub or sink. It is inefficient and has more ponding depth on the roof than you may expect.

The water swirls into Gravity drains by vortex.
Gravity drainage is extremely inefficient.

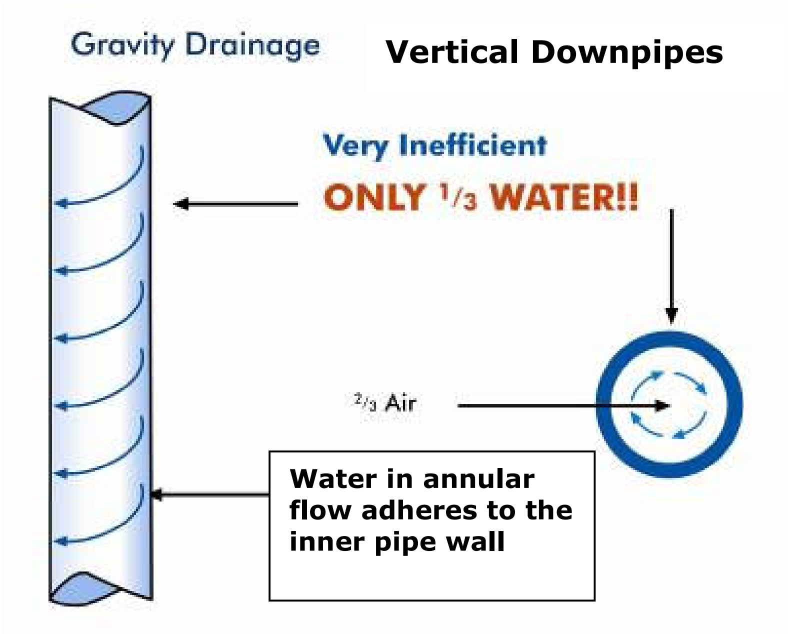
Vortex formation pulls air into piping system and results in high ponding depth as weir flow forms



In modern roof drainage design, a horizontal gravity pipe could be sloped to take up to two-thirds water with a one/third air mix, depending on gradient. The grade on the horizontal pipe also dictates how far the pipe can travel before it encroaches into the useful building space and as such, requiring a vertical downpipe.

If the system travels horizontally above ground for any distance, the acceptable flow rate is dramatically reduced and very large pipes are required and the slope frequently leads to the pipework encroaching into the building space. For this reason it is common in gravity systems to have a roof drain and vertical downpipe at every bay or two on the structure. This requires regular duct access through the building, which wastes space and can be particularly problematic in a central roof valley situation within warehouses and other open plan buildings, where clear space below the roof is important.

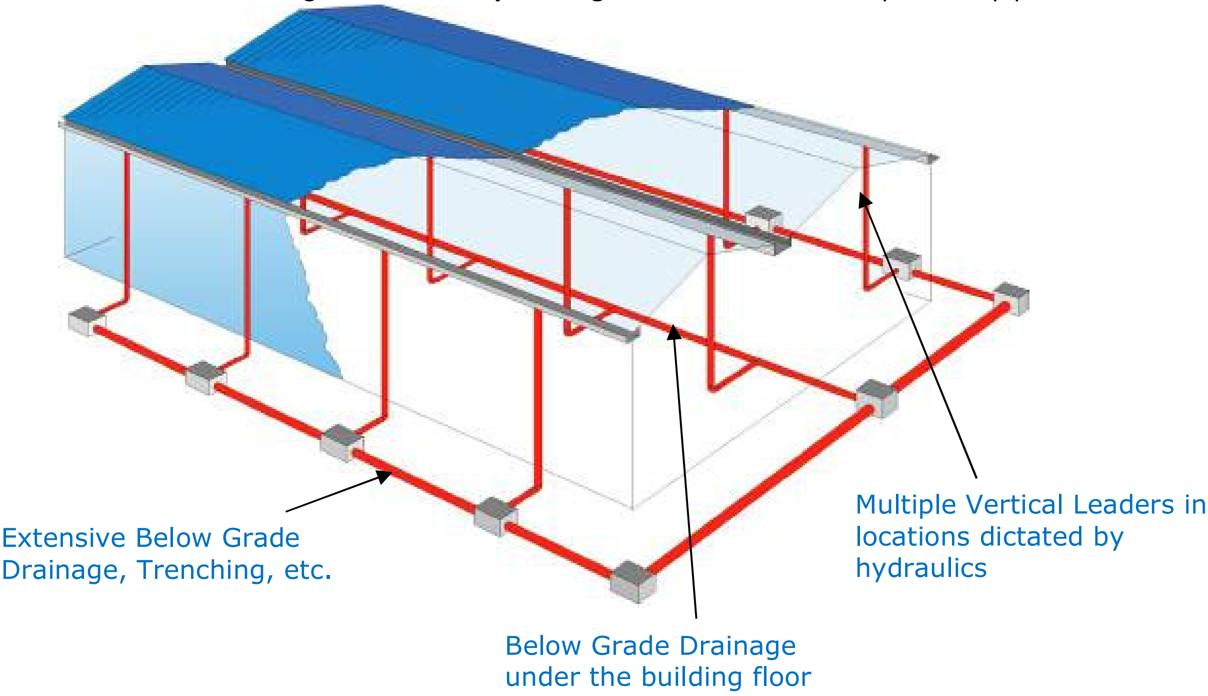
Additionally, the downpipes often drop vertically through the building to join below grade drainage systems. These systems often run under the floor of the building to convey the water away from the site.



Filling of a vertical gravity downpipe is restricted to ⅓ water, with ⅔ of pipe volume carrying air.

Typical Example of a Gravity Drainage Installation with Multiple Downpipes

Schematic Diagram of a **Gravity Drainage** Installation with Multiple Downpipes

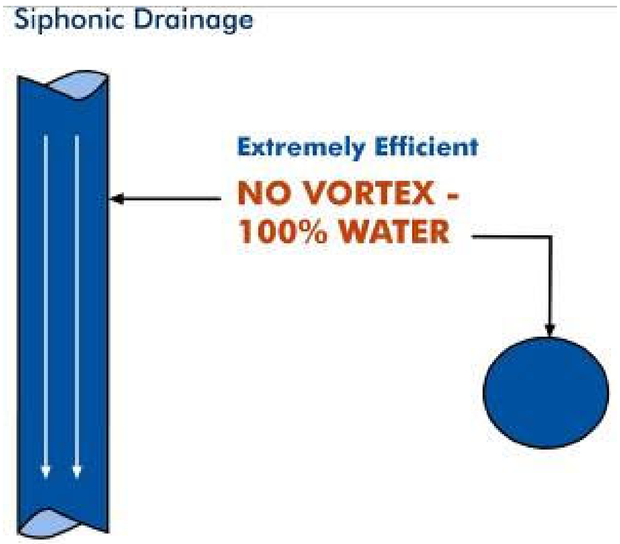


2.2 *MIFAB* HydroMax™ Siphonic Drainage

A key feature of our siphonic system is the special ***MIFAB*** **HydroMax™** roof drain. The unique design incorporates a one-piece inducer (or air baffle plate) securely fastened to the roof drain. As a relatively shallow water depth builds up on the roof or in the gutter, the inducer of the ***MIFAB*** **HydroMax™** roof drain creates a seal preventing air from entering the tailpipe whilst the fins on the inducer restrict vortex formation. The tailpipe below the roof drain is of a relatively small diameter and a series of tailpipes connect to a horizontal collector pipe (leader) below the roof.

This collector pipe is normally installed horizontally without slope at high level and runs to a convenient point in the building determined by the system designer where it drops to ground level with a transition break connection into the below grade gravity drainage system or manhole chamber.

The system is self-draining therefore the pipe has no water inside prior to the rainfall event - only air. As the rain starts to fall, further air ingress is prevented at the roof drain and only water enters the pipe. The movement of the water quickly draws the air out of the pipe in a process known as 'priming'. When all of the air has been removed from the system it is said to be fully primed and the pipe work is running full-bore with water.

