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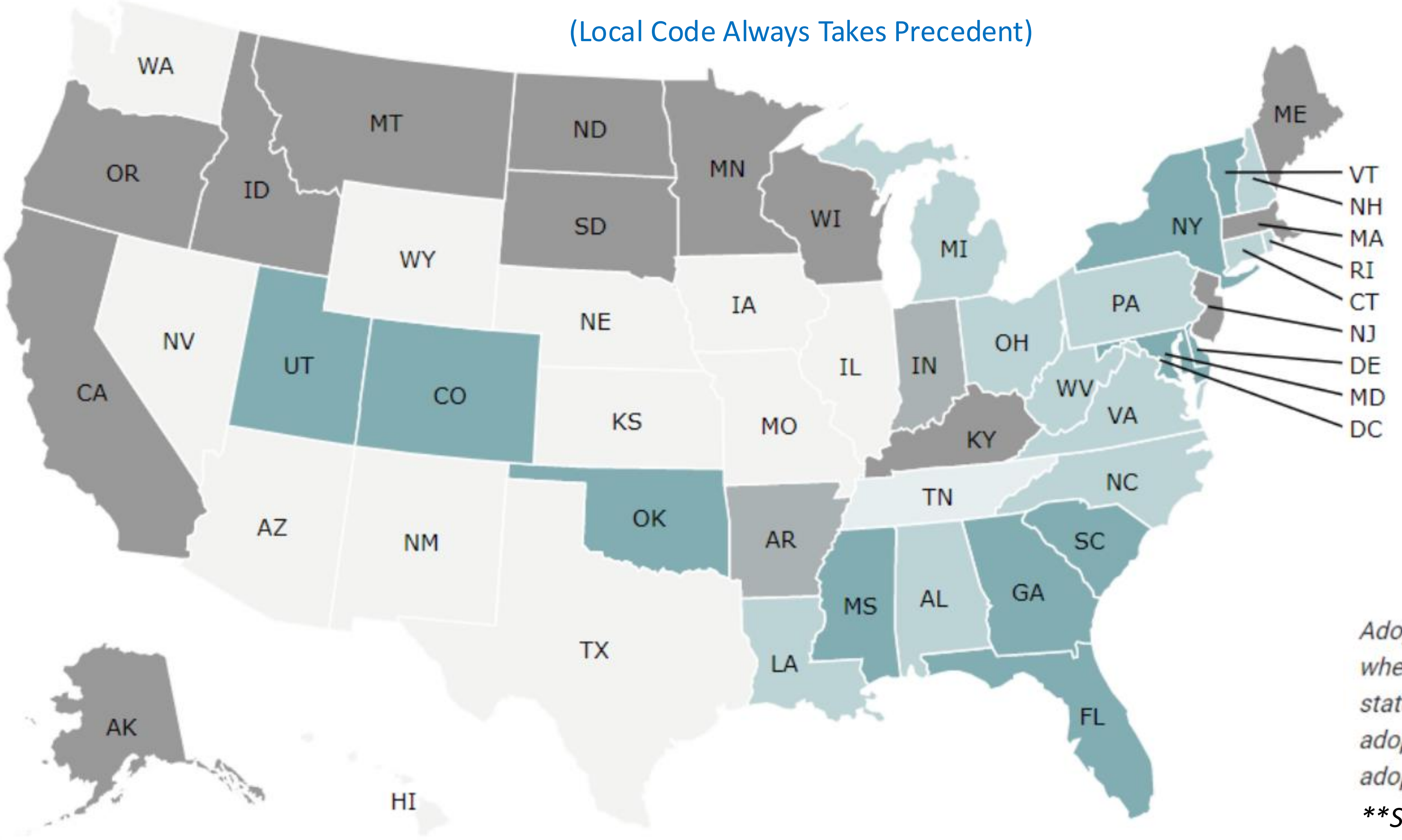
Gravity Roof Drains Fail: US Plumbing Code

Plumbing Code

IPC or UPC MAP

(Local Code Always Takes Precedent)



MAP KEY

Edition of code currently in effect by state:

- **2018 IPC®**
- **2015 IPC®**
- **2012 IPC®**
- **2009 IPC®**
- **2006 IPC®**
- **Local Adoptions**
- **No state-wide IPC adoption**

Adoption information is provided for states where the IPC is adopted statewide, adopted statewide for certain categories of buildings, or adopted by a state body to guide local code adoption.

***State of KY has its own Plumbing Code*

Gravity Drains

UPC

1101.12 Roof Drainage. Roof drainage shall comply with Section 1101.12.1 and Section 1101.12.2.

1101.12.1 Primary Roof Drainage. Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Authority Having Jurisdiction, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of 60 minutes duration and 100 year return period. Refer to Table D 101.1 (in Appendix D) for 100 years, 60-minute storms at various locations.

1101.12.2 Secondary Drainage. Secondary (emergency) roof drainage shall be provided by one of the methods specified in Section 1101.12.2.1 or Section 1101.12.2.2.

1101.12.2.2.1 Separate Piping System. The secondary roof drainage system shall be a separate system of piping, independent of the primary roof drainage system. The discharge shall be above grade, in a location observable by the building occupants or maintenance personnel. Secondary roof drain systems shall be sized in accordance with Section 1101.12.1 based on the rainfall rate for which the primary system is sized.

1101.12.2.2.2 Combined System. The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of the last horizontal offset located below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1103.0 based on double the rainfall rate for the local area.

Primary

100-year, 60 minutes

Overflow

100-year, 60 minutes

IPC

SECTION 1106
SIZE OF CONDUCTORS, LEADERS AND STORM DRAINS

1106.1 General. The size of the vertical conductors and leaders, building *storm drains*, building storm *sewers* and any horizontal branches of such drains or *sewers* shall be based on the 100-year hourly rainfall rate indicated in Figures 1106.1(1) through 1106.1(5) or on other rainfall rates determined from *approved* local weather data.

SECTION 1108
SECONDARY (EMERGENCY) ROOF DRAINS

1108.1 Secondary (emergency overflow) drains or scuppers. Where roof drains are required, secondary (emergency overflow) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. Where primary and secondary roof drains are manufactured as a single assembly, the inlet and outlet for each drain shall be independent.

1108.3 Sizing of secondary drains. Secondary (emergency) roof drain systems shall be sized in accordance with Section 1106 based on the rainfall rate for which the primary system is sized. Scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.7. Scuppers shall have an opening dimension of not less than 4 inches (102 mm) in height and have an opening width equal to the circumference of the roof drain required for the area served. The flow through the primary system shall not be considered when sizing the secondary roof drain system.

Sizing the Roof

UPC

TABLE 1103.1
SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING[2, 3]

SIZE OF DRAIN, LEADER, OR PIPE	FLOW	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)											
inches	gpm[1]	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)	7 (in/h)	8 (in/h)	9 (in/h)	10 (in/h)	11 (in/h)	12 (in/h)
2	30	2880	1440	960	720	575	480	410	360	320	290	260	240
3	92	8800	4400	2930	2200	1760	1470	1260	1100	980	880	800	730
4	192	18 400	9200	6130	4600	3680	3070	2630	2300	2045	1840	1675	1530
5	360	34 600	17 300	11 530	8650	6920	5765	4945	4325	3845	3460	3145	2880
6	563	54 000	27 000	17 995	13 500	10 800	9000	7715	6750	6000	5400	4910	4500
8	1208	116 000	58 000	38 660	29 000	23 200	19 315	16 570	14 500	12 890	11 600	10 545	9600

Chapter 11: Storm Drainage
https://epubs.iapmo.org/2024/UPC/

IPC

1105.2 Roof drain flow rate. The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106. The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain.

1106.2.1 Rainfall rate conversion method. The rainfall rate falling on a roof surface shall be converted to a gallon per minute (L/m) flow rate in accordance with Equation 11-1.

$$\boxed{GPM = R \times A \times 0.0104} \qquad \textbf{(Equation 11-1)}$$

where:

R = Rainfall intensity in inches (mm) per hour.

A = Roof area in square feet (m^2).

Chapter 11: Strom Drainage
https://codes.iccsafe.org/content/IPC2024P1/chapter-11-storm-drainage

Example 1

Rainfall Rate: 100-year, 60-minute: 4 in/hr
Area Feeding Each Drain = 13,500 sq ft

Sizing the Roof

Rainfall Rate: 100-year, 60-minute: 4 in/hr
Area Feeding Each Drain = 13,500 sq ft

UPC

TABLE 1103.1
SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING[2,3]

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inches	gpm[1]	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)	7 (in/h)	8 (in/h)	9 (in/h)	10 (in/h)	11 (in/h)	12 (in/h)
2	30	2880	1440	960	720	575	480	410	360	320	290	260	240
3	92	8800	4400	2930	2200	1760	1470	1260	1100	980	880	800	730
4	192	18 400	9200	6130	4600	3680	3070	2630	2300	2045	1840	1675	1530
5	360	34 600	17 300	11 530	8650	6920	5765	4945	4325	3845	3460	3145	2880
6	563	54 000	27 000	17 995	13 500	10 800	9000	7715	6750	6000	5400	4910	4500
8	1208	116 000	58 000	38 660	29 000	23 200	19 315	16 570	14 500	12 890	11 600	10 545	9600

6" Roof Drain is Required

IPC

Rainfall Rate x Area x .0104 = GPM

4"/hr x 13,500 sq ft x .0104 = GPM

561 = GPM

561 GPM is Required

But how do we take care of that demand?

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Select a Drain to Use: 2012 IAPMO/ASPE Study

Storm Drainage System Research Project

FLOW RATE THROUGH ROOF DRAINS

RESEARCH ASPE FOUNDATION

IAPMO®

In 2012 the IAPMO/ASPE Research Foundation did a study on Roof Drains; it was led by Julius Ballanco.

In the study they took all the major US drain manufacturers roof drains and tested them using the exact same parameters.

Test No.	Model No.	Description	Type of Strainer	Flow Rate (gpm) Based on Head Height					
				1″	2″	3″	4″	5″	6″
5	A-5	6″ cast iron drain	cast iron dome	10	185	199	238	267	218

Each drain was tested blindly so we don't which drain is A, B, C, etc., but we do know all the data is apples to apples.

Sizing The SAME Roof

Rainfall Rate: 100-year, 60-minute: 4 in/hr
Area Feeding Each Drain = 13,500 sq ft

Sample is 6” CI Gravity Drain w/ CI Dome

Chart shows **at given water depths, the drain’s GPM intake**: 4” ponding = 238 GPM

Test No.	Model No.	Description	Type of Strainer	Flow Rate (gpm) Based on Head Height					
				1″	2″	3″	4″	5″	6″
5	A-5	6″ cast iron drain	cast iron dome	10	185	199	238	267	218

Both are approved

UPC

(1) **6” Roof Drain** is required
GPM not taken into account

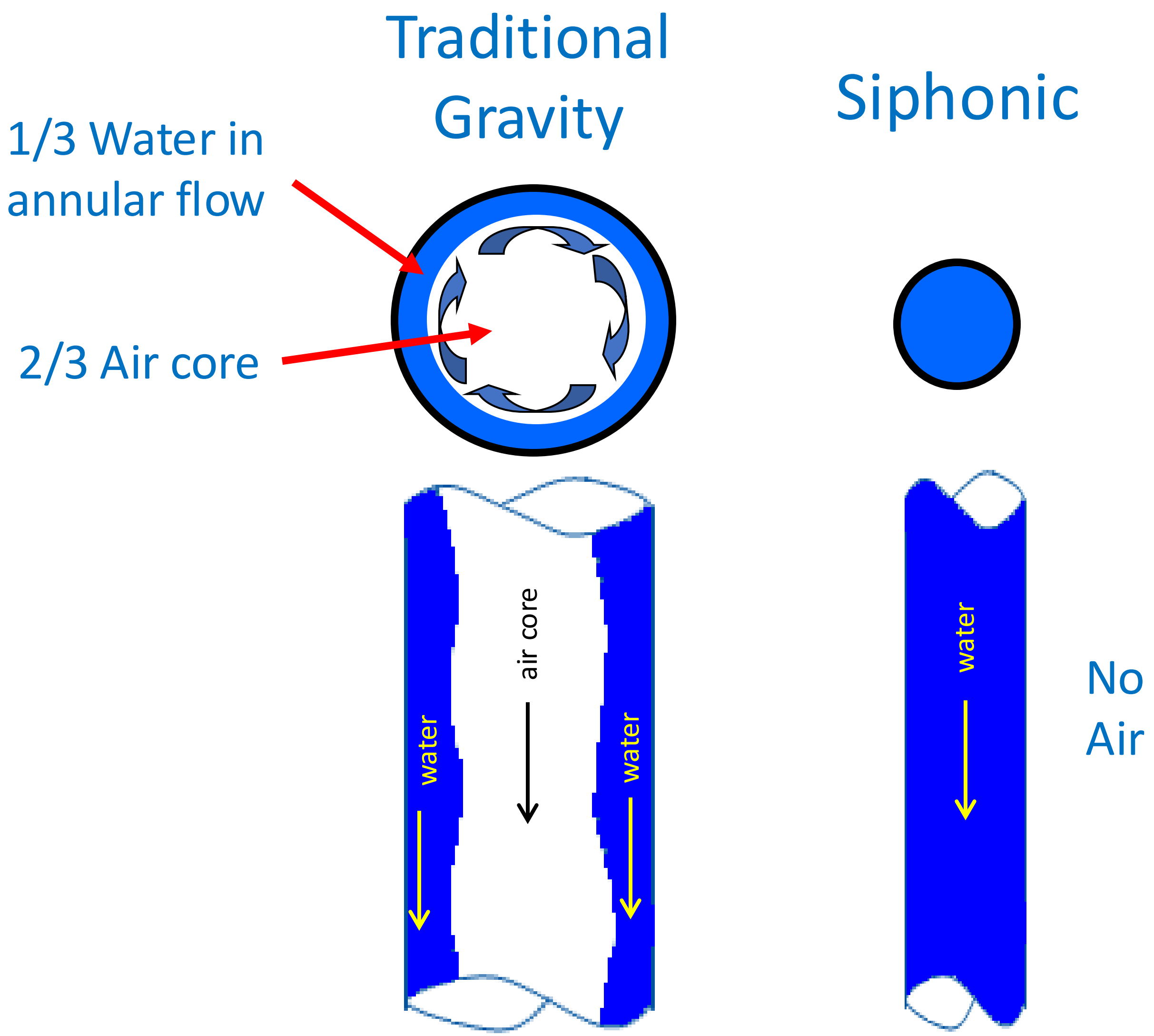
IPC

(3) **6” Roof Drains** are required to obtain the **561 GPM** Target Flow

Note the **drop in GPM flow** from 5” to 6” of ponding for this **gravity drain.**

Why?

Gravity Requires Air Flow



Gravity Drains require 2/3rds air to efficiently transport water.

When a **gravity drain becomes submerged**, air no longer enters the drain making it **less efficient**.

This is exactly what the drop from 5" to 6" is showing.

Siphonic drains become more efficient with increased supply.

Gravity Drains Fail: Prove Me Wrong

Drop in gravity drain efficiency, when water depth INCREASES

More ponding = less gravity drain efficiency

Confirmation of this shown in 2012 Study:

2012 IAMPO/ASPE Results for 6” Gravity Drains

Test	Test No.	Model No.	Description	Strainer	1"	2"	3"	4"	5"	6"
W/O Pipe	35	F-8	6" cast iron drain	ci dome	133	228	371	537	427	551
Straight Pipe	38	G-4	6" PVC drain	ABS dome	118	112	240	462	764	1142
Straight Pipe	24	E-6	6" cast iron drain	poly dome	150	135	211	281	418	873
Offset Pipe	24	E-6	6" cast iron drain	poly dome	145	138	238	257	376	712
Offset Pipe	5	A-5	6" cast iron drain	ci dome	228	240	549	1,008	1,014	1,026

1" to 2"	2" to 3"	3" to 4"	4" to 5"	5" to 6"
42%	39%	31%	-26%	23%
-5%	53%	48%	40%	33%
-11%	36%	25%	33%	52%
-5%	42%	7%	32%	47%
5%	56%	46%	1%	1%

Seeing **GPM stall out** and **even decline**

PLUS, An Upsize in Horizontal Pipe

561 GPM flow through the drain

UPC

TABLE 1103.2
SIZING OF HORIZONTAL RAINWATER PIPING[1, 2]

SIZE OF PIPE	FLOW (⅛ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
inches	gpm	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	34	3288	1644	1096	822	657	548
4	78	7520	3760	2506	1880	1504	1253
5	139	13 360	6680	4453	3340	2672	2227
6	222	21 400	10 700	7133	5350	4280	3566
8	478	46 000	23 000	15 330	11 500	9200	7670
10	860	82 800	41 400	27 600	20 700	16 580	13 800
12	1384	133 200	66 600	44 400	33 300	26 650	22 200
15	2473	238 000	119 000	79 333	59 500	47 600	39 650

IPC

TABLE 1106.2 STORM DRAIN PIPE SIZING

PIPE SIZE (inches)	CAPACITY (gpm)				
	VERTICAL DRAIN	SLOPE OF HORIZONTAL DRAIN			
		1/16 inch per foot	1/8 inch per foot	1/4 inch per foot	1/2 inch per foot
2	34	15	22	31	44
3	87	39	55	79	111
4	180	81	115	163	231
5	311	117	165	234	331
6	538	243	344	487	689
8	1,117	505	714	1,010	1,429
10	2,050	927	1,311	1,855	2,623
12	3,272	1,480	2,093	2,960	4,187
15	5,543	2,508	3,546	5,016	7,093

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10” Pipe in the horizontal

IPC

8” Pipe in the horizontal

Pipe is never downsized, so this becomes the new MIN pipe diameter used through the main vertical stacks in multiple locations and the length of the entire building height.

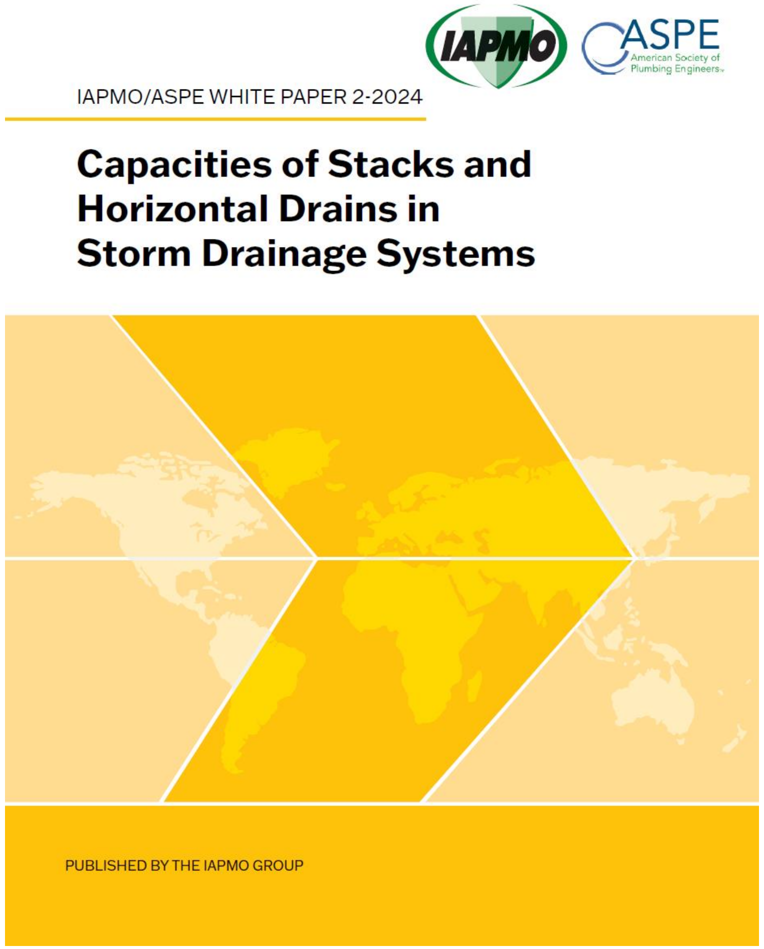
Gravity Roof Drains Fail: Prove Science Wrong

Here's the Reality:

Calculations for a Gravity Storm System can NOT be done

(seriously…)

Sizing Pipe in the Vertical



June 2024 IAMPO/ASPE White Paper

"Capacities of Stacks and Horizontal Drains in Storm Drainage Systems"

"The **annular ratio is significant to the flow capacities** in vertical pipes.

The annular ratio of **1/3 is the maximum ratio** for pneumatic reasons with lesser annular **(water/air)** ratios as an optional limiting factor"

How do we account for the air/water mix within gravity calculations? Or on the roof? (Not currently considered)

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Most Efficient Air/Water Mix

June 2024 IAMPO/ASPE White Paper

"Capacities of Stacks and Horizontal Drains in Storm Drainage Systems"

TABLE 2.2
COMPARISONS OF FLOW CAPACITY IN PVC AND CAST-IRON VERTICAL STACKS

PIPE SIZES			$r_s = 1/3$		$r_s = 7/24$		$r_s = 1/4$	
Nominal Pipe Size	PVC Internal Diameter [in]	Cast Iron Internal Diameter [in]	PVC Vertical Flow [gpm]	Cast Iron Vertical Flow [gpm]	PVC Vertical Flow [gpm]	Cast Iron Vertical Flow [gpm]	PVC Vertical Flow [gpm]	Cast Iron Vertical Flow [gpm]
2	2.067	1.960	72.4	26.8	58.0	21.5	44.8	16.6
3	3.068	2.960	207.6	80.5	166.2	64.4	128.6	49.8
4	4.026	3.940	428.6	172.5	343.1	138.1	265.3	106.8
5	5.047	4.940	783.1	315.3	626.8	252.4	484.8	195.2
6	6.065	5.940	1278.2	515.6	1023.2	412.7	791.3	319.2
8	7.981	7.940	2657.9	1117.8	2127.5	894.8	1645.5	692.0
10	10.020	9.940	4875.6	2034.9	3902.8	1628.9	3018.5	1259.8
12	11.938	11.940	7777.9	3317.8	6226.0	2655.8	4815.4	2054.1
14	13.126	---	10016.9	---	8018.2	---	6201.6	---
15	---	14.035	---	5105.9	----	4087.2	---	3161.1

r_s = ratio of area of cross section of water stream in a drainage stack to total area of cross section of the stack; Water to Air mix in the pipe.

r_s = 1/3 = 1/3rd of the pipe is full of water (33%), 2/3rds of the pipe is full of Air (66%)

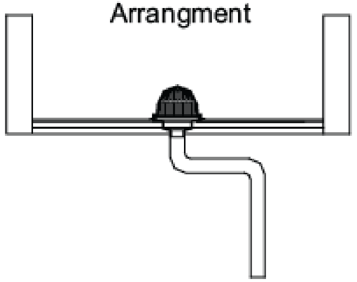
How do we account for pipe material within gravity calculations? (Not currently considered)