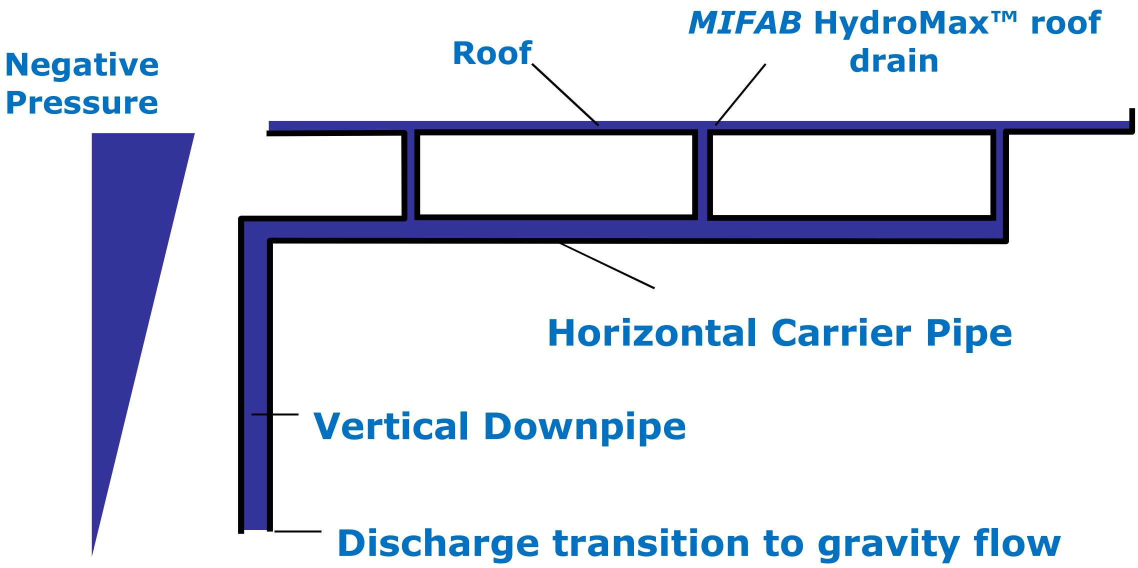


Extremely Efficient

MIFAB **HydroMax™ Siphonic System flows utilizing the full-bore of the pipe with high flow rates commonly 10 times the flow capacity of an equivalent diameter Gravity Pipe.**

In this full-bore flow condition, the hydraulic driving force conveying water from the roof ceases to be the head of water built up around the roof drain as with traditional gravity drainage systems and instead becomes the head generated by the full height of the building. Siphonic systems are thus able to efficiently remove large quantities of water in small diameter pipes to fewer, conveniently routed locations.

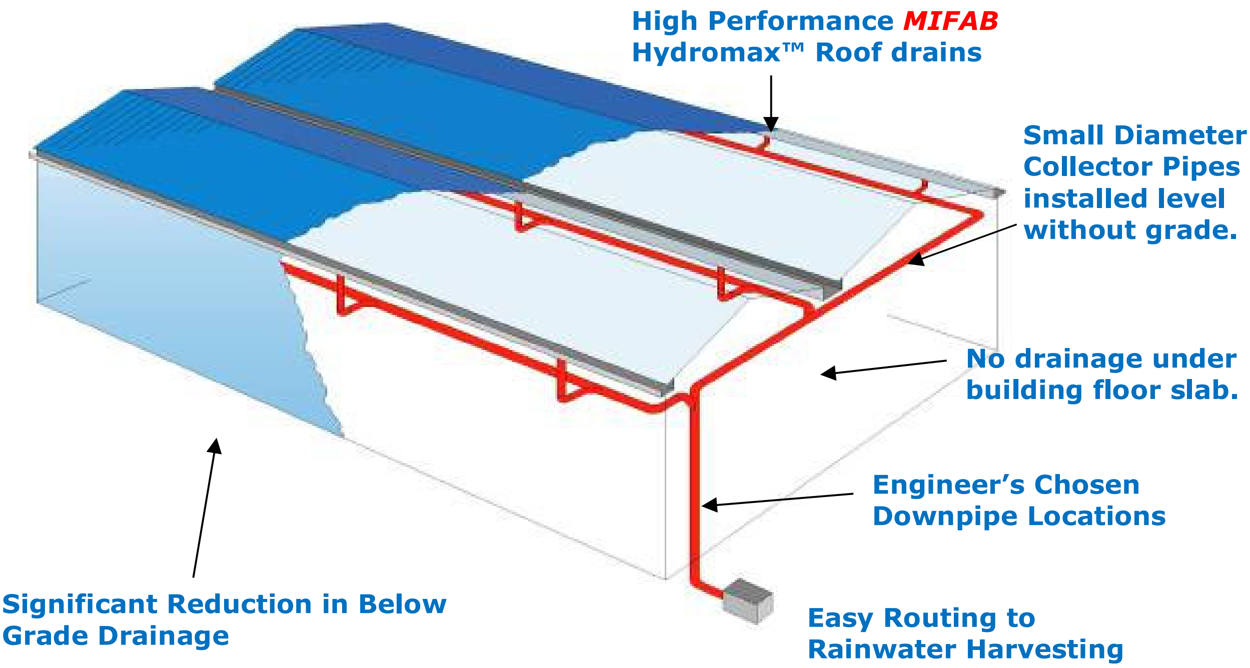
The Whole Building Height is the Driving Force



The Main Roof of this Stadium was drained using Vertical Downpipes (max. dia. 12”) dropping in each of the four corners.

The Arena Section roof used only 2 Vertical Downpipes

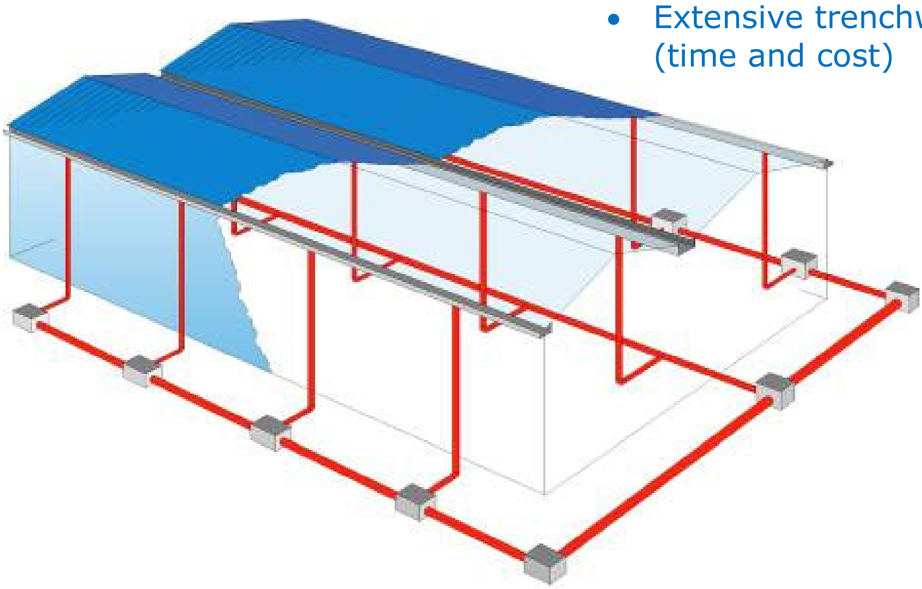
Below is a Typical Diagram of a Siphonic Drainage Installation with Minimum Downpipes



The ***MIFAB*** **HydroMax™** siphonic roof drain has been developed to provide superior performance during storm conditions. The HydroMax™ siphonic drain and HydroTechnic™ pipe sizing software have been tested for accuracy by HR Wallingford in accordance with the performance requirements of the current European Standard EN 12056-3:2000 enabling designs with ASPE/ANSI Technical Engineering Design Standard 45:2013.