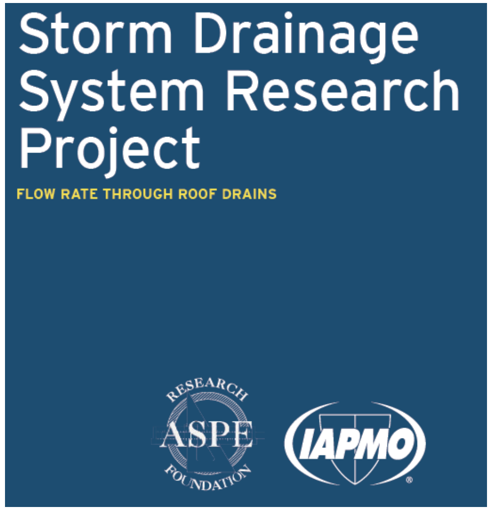
LAST: Pipe Routing Matters

2012 IAMPO/ASPE Results for 3” Gravity Drains

Tests show **pipe routing influences GPM** flow, no constant shown even though the pipe setup is the same for each drain

Modified Piping Arrangment





Test No.	Model No.	Description	Type of Strainer	1"	2"	3"	4"	5"	6"
2	A-2	3" cast iron drain	cast iron dome	41	135	405	414	418	429
7	B-2	3" cast iron drain	cast iron dome	58	152	202	414	448	467
11	C-2	3" cast iron drain	poly dome	27	181	415	468	485	495
16	D-2	3" cast iron drain	aluminum dome	25	101	149	171	490	522
~~27~~	~~F-1~~	~~3" cast iron drain~~	~~cast iron dome~~	~~105~~	~~220~~	~~137~~	~~171~~	~~261~~	~~522~~
31	F-5	3" cast iron drain	cast iron dome	47	133	266	398	411	429
36	G-2	3" PVC drain	ABS dome	16	95	140	195	475	500
40	H-2	3" cast iron drain	cast iron dome	16	91	208	226	239	498
45	I-2	3" PVC drain	poly dome	13	50	119	188	379	474
48	J-2	3" cast iron drain	cast iron dome	32	65	388	462	485	493
53	J-7	3" cast iron drain	brass dome	38	114	179	249	453	487
58	J-13	3" cast iron drain	brass dome	22	100	165	162	186	522
		3" Average		30	111	240	304	406	483

Test No.	Model No.	1" to 2"	2" to 3"	3" to 4"	4" to 5"	5" to 6"
2	A-2	68%	51%	5%	2%	3%
7	B-2	68%	7%	34%	29%	8%
11	C-2	90%	47%	-1%	4%	2%
16	D-2	48%	27%	13%	50%	16%
~~27~~	~~F-1~~	~~23%~~	~~30%~~	~~15%~~	~~9%~~	~~32%~~
31	F-5	64%	50%	8%	11%	-1%
36	G-2	78%	50%	21%	32%	6%
40	H-2	81%	55%	12%	21%	19%
45	I-2	71%	59%	45%	28%	25%
48	J-2	62%	48%	3%	14%	10%
53	J-7	67%	33%	7%	7%	47%
58	J-13	72%	28%	15%	10%	50%
	Avg	71%	43%	14%	20%	18%

***Crossed out values not included in the average calculations*

How do we account for pipe length or fittings loss within gravity calculations? (Not currently considered)

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Gravity Roof Drains Fail: US Gravity Drains Approved?

Performance Standard for Roof Drains

UPC

1102.0 Roof Drains.

1102.1 Applications. Roof drains shall be constructed of aluminum, cast-iron, copper alloy of not more than 15 percent zinc, leaded nickel bronze, stainless steel, ABS, PVC, polypropylene, polyethylene, or nylon and shall comply with ASME A112.3.1 or ASME A112.6.4.

IPC

1102.6 Roof drains. Roof drains shall conform to ASME A112.3.1 or ASME A112.6.4. Roof drains, other than siphonic roof drains, shall be tested and rated in accordance with ASME A112.6.4 or ASPE/IAPMO Z1034.

ASME A112.6.4

Drains **tested** and results **documented**

10 Flow measurement

10.1 Overview

The flow of general purpose roof drains shall be measured in accordance with Clause 10.2. In addition, the

a) flow characteristics of general purpose roof drains shall be verified experimentally and the results documented;

b) flow rate shall be determined by measuring the flow necessary to maintain the sustained water depth specified in Clause 10.3.2; and

c) flow measurements shall be conducted in an apparatus constructed as specified, in Figure 11, in this standard and in ASME A112.6.9/CSA B79.9, with a 1219 mm (48 in) long vertical discharge pipe with a nominal diameter equal to that of the outlet of the roof drain being tested.

Note: *Results obtained from application of flow measurement procedures indicate a flow rate achieved under laboratory conditions using 1219 mm (48 in) vertical discharge configuration; all added elements of drainage design will increase or decrease flow rates obtained in testing. Variables such as wind, vortices, debris, roof design, roof obstructions, slope, etc., can significantly change flow rate. Designers are advised to consider these and other possible variables in roof drainage system design.*

Data not accurate with more pipe connected

Note: *Results obtained from application of flow measurement procedures indicate a flow rate achieved under laboratory conditions using 1219 mm (48 in) vertical discharge configuration; all added elements of drainage design will increase or decrease flow rates obtained in testing. Variables such as wind, vortices, debris, roof design, roof obstructions, slope, etc., can significantly change flow rate. Designers are advised to consider these and other possible variables in roof drainage system design.*

There are **0** gravity overflow drains with ASME A112.6.4 approval; **ZERO**

MAX Hydraulic Head = MAX Overflow Ponding = MAX Water Depth

MFG A ("Traditional" Gravity Primary Drain)

3" Drain	1"	2"	3"	4"	5"	6"
AVG	25	87	214	225	231	247

MFG C ("Traditional" Gravity Primary Drain)

3" Drain	1"	2"	3"	4"	5"	6"
AVG	38	68	292	289	298	299

MFG B ("High-Performance" Gravity Primary Drain)

3" Drain	1"	2"	3"	4"	5"	6"
4ft Vert	81	320	350	352	356	359

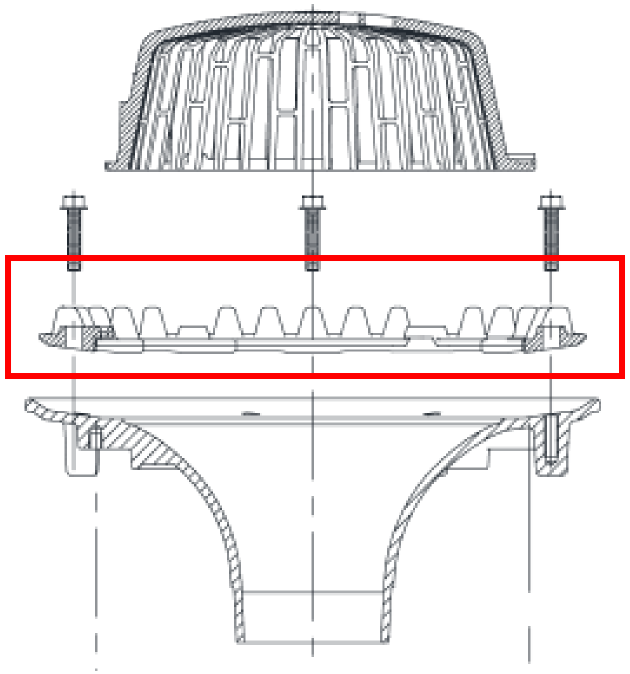
ONLY Measurement Structural Engineers Use to Size the Roof Load

Water height on the roof at **worst case scenario**, if the primary drain was clogged

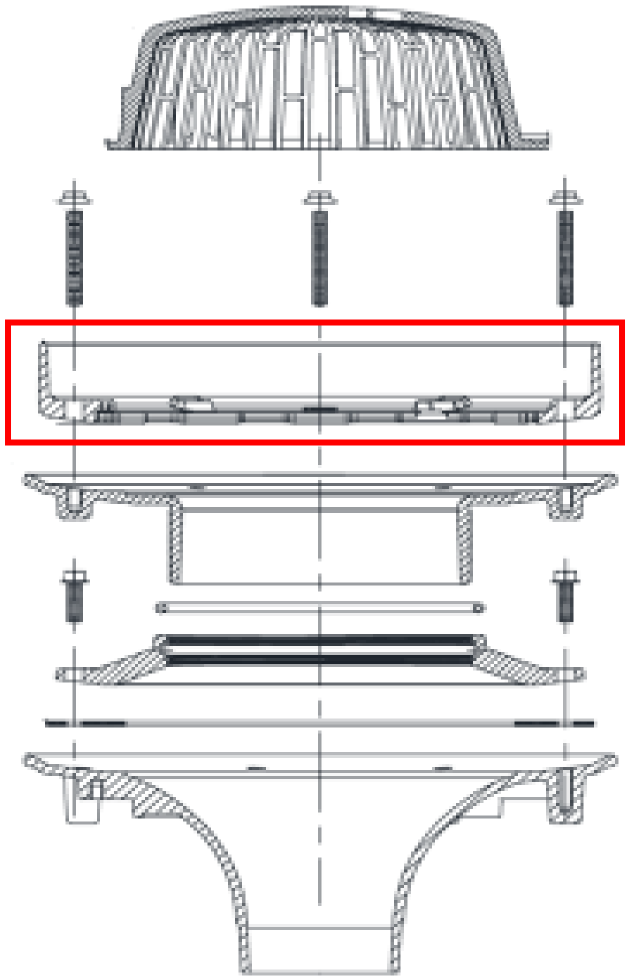
Why is just adding 2" to the primary data for the water dam problematic?

IT'S A TOTALLY DIFFERENT DRAIN!!

MFG B's Gravity Primary Roof Drain



MFG B's Gravity Overflow Roof Drain



MFG B claims at trade shows to **achieve a 'high-performance'** gravity primary roof drain **due to the nibs** placed around the membrane clamp. That is a great discovery to increase performance, but as we can visually see looking at the gravity overflow roof drain diagram, the clamping collar with **nibs are no longer included on the overflow design**, replaced instead with a typical 2" water dam.

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Gravity Roof Drains Fail: Math Doesn't Lie

Example 1
US Sizing on Smaller Roof

Rainfall Rate: 100-year, 60-minute: 3.67 in/hr
Area Feeding Each Drain = 2,000 sq ft

GPM = sq ft x rainfall rate x .0104
GPM = 2,000 sq ft x 3.67 in/hr x .0104
GPM = 76 per drain

Overflow Drain Comparison: Example 1

Rainfall Rate: 100-year, 60-minute: 3.67 in/hr
Area Feeding Each Drain = 2,000 sq ft
GPM = 76 per drain

	GPM	Static Head Water Dam Height	MAX Hydraulic Head Overflow Ponding Depth	% Difference to Siphonic
MFG A ("Traditional" Gravity Primary Drain)	76	2"	3.82"	49%
MFG B ("High-Performance" Gravity Primary Drain)	76	2"	2.94"	15%
ASCE/FM Global Overflow (3")	76	2"	3.50"	37%
ASCE/FM Global Scupper (6" wide, 4" high)	76	4"	7.00"	173%
MFG C (Siphonic Roof Drains)	76	2"	2.56"	

Example 2	Weight (lbs.) per sq ft MAX Ponding	% Difference to Siphonic	Total Roof Weight (lbs.)	% Difference to Siphonic
MFG A ("Traditional" Gravity Primary Drain)	20	49%	39,734	49%
MFG B ("High-Performance" Gravity Primary Drain)	15	15%	30,581	15%
ASCE/FM Global Overflow (3")	18	37%	36,406	37%
ASCE/FM Global Scupper (6" wide, 4" high)	36	173%	72,812	173%
MFG C (Siphonic Roof Drains)	13		26,628	

Example 2 with
US Approved Roof Drains

Rainfall Rate: 100-year, 60-minute: 4 in/hr
Area Feeding Each Drain = 13,500 sq ft
GPM = 561 per drain

Overflow Drain Comparison: Example 2

Rainfall Rate: 100-year, 60-minute: 4 in/hr
Area Feeding Each Drain = 13,500 sq ft
GPM = 561 per drain

	GPM	Static Head Water Dam Height	MAX Hydraulic Head Overflow Ponding Depth	% Difference to Siphonic
MFG A ("Traditional" Gravity Primary Drain)	187	3"	5.45"	11%
MFG B ("High-Performance" Gravity Primary Drain)	561	3"	5.48"	11%
ASCE/FM Global Overflow (6")	561	3"	8.50"	43%
ASCE/FM Global Scupper (6" wide, 6" high)	561	6"	11.00"	56%
MFG C (Siphonic Roof Drains)	561	3"	4.85"	

***MFG B Primary Data used for both ASCE/FM Global metrics above*

Example 1	Weight (lbs.) per sq ft MAX Ponding	% Difference to Siphonic	Total Roof Weight (lbs.)	% Difference to Siphonic
MFG A ("Traditional" Gravity Primary Drain)	28	12%	382,651	12%
MFG B ("High-Performance" Gravity Primary Drain)	29	13%	384,758	13%
ASCE/FM Global Overflow (6")	44	75%	596,796	75%
ASCE/FM Global Scupper (6" wide, 6" high)	57	127%	772,324	127%
MFG C (Siphonic Roof Drains)	25		340,525	

Conclusion:

There is NO WAY to determine MAX HYDRAULIC HEAD/ OVERFLOW PONDING DEPTH for a gravity system to provide reliable data to structural for roof load sizing

**Saving grace is that ASCE/FM Global size gravity loads 2x what IPC/UPC communicate

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Guide to Siphonic Roof Drainage

What is Siphonic Roof Drainage?

Based on the simple principle of a siphon using negative pressure caused from the height of the building and lack of air in the pipes.

This pressure pulls storm water off the roof.

The higher the elevation, the faster the flow of discharge.

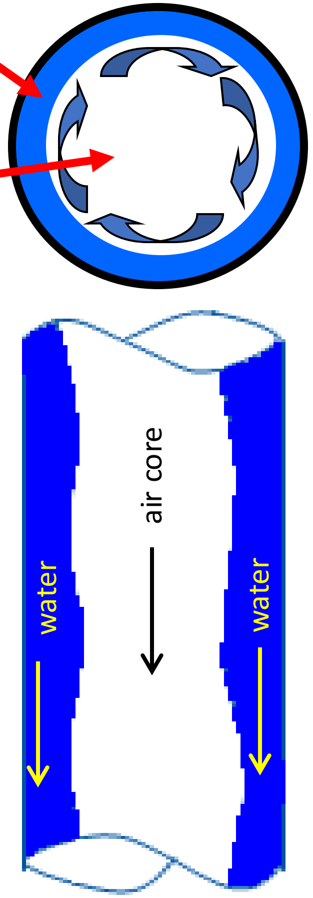
Half Diameter Storm Pipe

Traditional Gravity

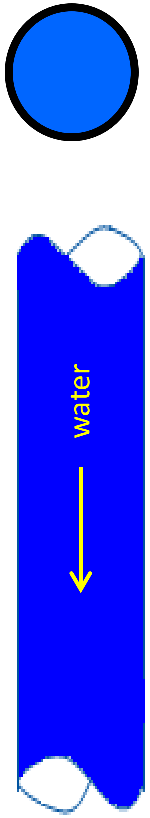
Siphonic

1/3 Water in annular flow

2/3 Air core



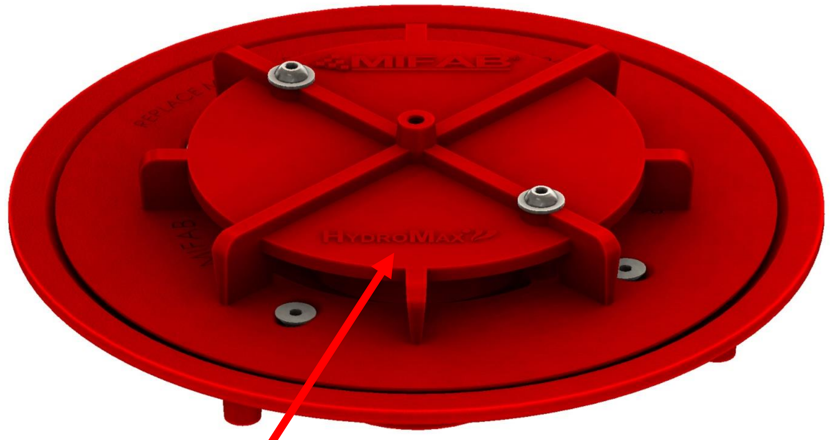
8” Pipe



No Air

4” Pipe

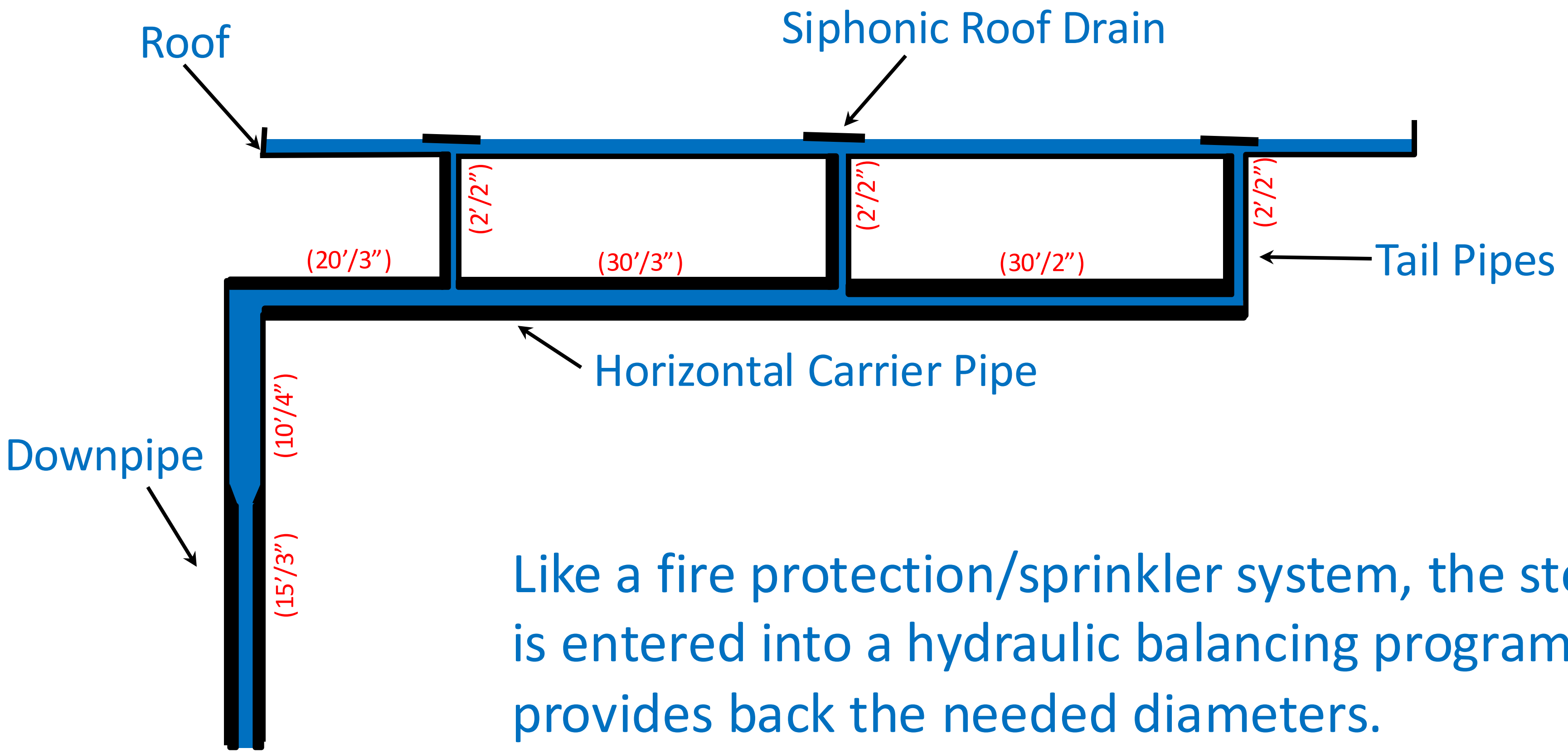
Siphonic Drain



Baffle Plate eliminates air from entering the system, allowing smaller diameter pipe to be used

(approximately half the diameter)

No Horizontal Slope, Zero Pitch



Like a fire protection/sprinkler system, the storm routing is entered into a hydraulic balancing program which provides back the needed diameters.

1. Vertical = Natural Energy from Building Height + Energy Created by Reducing Pipe Diameter
2. Horizontal + Fittings = Energy Loss

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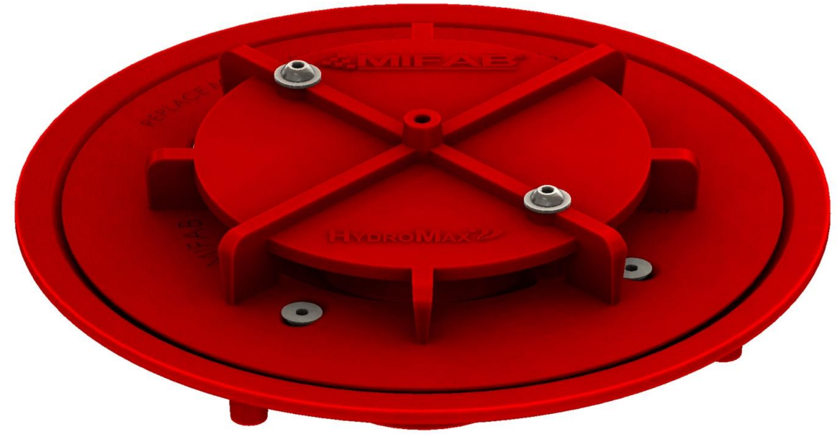
What Makes it Work?