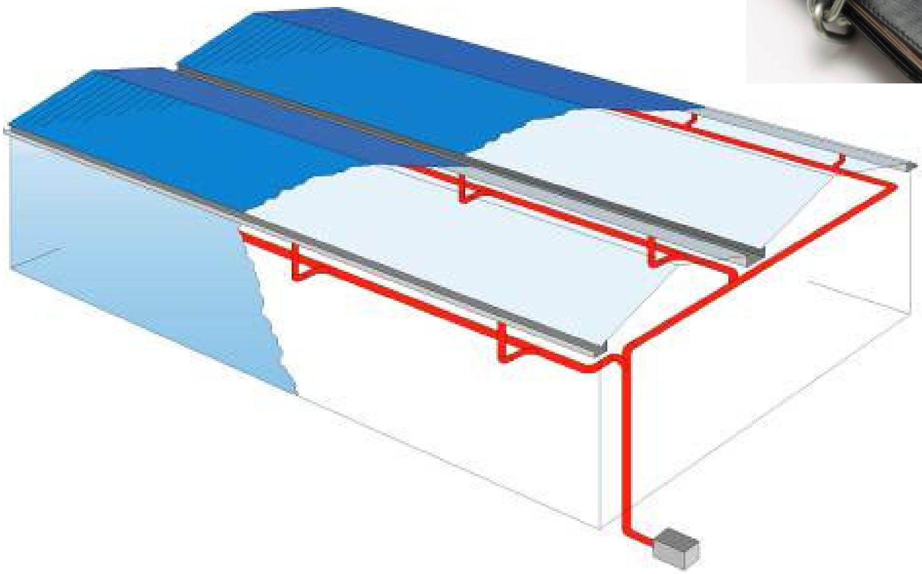
Traditional gravity Scheme

- 1600 feet of piping
- Pipe Diameters from 6” to 18”
- Extensive trenchwork (time and cost)



MIFAB HydroMax™ Siphonic Solution

- Only 1000 feet of piping
- Pipe Diameters from 3” to 8”



2.3 The Priming stages of a *MIFAB* HydroMax™ Siphonic System

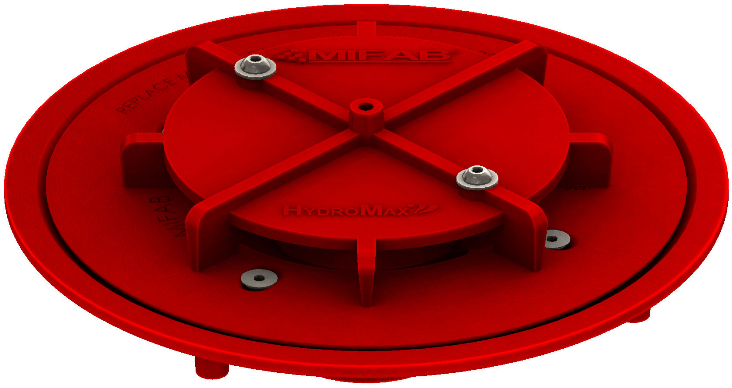
The advanced ***MIFAB* HydroTechnic**™ software enables the design engineer to create a system with the correct pipe sizing to ensure the best possible configuration, rapid prime and optimum performance.

Step 1: Prevent Air Ingress

A MIFAB HydroMax™ siphonic roof drainage system does not use any moving parts to create the full bore flow conditions - only hydraulics.

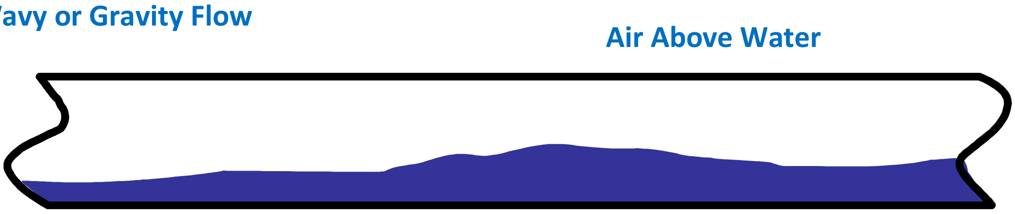
The one-piece inducer on the MIFAB HydroMax™ roof drain (pictured right), seals off air ingress to only permit water to enter the pipework.

The anti-vortex fins prevent the formation of vortices which would also draw air into the piping.



Being a self-draining piping system, at the start of a rainstorm the pipework is empty. Initial rainfall will flow through a gravity flow pattern as shown in Step 2 diagram. The tailpipe will continue to discharge water into the carrier pipe and as more water is supplied to the main carrier pipe it will also start to prime in a process that follows three further flow phases.

Step 2: Wavy or Gravity Flow



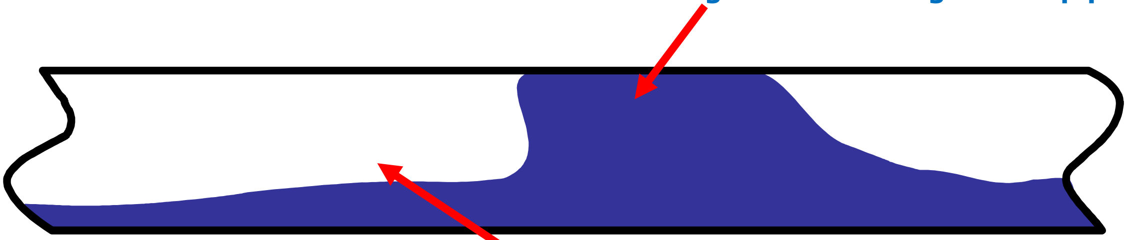
Step 3: Plug Flow

The increase in rainfall leads to the water surging to fill the pipe for short lengths and pushes out pockets of air entrapped between the full bore plugs as shown below.

University research has shown that this flow pattern is typically achieved at 10% to 15% of the design rainfall intensity.

Importantly, self-scouring velocities are achieved at this stage.

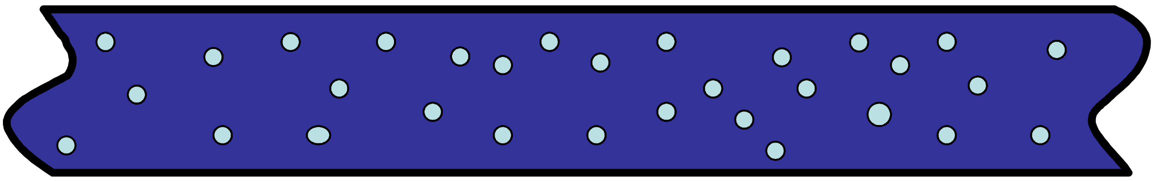
Plug of water filling whole pipe



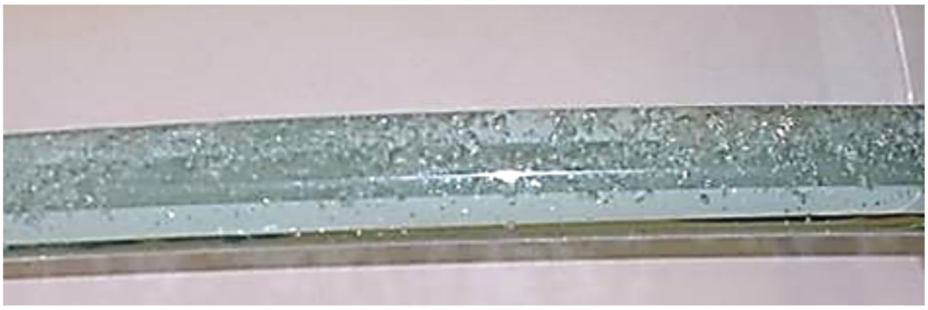
Air pockets driven and purged through pipework at high velocities.

As the rainfall gets heavier the water almost fills the whole of the pipe and any remaining air is carried out as bubbles entrained in the water. See Step 4.

Step 4: Bubble Flow



Air bubbles in suspension at high velocity



As the design rainfall rate is achieved, no air remains in the pipework leaving the pipes fully primed to run full bore.

The system is now utilizing the full height of the building to draw water off the roof.

Step 5: Full-Bore Flow

Water fills the whole pipe – Full Bore

Storm Profiling

Once the rainstorm starts to abate, air will be admitted through the roof drain into the piping system. The above noted flow patterns will reverse in a process known as de-priming. This takes place seamlessly in a smooth controlled manner that mirrors the storm profile.