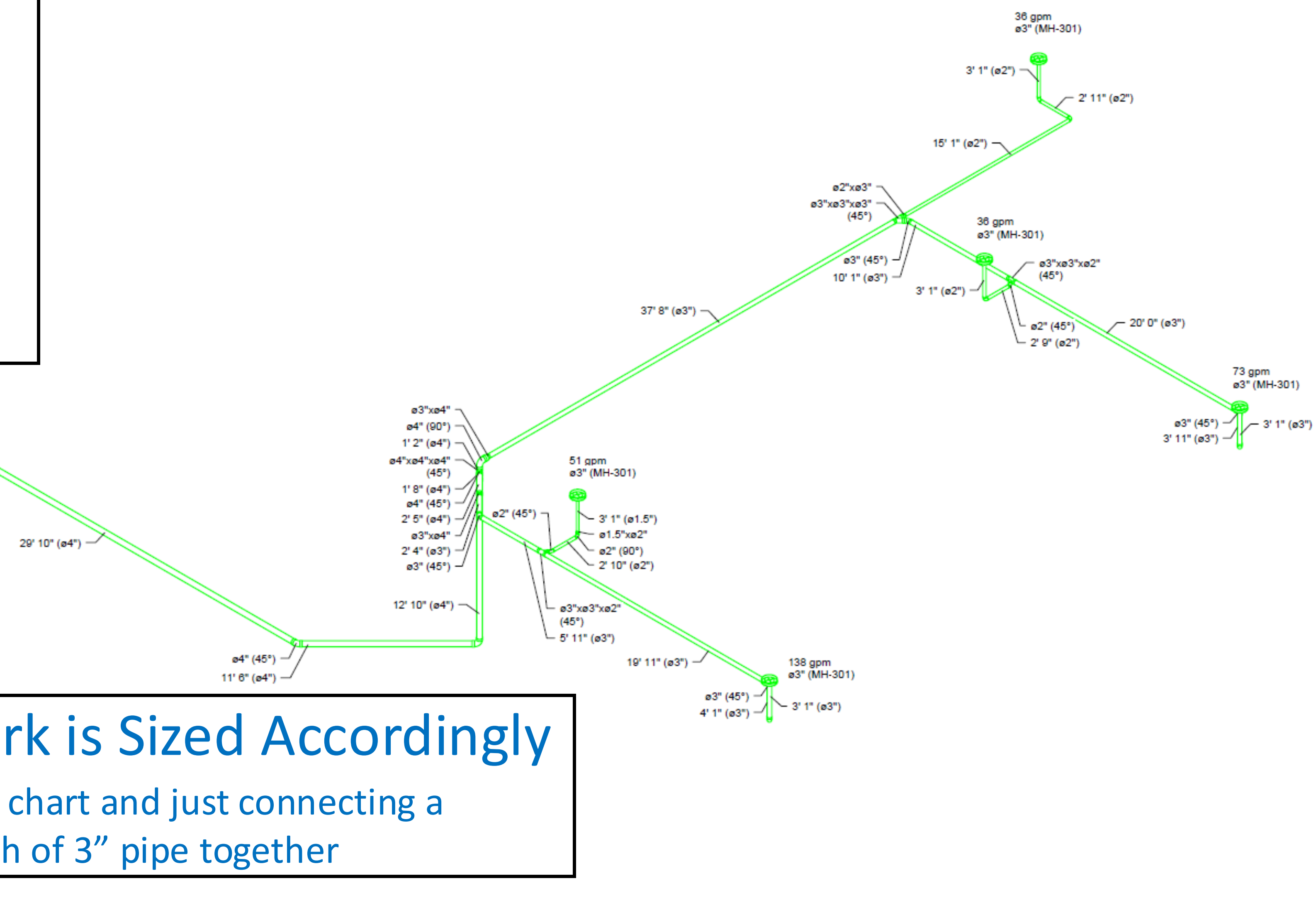
There are NO PUMPs used

Height of the building naturally pulls water towards the roof drain from every direction

#1 The Baffle Plate

eliminates air from entering the system





#2 The Pipework is Sized Accordingly

Not using a chart and just connecting a bunch of 3" pipe together

Plumbing Code

Is Siphonic Drainage approved?

Yes, by both IPC and UPC as an engineered system.

IPC 2015 CODE	UPC 2018 CODE
1107.1 GENERAL SIPHONIC ROOF DRAINS AND DRAINAGE SYSTEMS SHALL BE DESIGNED IN ACCORDANCE WITH ASME A112.6.9 AND ASPE 45.	1106.2 SIPHONIC ROOF DRAINAGE SYSTEMS THE DESIGN OF A SIPHONIC ROOF DRAINAGE SYSTEM SHALL COMPLY WITH ASPE 45. 1106.3 SIPHONIC ROOF DRAINS SIPHONIC ROOF DRAINS SHALL COMPLY WITH ASME A112.6.9

ASPE 45 Standard: Design standard for rules and regulations governing siphonic roof drainage

ASME A112.6.9: Performance standard for siphonic roof drains

IAMPO: ASME A112.6.9

IAPMO is a testing corporation that then lists the products and certifies that products are manufactured to and meet standards

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Product: Siphonic Roof Drains — File No. 6009

Issued To: MIFAB, Inc.
1321 WEST 119TH STREET
CHICAGO, IL 60643

(File Reference 6009)

Siphonic Drain Options

CI body, DI Baffle Plate

Membrane Installations

S/S body and Baffle Plate

Only Requires
12" Gutter

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Issues with Gravity Drains

Why Do Gravity Drains Need Air? A Century of Research

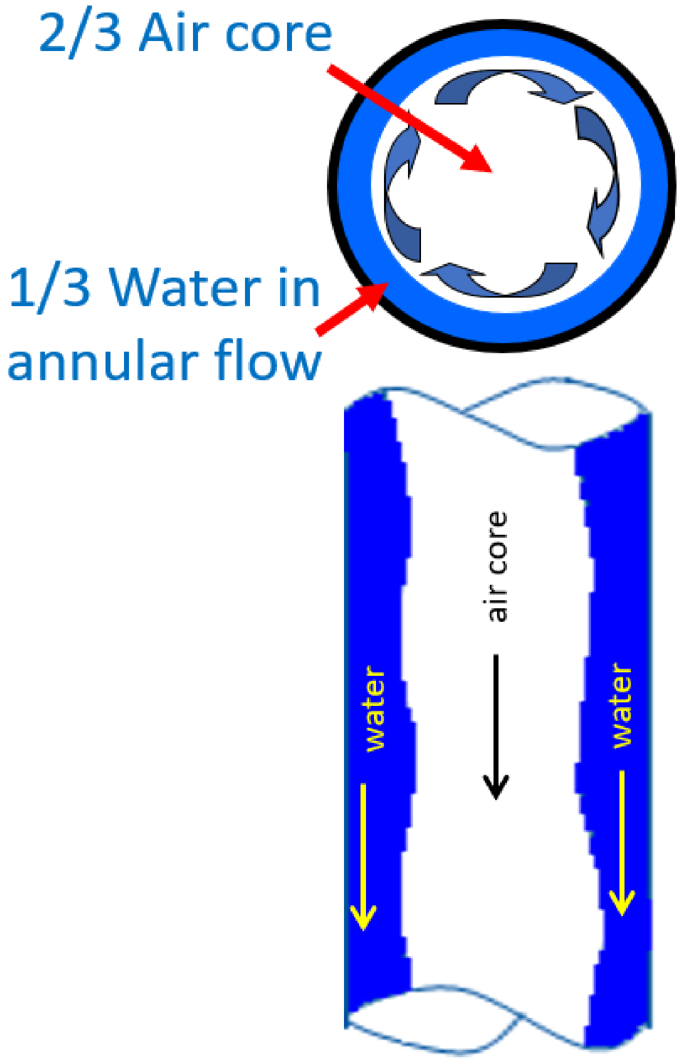
In **1929, the Sub-Committee on Plumbing, Building Code Committee for the U. S. Department of Commerce** recommended minimum requirements for plumbing:

> *"This diaphragming and forming slugs probably first appears in a 3-inch stack when the* ***stack is from one-fourth to one-third full****."*

Next in **1937 at the University of Iowa, Dawson and Kalinske** conducted the first known recorded test considering the hydraulic properties of a liquid:

> *"The water flow at a definite rate depending on the water discharge and the* ***ability of the water to carry the air along****."*

> *"With the pneumatic disturbances caused by the flow of water in vertical pipes, and with the* ***factors effecting the amount of air*** *necessary to prevent excessive negative pressures in adjoining drains."*



Why Do Gravity Drains Need Air? A Century of Research

Finally in **1961, NBS Monograph 31** conducted a study on the **"Capacities of Stacks in Sanitary Drainage Systems for Buildings"** which to this day helped create the GPM sizing charts for modern gravity storm sizing:

*"The ratio of area of cross section of this **annular layer of water stream in a drainage stack** to total area of cross section of the stack is recommended to be no greater than **one fourth to one third**".*

Recently in **June 2024, IAMPO/ASPE** released a white paper titled **"Capacities of Stacks and Horizontal Drain in Storm Drainage System"**. The new study does a great job of showing the negative effect on performance when the water/air mix transitions away from 1/3rd:

*"The **annular ratio is significant to the flow** capacities in vertical pipes. The **annular ratio of 1/3 is the maximum ratio** for pneumatic reasons with lesser annular (water/air) ratios as an optional limiting factor"*

TABLE 2.2
COMPARISONS OF FLOW CAPACITY IN PVC AND CAST-IRON VERTICAL STACKS

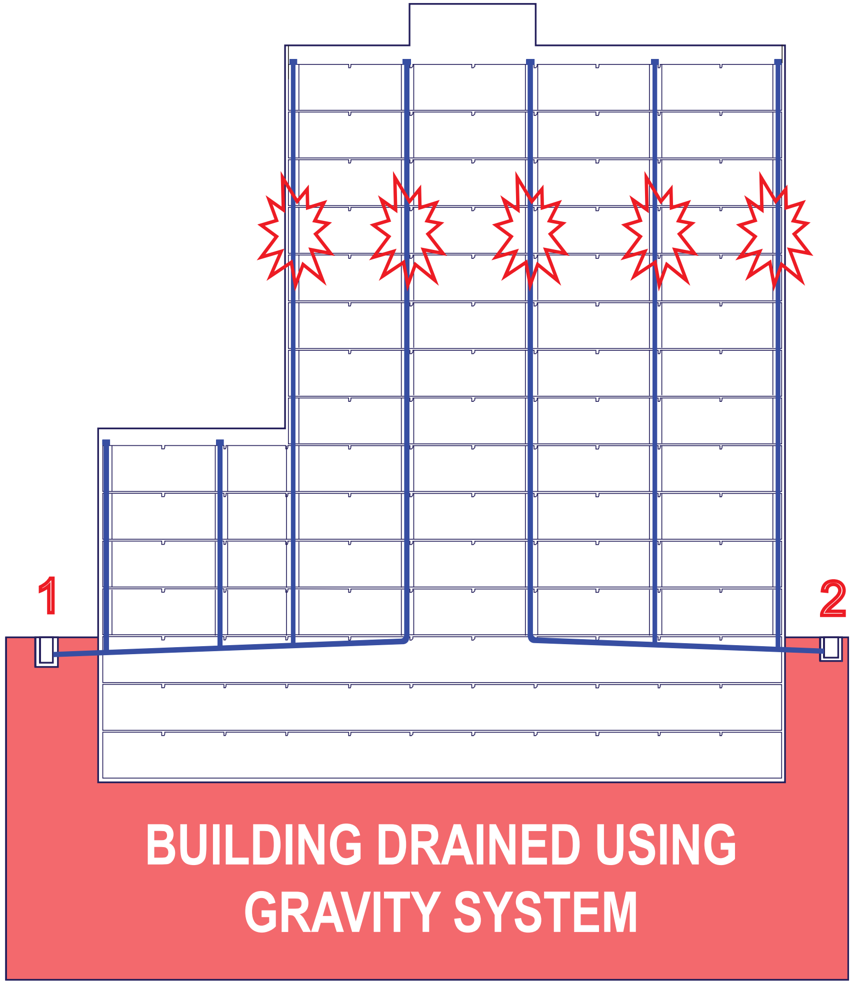
PIPE SIZES			$r_s = 1/3$	
Nominal Pipe Size	PVC Internal Diameter [in]	Cast Iron Internal Diameter [in]	PVC Vertical Flow [gpm]	Cast Iron Vertical Flow [gpm]
2	2.067	1.960	72.4	26.8
3	3.068	2.960	207.6	80.5
4	4.026	3.940	428.6	172.5
5	5.047	4.940	783.1	315.3
6	6.065	5.940	1278.2	515.6
8	7.981	7.940	2657.9	1117.8
10	10.020	9.940	4875.6	2034.9
12	11.938	11.940	7777.9	3317.8
14	13.126	---	10016.9	---
15	---	14.035	---	5105.9