Furthermore, if the rainfall rate increases again, prime is quickly re-established and the ***MIFAB* HydroMax™** siphonic solution therefore provides a highly efficient Engineered Roof Drainage System.

2.4 Typical Applications of Siphonic Systems

Retail Centres

Walmart Stores – Nationwide, USA

Retail Malls

Dundrum Town Centre, Ireland

Orchard Road, Singapore

Kilkenny, Ireland

Multi-Storey Parking Garages

Car Park Drain

Distribution Centres

Target Distribution Center, CA

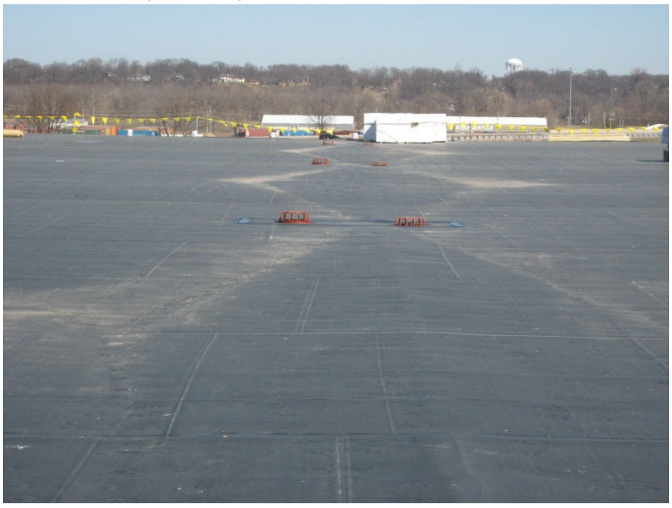
Airports

Newcastle International, UK

Gim Hae International, Korea

Manufacturing

John Deere, Milan, IL



Pfizer Pharmaceuticals

Commercial Offices

Accident Fund, Lansing, MI

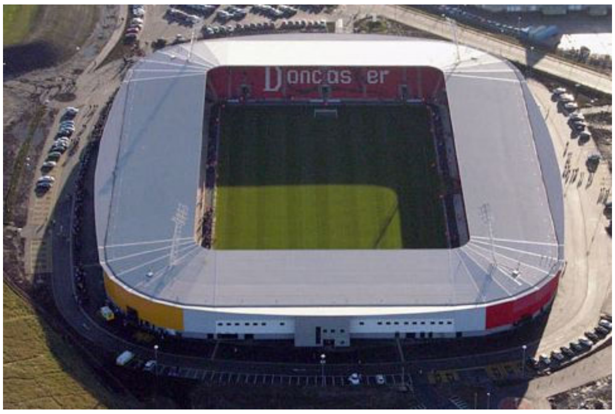
E-Tek Flagship, Trinidad

Hospitals

Mercy Hospital, Des Moines, IA

Forest Park Medical Center, Dallas, TX

Stadium



Other Projects

Fusionopolis Commercial Project

Formula One Pit lane, Singapore

Scottish Parliament

St. George's Tower, London

National Science Museum, South Korea

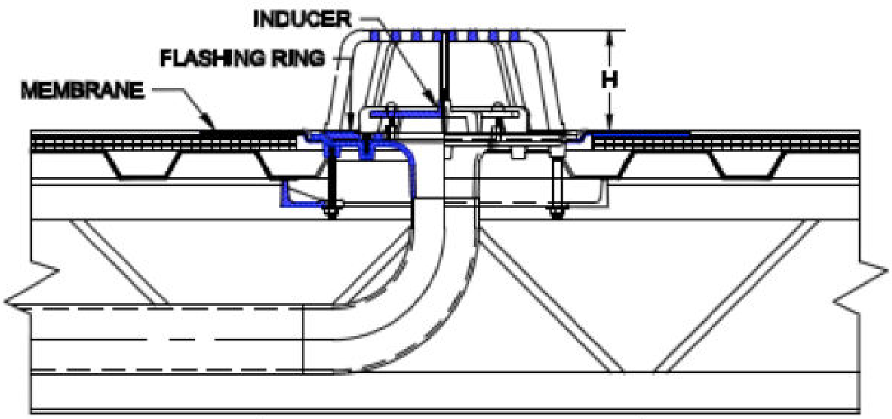
3. The *MIFAB* HydroMax™ Siphonic Roof Drain

The ***MIFAB*** **HydroMax™** roof drain has been specially designed to efficiently ensure self-priming of the pipework. The inducer (air-baffle) is firmly attached to the roof drain body to ensure integrity from foot traffic etc. on the roof.

The drain body itself is supplied for compatibility with all types of roof build up.

The full range of roof drain submittals can be obtained from MIFAB at www.mifab.com.

Typical Assembly Detail for Roof drains with Flashing Ring



MIFAB **Hydromax siphonic roof drains with optional dome (debris guard) are compliant with IPC (International Plumbing Code) Section 1105.**

CATALOG NUMBER	PIPE SIZE	H
MH-300	3 (75)	5 (125)
MH-400	4 (100)	5 (125)
MH-500	5 (125)	5 (125)
MH-600	6 (150)	5 (125)

MIFAB **Hydromax siphonic roof drains are compliant with ANSI/ASME A112.6.9**

The fins on the inducer extend beyond the cover plate and restrict water from swirling around the roof drain thus reducing the risk of vortices forming which would entrain air.

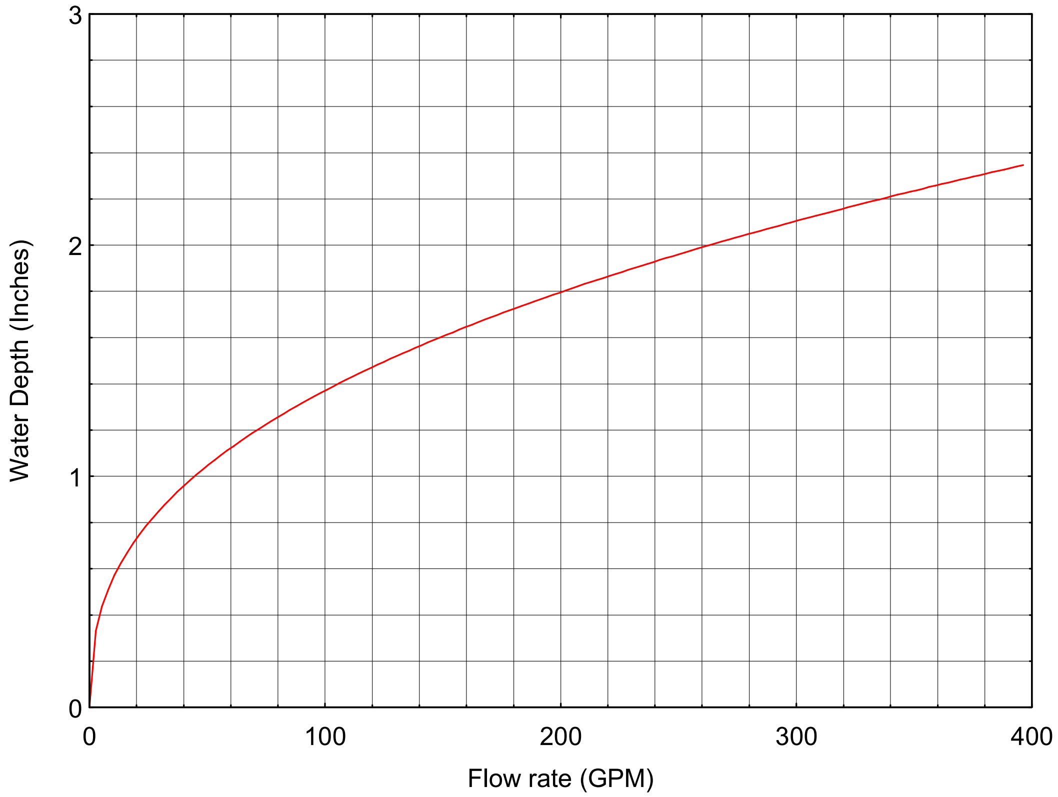
This design also improves resistance to blockage by large objects like leaves and twigs, plastic bags or bird debris. These objects tend to become trapped against the ends of the fins allowing water to pass over and still enter the roof drain.