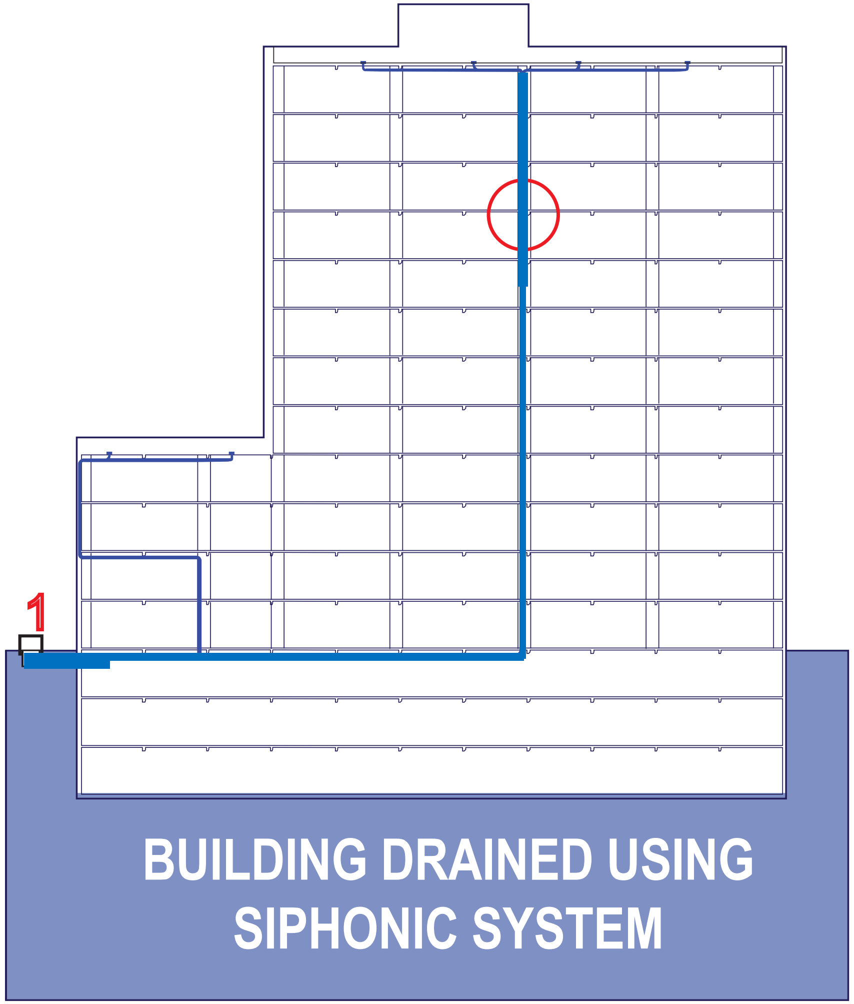
June 2024, IAMPO/ASPE, "Capacities of Stacks and Horizontal Drain in Storm Drainage System".

Gravity Pipe Slopes = More Verticals

What's Wrong with Pitch?

- More material required
- More space required
- Pitch dictates pipe routing and discharge location
- Numerous vertical drops and penetrations
- Added civil connections and site disturbance
- Increased building elevations
- Added chases throughout

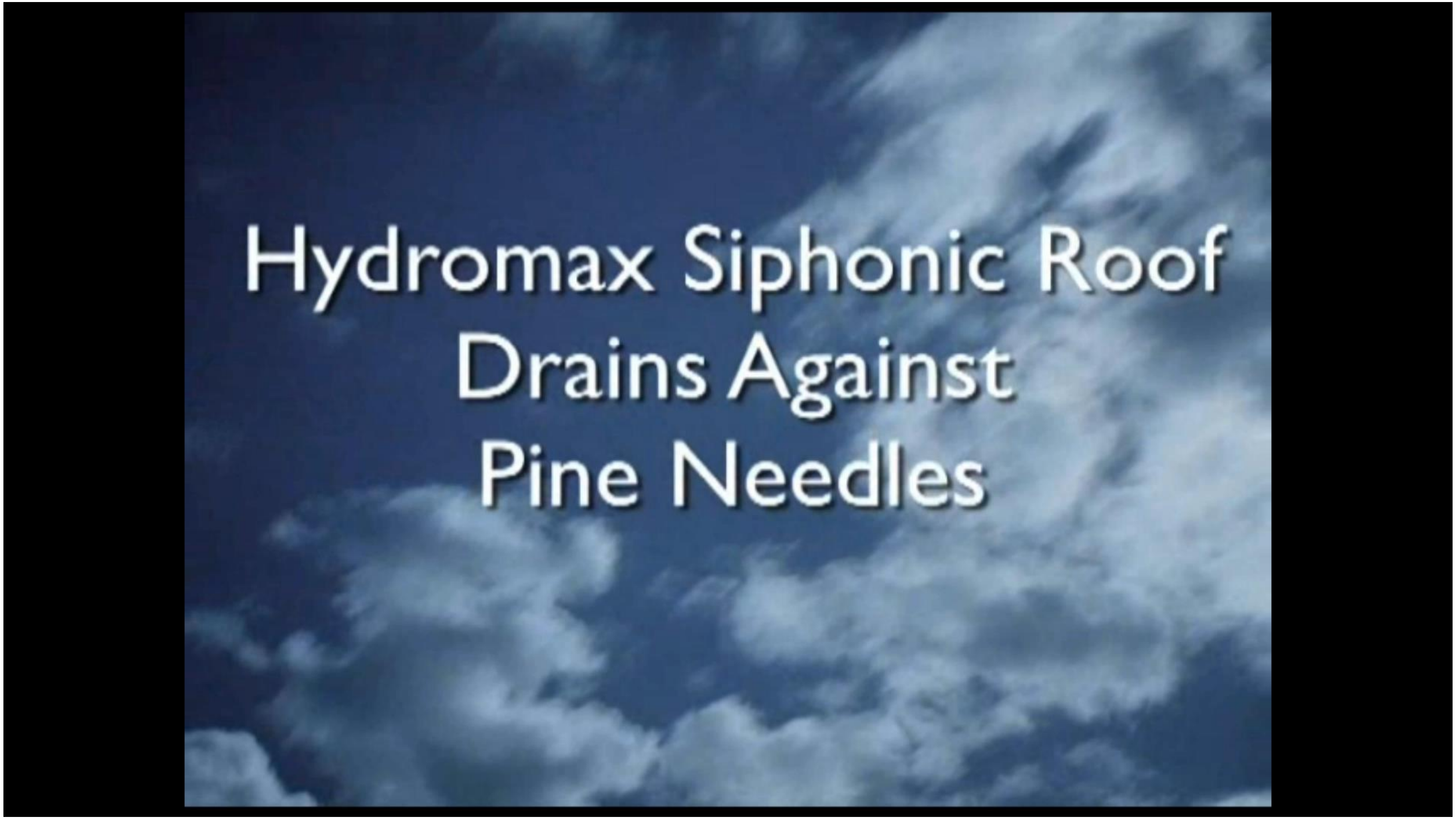




Gravity Drains Clog

Anti-Clog Drain

Siphonic drainage is so powerful it pulls **debris off the roof** – no need for a dome



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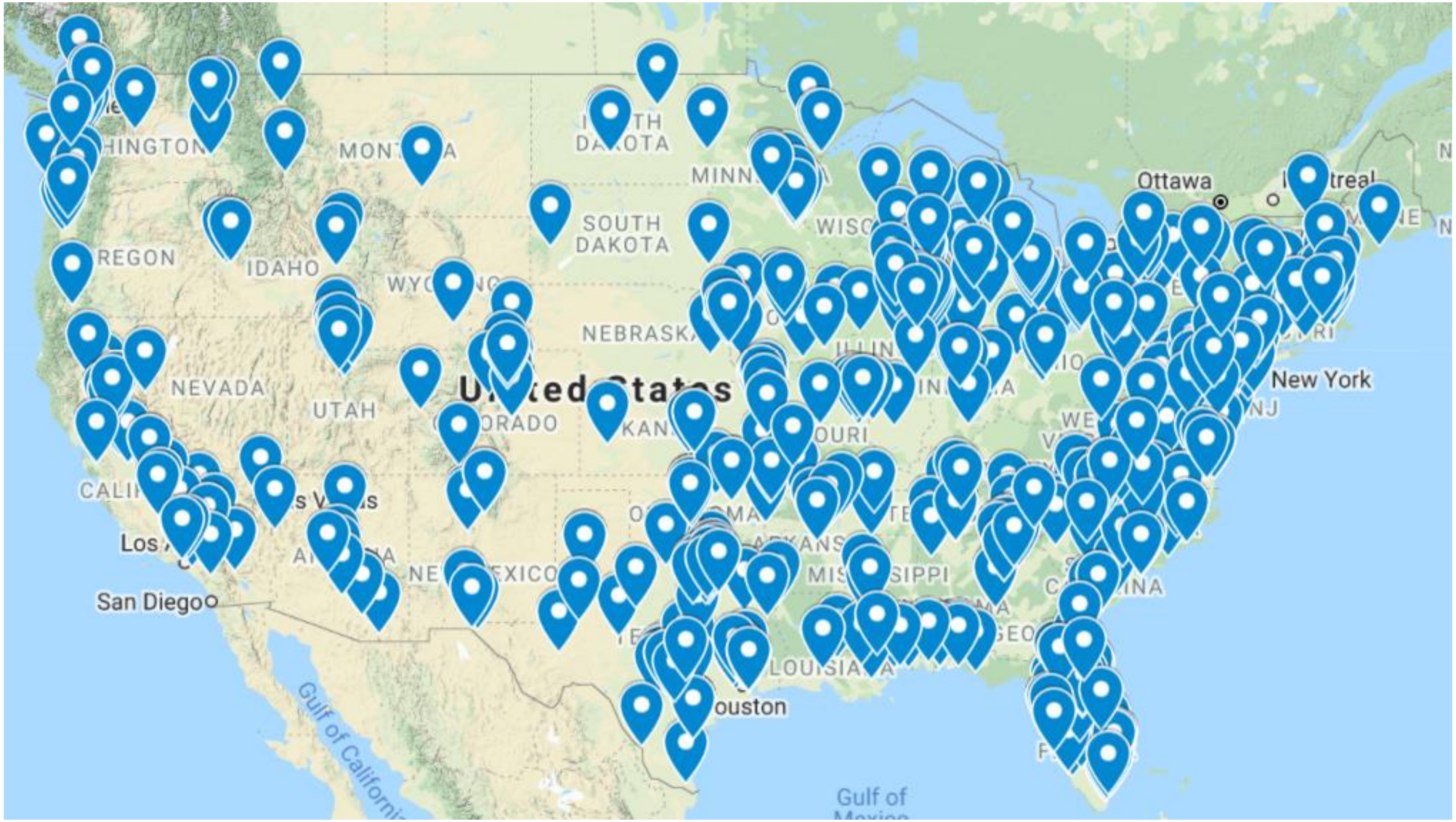
Walmart – 1,000+ US Installs

Zero Roof Failures, Clogs, or Leaks



US Design Partners

AHA Consulting Engineers
Mercedes-Benz
U.S. Department of Homeland Security
State Farm
HDR
BlueCross BlueShield
amazon
Balfour Beatty
wsp

LEO A DALY
Walmart
WEXFORD SCIENCE+TECHNOLOGY
Nashville Predators
HIGHLANDS ONCOLOGY
University of South Dakota
nm Nashville Machine
TLC Engineering Solutions
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Henderson Engineers
Waldinger
FritoLay
Southern
VCU Health
Conway Regional Health System
Boeing
Komatsu
Smith&Wesson

Lee Company
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The Muscogee Nation
Columbus Crew
RH
CBRE
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ME Engineering

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RJTR
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Skanska
SOSH
Polk Stanley Wilcox
Ziegler Cooper
Gensler
Stantec
Hobbs + Black Architects
MPW
Whiting-Turner

JSE Jordan & Skala Engineers
Perkins&Will
HKS
Hastings
HP Engineering
HOK
Humphreys & Partners Architects
Integrity Nabholz
Tutor Perini Corporation