As with all roof drainage systems good housekeeping maintenance by the building owner is recommended to keep roofs clean and roof drains free from such debris.

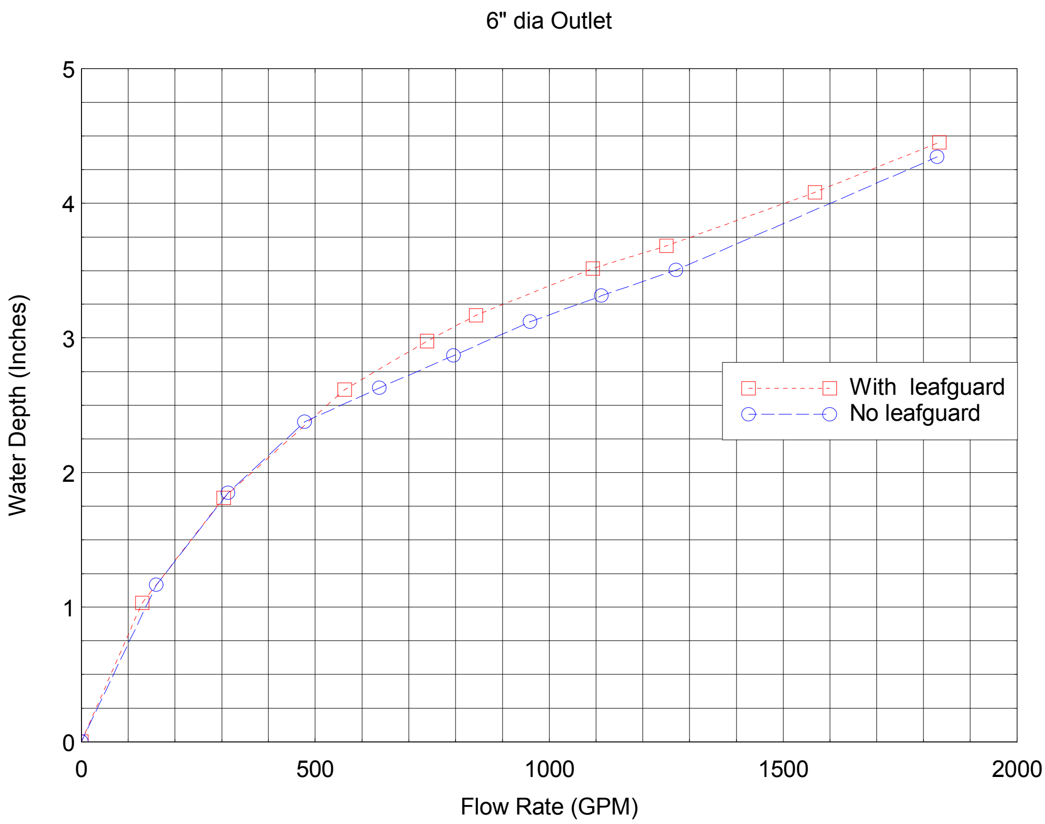
The diameter and height of the inducer above the body is an important feature of the MIFAB HydroMax™ design that ensures that the system primes rapidly with a minimum depth of water around the roof drain. At the same time the roof drain can deliver high flow capacities, up to 400 GPM on the 3” drain and 1800GPM on the 6” drain with certain piping configurations. This flow is achieved whilst maintaining a low head loss. The roof drain is stable at a range of flow rates and can respond quickly to changes in rainfall intensity.

With market leading efficiency (low “K” factors borne through testing to ASME A112.6.9:2005) you can rely on MIFAB HydroMax™ to provide efficient water removal with high flows and low ponding.

MIFAB HydroMax™ 3" Roof Drain – Performance curve



MIFAB HydroMax™ 6" Roof Drain – Performance curve



The full range of ponding graphs are available at www.mifab.com and www.hydromax.com

MIFAB HydroMax Siphonic Roof Drains

3", 4", 5" and 6" Siphonic Roof Primary and Overflow Drains

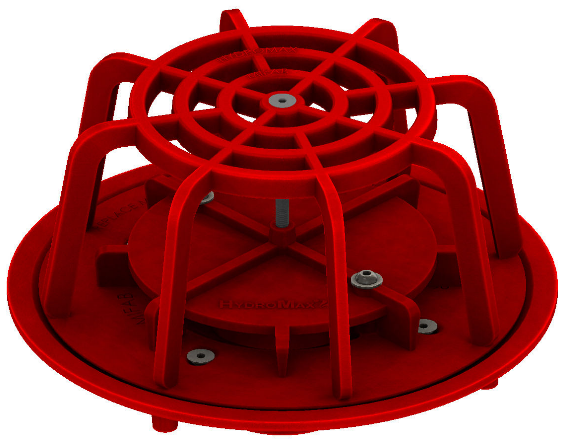
All our drains have been tested to ASME A112.6.9:2005

C.I. No-Hub Outlet	K factor	Minimum GPM Inflow	Maximum GPM Inflow
3"	0.12	23	415
4"	0.08	75	750
5"	0.04	120	1300
6"	0.04	160	1800

Low 'K' Factors = High Efficiency & Low Ponding Depths

Gravel Guard

Debris Guard



Our 3" and 4" Drains are available as Podium Deck Drains or Parking Garage Drains

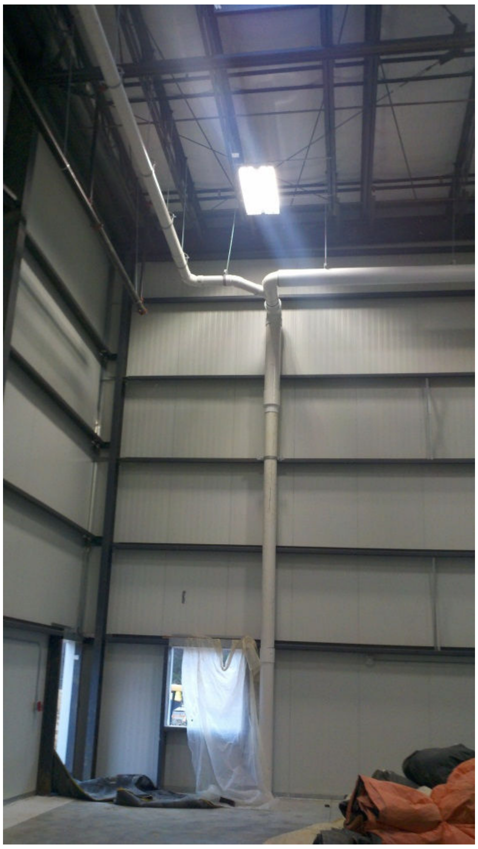
4. Siphonic Drainage Piping Systems

Correct installation of the pipework is an important part of any siphonic system.

HydroTechnic™ has been programmed for the US market to calculate using non-proprietary no-hub cast iron, roll grooved galvanised steel, roll grooved copper and solid wall schedule 40 PVC.

No-Hub Cast Iron systems would follow normal construction practices.

The pipework must be suitably restrained using pipe brackets at all changes of direction as required with a gravity installation.