Most Common Misconception

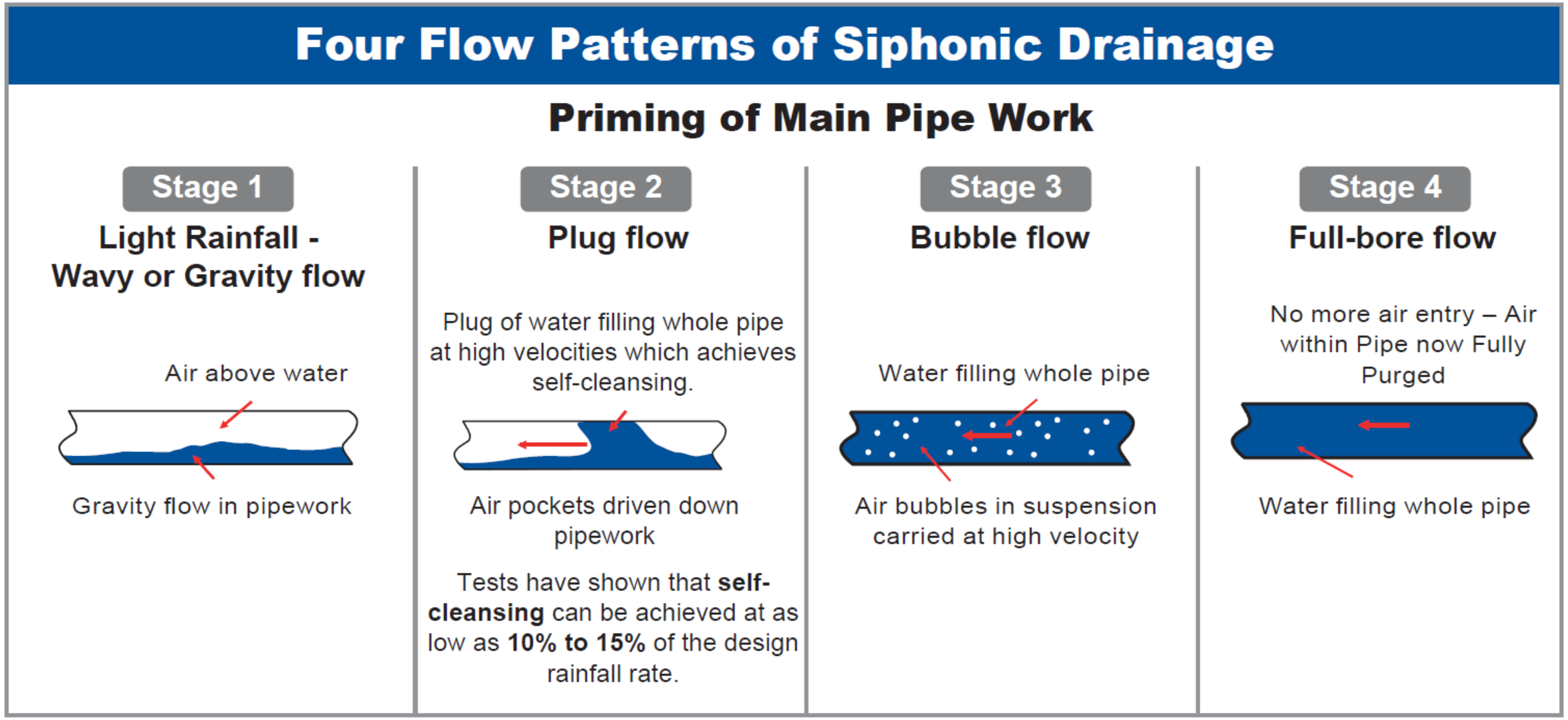
"Does the drain need to be submerged to be Siphonic?"

"I'll need to talk with structural"

TRUTH:

At only ¼" to ½" of ponding on the roof, the siphonic action will start to take effect

4 Stages of Siphonic Flow



Siphonic Action Starts at Stage 2

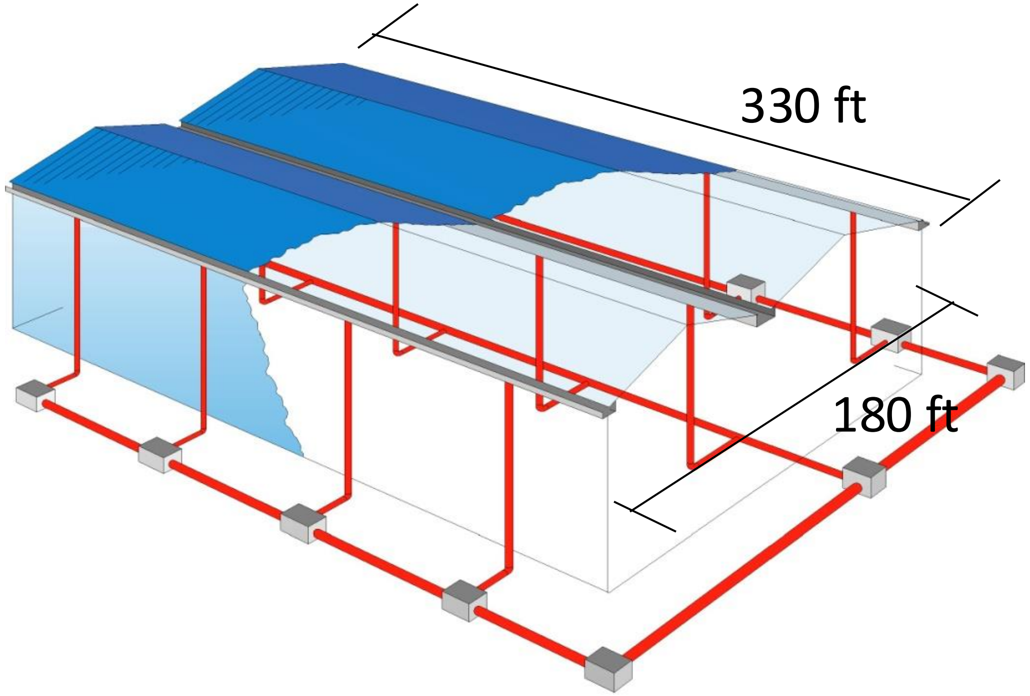
Less Ponding

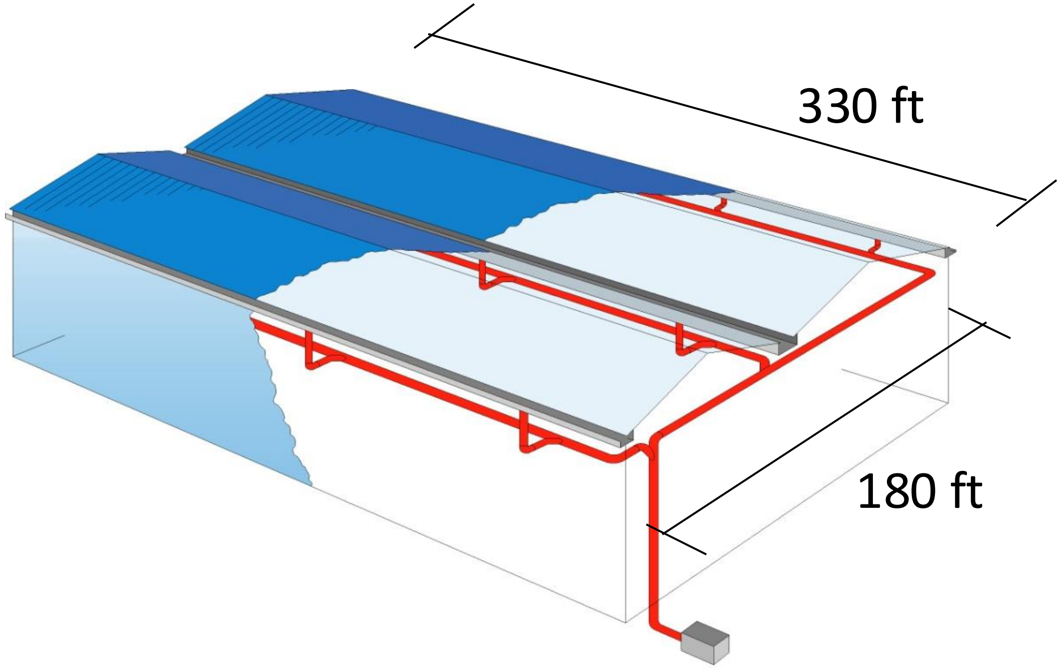
3-4x More Efficient Discharge = **LESS PONDING**
compared to traditional gravity drains

3" Drain			4" Drain			5" Drain			6" Drain		
Ponding	Gravity	HydroMax	Ponding	Gravity	HydroMax	Ponding	Gravity	HydroMax	Ponding	Gravity	HydroMax
1"	25 GPM	75 GPM	1"	25 GPM	93 GPM	1"	27 GPM	115 GPM	1"	15 GPM	140 GPM
2"	87 GPM	310 GPM	2"	90 GPM	350 GPM	2"	100 GPM	345 GPM	2"	75 GPM	400 GPM
3"	214 GPM		3"	215 GPM	785 GPM	3"	230 GPM	890 GPM	3"	210 GPM	990 GPM
4"	225 GPM		4"	232 GPM		4"	295 GPM		4"	250 GPM	1580 GPM
5"	231 GPM		5"	240 GPM		5"	440 GPM		5"	490 GPM	
6"	247 GPM		6"	252 GPM		6"	720 GPM		6"	715 GPM	

**MIFAB Data

Less Pipe and Labor





<u>**Traditional Gravity System**</u>

1600 feet of Pipe: 6” to 18”

1050 feet of Trenching

12 Downspouts/10 Manholes

<u>**Siphonic Drainage**</u>

1000 feet of Pipe: **3” to 8”**

20 feet of Trenching

1 Downspout/**1** Manhole

Gutter Downspouts: Keep all Pipework Outside

Only Requires
12” Gutter MIN

1 Vertical Riser
vs 4 uneven

Add More
Garage Bays

Eliminate 3 civil
connections, plus
trenching costs

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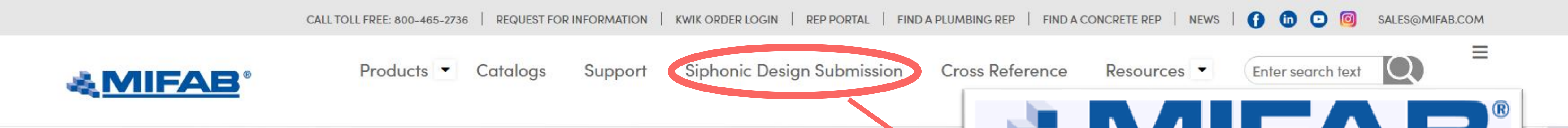
How to Submit a Design