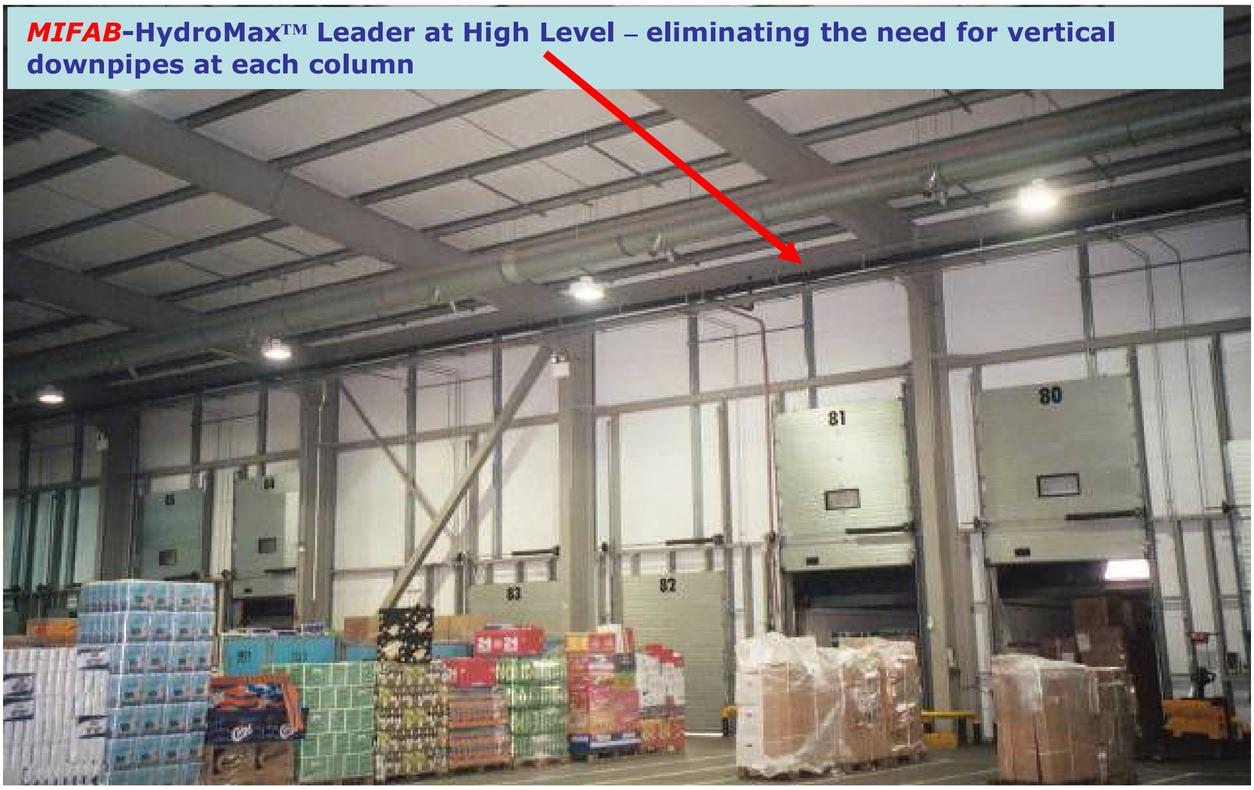


PVC Schedule 40 Solid wall systems provide an easy to install drainage solution.

The pipework must be suitably restrained using pipe brackets at all changes of direction as required with a gravity installation.

Running without slope the pipework can be "zoned" for easy coordination with the structure and other building services.


MIFAB-HydroMax™ enables long horizontal runs without slope giving flexibility to the design team for choosing downpipe positions


MIFAB-HydroMax™ Leader at High Level – eliminating the need for vertical downpipes at each column
81
80

5. MIFAB HydroTechnic™ Pipe Sizing Software

The accurate and technically advanced **MIFAB-HydroTechnic™** analytical design software program was developed with the ability to calculate using different pipework materials – even within a single piping system. This offers additional aesthetic or technical benefits to the building design team. The software has been independently tested by HR Wallingford for compliance with the performance requirements of the BS EN 12056-3:2000 code and enables the USA engineers to design in compliance with ASPE/ANSI Technical Design Standard 45:2013.

The **MIFAB-HydroTechnic™** analytical design program has been further developed to enable USA Engineers to gain easy access to the piping program through the internet with registered users obtaining access to the program through a log-in name and password anywhere and anytime they have access to the web.

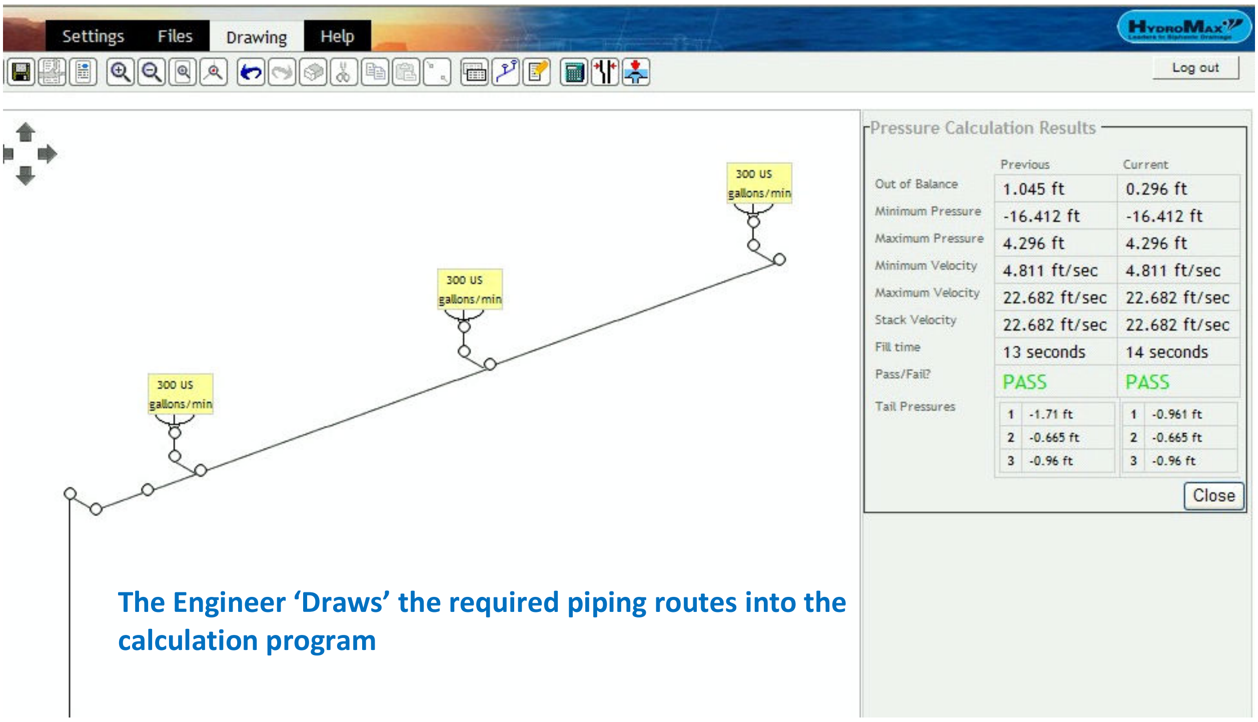
Allowing accurate calculations in both US customary and SI units (as may be required for GSA projects) the market leading MIFAB-HydroTechnic™ is the essential design tool for sizing the pipework within a siphonic system.

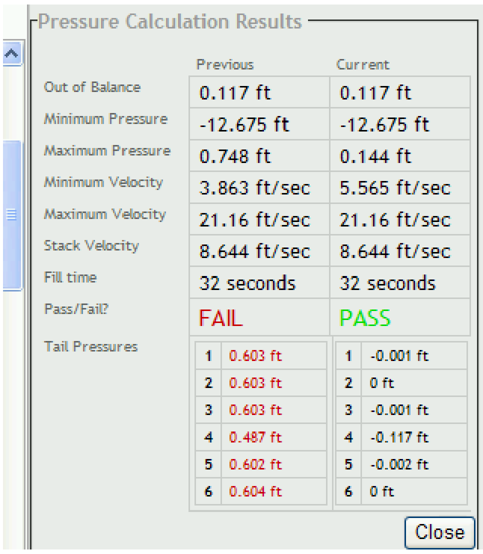
Siphonic systems are an engineered solution to the problem of draining building roofs and it is important that the pipework is correctly sized. When a number of roof drains are connected together through a horizontal collector pipe, the available head at each roof drain must be the same if they are to transport equal flow rates. The driving head is given by the difference in level of the water at the roof drain and the point of discharge.

This available head has to be resisted by the energy lost in friction against the pipe walls and at bends, joints, junctions, size changes and other fittings, which would not be the same if all pipework is installed at the same diameter. As a result a siphonic system has to be carefully designed to give equal energy losses along the route to each roof drain. This process is called 'balancing the system' and is normally done by changing pipe diameter sizes throughout the system. For example, it would be normal for tailpipes that connect to the horizontal collector leader close to the vertical downpipe to be a smaller diameter than those at the far end of the collector and for the collector to get smaller in an upstream direction. It is also common for the vertical section of the downpipe to be a smaller size than the collector and for the downpipe to be smaller at the bottom than at the top. The MIFAB HydroTechnic™ software has been specifically developed to design the siphonic system and allow it to be easily balanced.

MIFAB-HydroTechnic™ Design View

After the designer has calculated roof areas, rainfall rates etc., the desired pipe routes are drawn into the **MIFAB-HydroTechnic™** program and the hydraulic calculations are made.





Pressure Calculation Results

	Previous	Current
Out of Balance	0.117 ft	0.117 ft
Minimum Pressure	-12.675 ft	-12.675 ft
Maximum Pressure	0.748 ft	0.144 ft
Minimum Velocity	3.863 ft/sec	5.565 ft/sec
Maximum Velocity	21.16 ft/sec	21.16 ft/sec
Stack Velocity	8.644 ft/sec	8.644 ft/sec
Fill time	32 seconds	32 seconds
Pass/Fail?	FAIL	PASS
Tail Pressures	1 0.603 ft	1 -0.001 ft
	2 0.603 ft	2 0 ft
	3 0.603 ft	3 -0.001 ft
	4 0.487 ft	4 -0.117 ft
	5 0.602 ft	5 -0.002 ft
	6 0.604 ft	6 0 ft

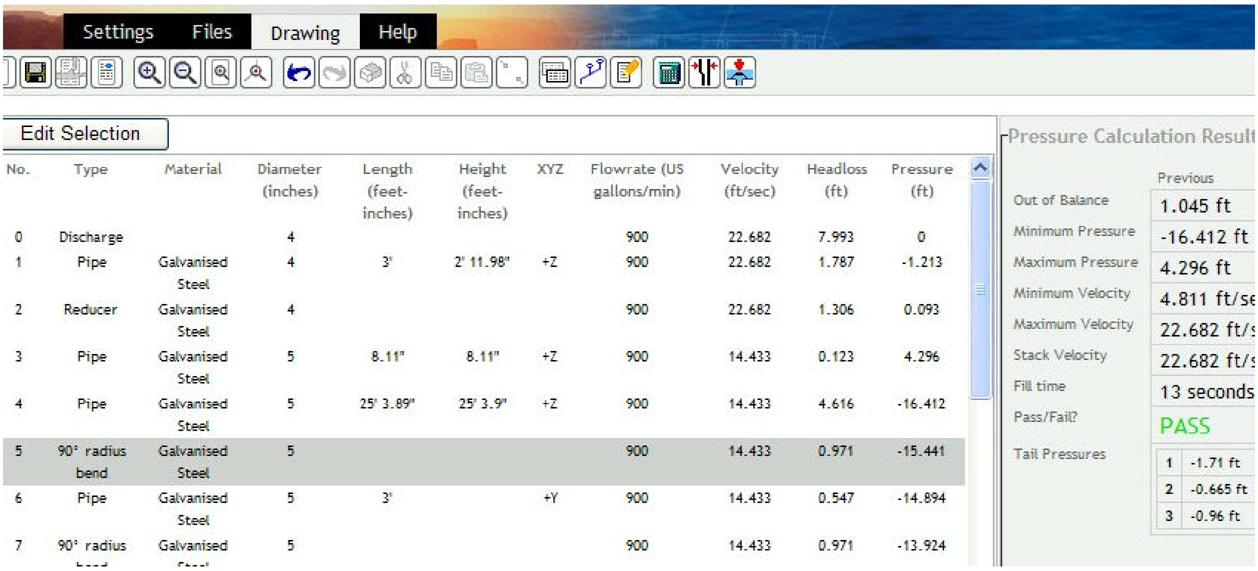
Close

All Hydraulic Parameters must be met.

Pipe diameters are edited to find the 'PASS' solution

MIFAB HydroTechnic™ Data View

Once the calculations have been made, the designer can use the data form to alter pipe diameters to find the optimized technical and cost solution.



Settings Files Drawing Help

Edit Selection

No.	Type	Material	Diameter (inches)	Length (feet-inches)	Height (feet-inches)	XYZ	Flowrate (US gallons/min)	Velocity (ft/sec)	Headloss (ft)	Pressure (ft)
0	Discharge		4				900	22.682	7.993	0
1	Pipe	Galvanised Steel	4	3'	2' 11.98"	+Z	900	22.682	1.787	-1.213
2	Reducer	Galvanised Steel	4				900	22.682	1.306	0.093
3	Pipe	Galvanised Steel	5	8.11"	8.11"	+Z	900	14.433	0.123	4.296
4	Pipe	Galvanised Steel	5	25' 3.89"	25' 3.9"	+Z	900	14.433	4.616	-16.412
5	90° radius bend	Galvanised Steel	5				900	14.433	0.971	-15.441
6	Pipe	Galvanised Steel	5	3'		+Y	900	14.433	0.547	-14.894
7	90° radius	Galvanised	5				900	14.433	0.971	-13.924

Pressure Calculation Result

	Previous
Out of Balance	1.045 ft
Minimum Pressure	-16.412 ft
Maximum Pressure	4.296 ft
Minimum Velocity	4.811 ft/se
Maximum Velocity	22.682 ft/
Stack Velocity	22.682 ft/
Fill time	13 seconds
Pass/Fail?	PASS
Tail Pressures	1 -1.71 ft
	2 -0.665 ft
	3 -0.96 ft

The MIFAB HydroTechnic™ program uses established hydraulic equations including the Bernoulli energy equation to perform the calculations and balance head-losses within the system.

$$\frac{P_2}{\rho g} = \frac{P_1}{\rho g} + \left(\frac{v_1^2}{2g} - \frac{v_2^2}{2g}\right) + (z_1 - z_2) + h_f + h_L$$

Where P is pressure, V is Velocity, g is gravitational constant, z is height h_f is the frictional loss from pipe walls and h_L is the energy lost in pipe fittings calculated from the Darcy-Weisbach and Colebrook-White equations. At most points in the pipe system, the solution of this equation will result in the pressure (P_2) being sub-atmospheric and it is this that has given the name 'siphonic' to this method of drainage.

The driving force is given by the difference in height between the water at the roof drain and the point of discharge. This available pressure head has to be resisted by the energy lost in friction against the pipe walls and at bends, joints, junctions, other fittings and diameter changes. As a result, a siphonic system has to be carefully designed to give equal energy losses along the route from each roof drain. This process is called 'balancing the system' and is done by changing pipe diameters throughout the system.

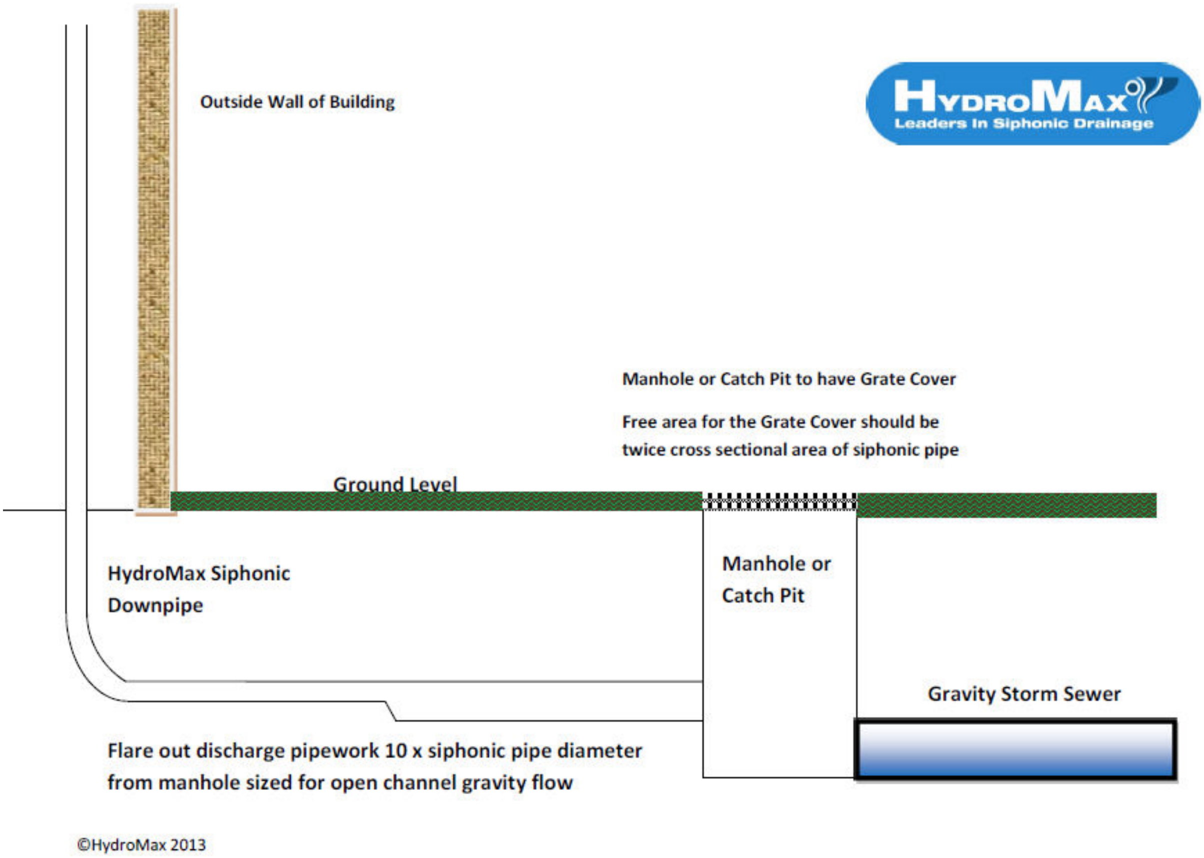
HydroTechnic™ systems are always balanced correctly to ensure secure operation in every instance. If a roof drain has too little resistance and cannot be supplied with enough water, it will let air into the pipework causing a loss of prime. HydroTechnic™ eliminates this possibility and ensures optimum design performance is always achieved.

6. Termination Options for Siphonic Systems

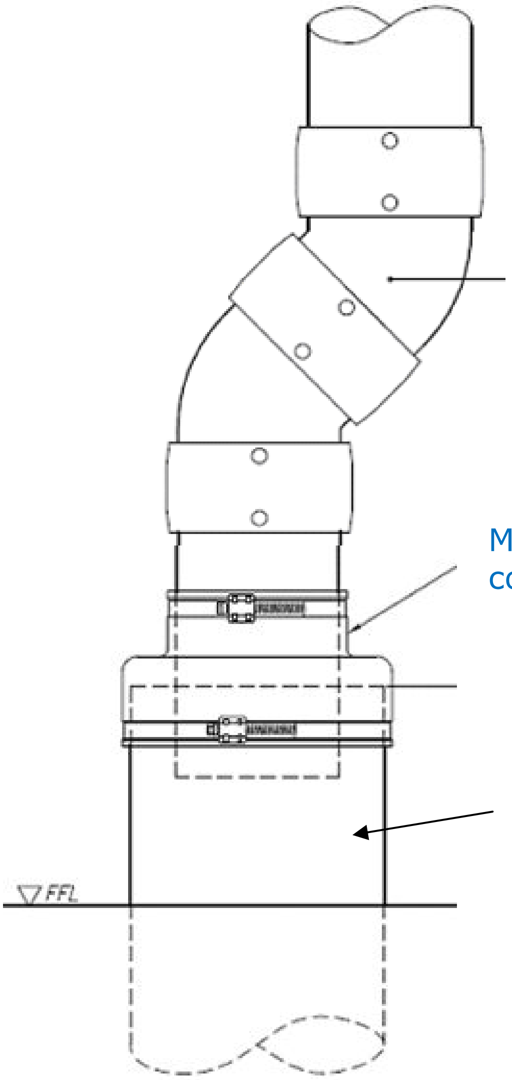
The siphonic system will normally discharge into an underground drainage system at, or close to, ground level. The design of the receiving chamber should take account of the fact that the water will be exiting the downpipe with high velocity.

The HydroTechnic™ program identifies this velocity to enable the engineer to ensure compatibility with the receiving pipe or chamber. If the exit velocity is too great for a particular system, the design engineers can manipulate pipe sizes to obtain lower exit velocities.

Provision should also be made to allow air into the receiving chamber to ensure that prime is broken at the correct point on the system. The drain out of the receiving chamber should be of adequate size to transmit the discharge from the siphonic system without running full. This is an especially important consideration to ensure that the design for underground drainage is fully compatible and has the capacity to cater for the discharge from the roof. Possible receiving chamber details are shown below. It is also good practice to flare out to a gravity-sized pipe before pipe entry to the chamber.



Siphonic Termination into Gravity Drain.

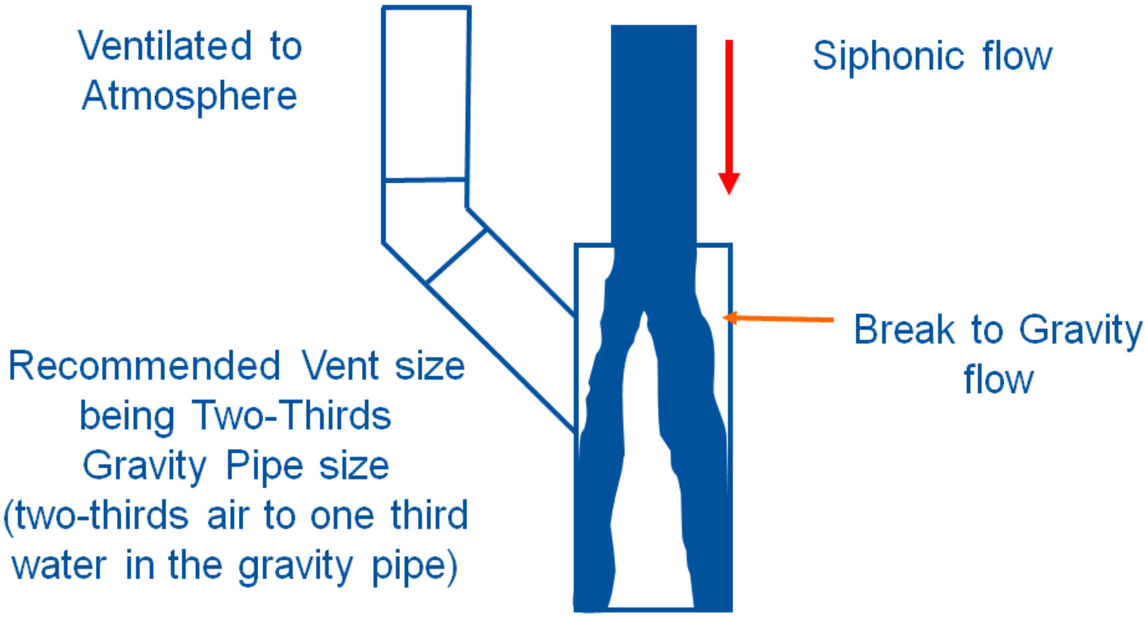


Important:

Below Grade Drain must be ventilated and sized to take the volume of discharge under Gravity flow conditions.

Under no circumstances should the gravity drain be sized to match the siphonic Pipe diameter.

Termination in High Rise Applications



Important:

If siphonic drainage is utilized to drain a high-rise building, it is possible that negative pressures will become excessive.

The siphonic pipe must therefore break to a gravity flow.

The transition break point must be adequately vented to atmosphere and the gravity pipe sized to take the discharge flow.

Under no circumstances should the pipe diameter of the gravity pipe be the same as the siphonic pipe.

For further information, including videos of the ***MIFAB*** **HydroMax™** Siphonic Roof Drainage system in operation, please visit our website on the following web-link

www.hydromax.com

Contact Details

MIFAB, Inc.
1321 West 119th Street
Chicago, IL 60643

Tel: (800) 465-2736
Fax: (773) 341-3030

Websites:
www.mifab.com
www.hydromax.com

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