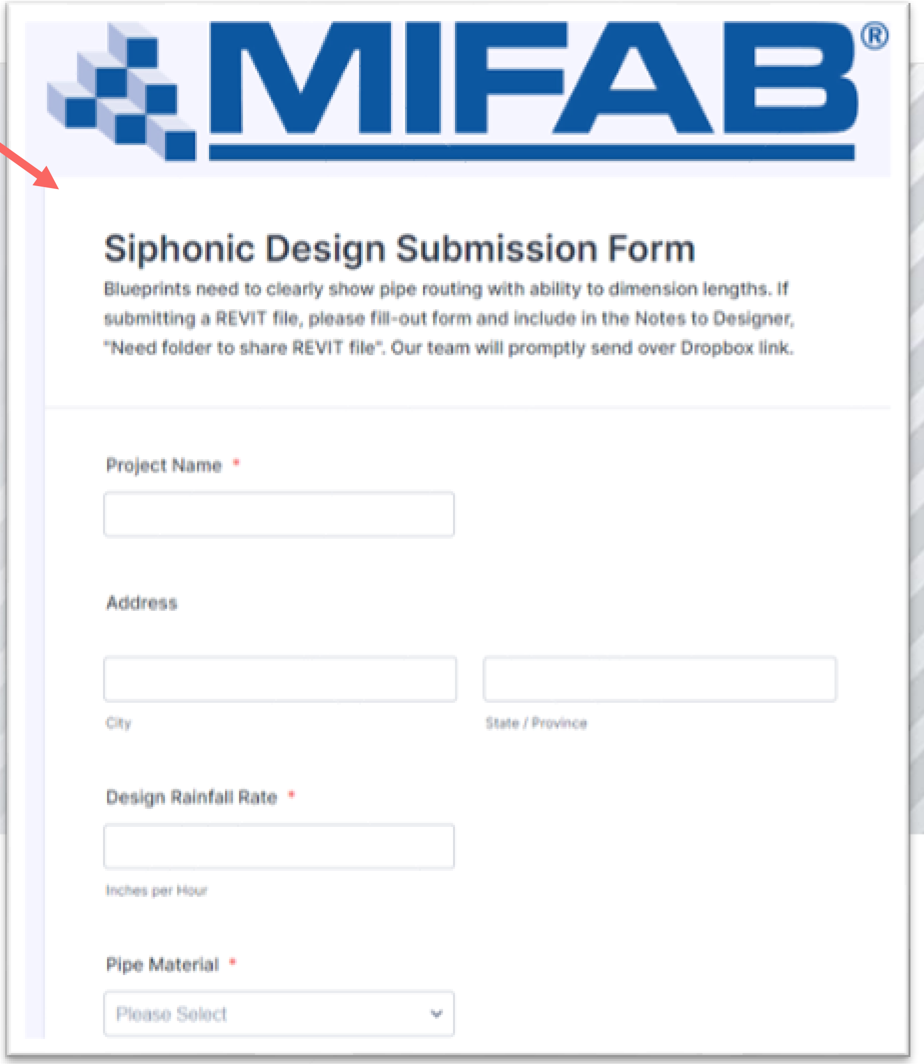
Submit To Manufacturer



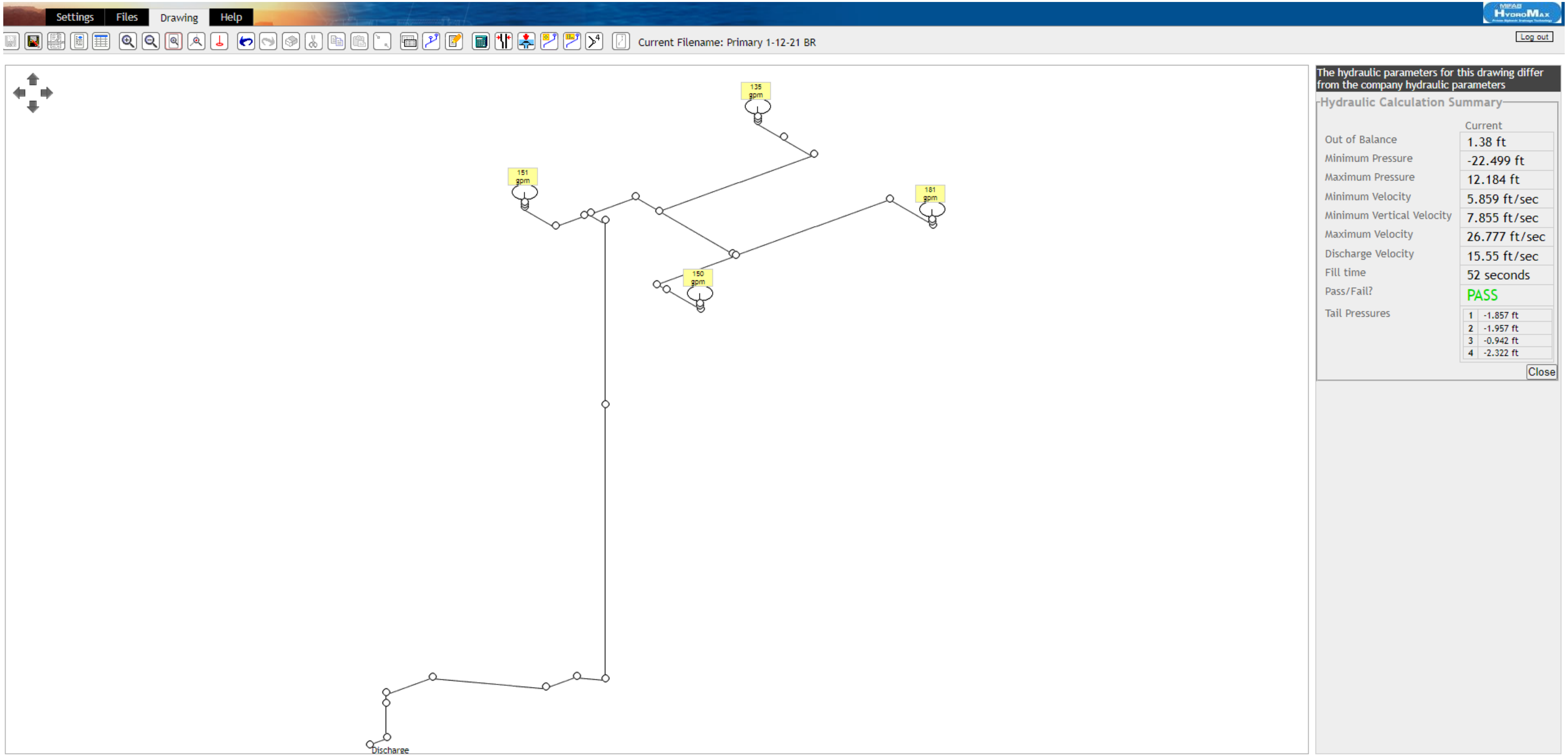
Make sure all connected drains are:
- On the same roof level
- Over 23 GPM (750sq ft) minimum

Information Needed to Balance:
- Routing (horizonal and vertical lengths)
- Area for each drain
- Rainfall Rate
- Pipe Material

Plans can be REVIT model or Blueprints with elevation view, pipe routing, and roof plan.



Siphonic Balancing Program



Calculation Report + BOM

4/20/2021 Calculation Report < "Primary 1-12-21 BR" < Hydrotechnic

Calculation Report for "Primary 1-12-21 BR"

Export to Excel

Project Information

Project:
System:
Client:
Reference:
Designer:
Date:

System Designed By

MIFAB, Inc
1321 West 119th Street
Chicago
IL
60643-5109
USA
1-800-465-2736
1-773-341-3049
hydromax@mifab.com

Design Software Supplied By

MIFAB, Inc
1321 West 119th Street
Chicago
IL
60643-5109
USA
1-800-465-2736
1-773-341-3049
hydromax@mifab.com

Hydraulic Calculation Summary

	Current
Out of Balance	1.38 ft
Minimum Pressure	-22.499 ft
Maximum Pressure	12.184 ft
Minimum Velocity	5.859 ft/sec
Minimum Vertical Velocity	7.855 ft/sec
Maximum Velocity	26.777 ft/sec
Discharge Velocity	15.55 ft/sec
Fill time	52 seconds
Pass/Fail?	PASS

Tail Pressures

1	-1.857 ft
2	-1.957 ft
3	-0.942 ft
4	-2.322 ft

Material Parameters

Material	Actual Diameter	Nominal Diameter	K/Roughness
PVC sch 40 solid	2"	2"	0.15
PVC sch 40 solid	4"	4"	0.15
PVC sch 40 solid	3"	3"	0.15

Overall Parameters

No.	Type	Diameter	Length	Height	Direction	Flowrate	Velocity	Headloss	Pressure	Loading
0	Discharge	4"		0		617 gpm	15.55 ft/sec	3' 9"	0 ft	0 lb/ft
1	Pipe	4"	5'	0	+X	617 gpm	15.55 ft/sec	1' 3"	1.243 ft	7.3 lb/ft
2	90° radius bend	4"		0		617 gpm	15.55 ft/sec	1' 1½"	2.37 ft	7.3 lb/ft
3	Pipe	4"	10'	10'	+Z	617 gpm	15.55 ft/sec	2' 6"	-5.143 ft	7.3 lb/ft
4	Pipe	4"	3'	3'	+Z	617 gpm	15.55 ft/sec	9"	-7.398 ft	7.3 lb/ft
5	90° radius bend	4"		0		617 gpm	15.55 ft/sec	1' 1½"	-6.271 ft	7.3 lb/ft
6	Pipe	4"	14' 4"	0	+X	617 gpm	15.55 ft/sec	3' 7"	-2.707 ft	7.3 lb/ft
7	45° elbow	4"		0		617 gpm	15.55 ft/sec	1' ½"	-1.655 ft	7.3 lb/ft
8	Pipe	4"	26' 6"	0	+X +Y	617 gpm	15.55 ft/sec	6' 7"	4.934 ft	7.3 lb/ft
9	45° elbow	4"		0		617 gpm	15.55 ft/sec	1' ½"	5.986 ft	7.3 lb/ft
10	Pipe	4"	9' 4"	0	+X	617 gpm	15.55 ft/sec	2' 4"	8.306 ft	7.3 lb/ft
11	45° elbow	4"		0		617 gpm	15.55 ft/sec	1' ½"	9.358 ft	7.3 lb/ft

4/20/2021 Calculation Report < "Primary 1-12-21 BR" < Hydrotechnic

No.	Type	Diameter	Length	Height	Direction	Flowrate	Velocity	Headloss	Pressure	Loading
12	Pipe	4"	6' 10"	0	+X +Y	617 gpm	15.55 ft/sec	1' 8½"	11.057 ft	7.3 lb/ft
13	90° radius bend	4"		0		617 gpm	15.55 ft/sec	1' 1½"	12.184 ft	7.3 lb/ft
14	Expansion	3"		0		617 gpm	26.78 ft/sec	1' 11½"	6.76 ft	4.4 lb/ft
15	Pipe	3"	81'	81'	+Z	617 gpm	26.78 ft/sec	83' 2"	8.908 ft	4.4 lb/ft
16	Reducer	3"		0		617 gpm	26.78 ft/sec	2' 2"	11.067 ft	4.4 lb/ft
17	Pipe	4"	54' 6"	54' 6"	+Z	617 gpm	15.55 ft/sec	13' 6½"	-22.499 ft	7.3 lb/ft
18	90° radius bend	4"		0		617 gpm	15.55 ft/sec	1' 1½"	-21.372 ft	7.3 lb/ft
19	Pipe	4"	5'	0	-Y	617 gpm	15.55 ft/sec	1' 3"	-20.129 ft	7.3 lb/ft
20	Junction	4"		0		151 gpm	3.81 ft/sec	6"	-16.088 ft	7.3 lb/ft
21	Expansion	3"		0		151 gpm	6.55 ft/sec	1½"	-16.413 ft	4.4 lb/ft
22	90° radius bend	3"		0		151 gpm	6.55 ft/sec	2½"	-16.212 ft	4.4 lb/ft
23	Expansion	2"		0		151 gpm	14.44 ft/sec	11½"	-17.818 ft	2 lb/ft
24	Pipe	2"	2'	0	-X	151 gpm	14.44 ft/sec	1'	-16.818 ft	2 lb/ft
25	Pipe	2"	9'	0	-X	151 gpm	14.44 ft/sec	4' 6"	-12.32 ft	2 lb/ft
26	90° radius bend	2"		0		151 gpm	14.44 ft/sec	11½"	-11.348 ft	2 lb/ft
27	Pipe	2"	10' 6"	0	-Y	151 gpm	14.44 ft/sec	5' 3"	-6.1 ft	2 lb/ft
28	90° radius bend	2"		0		151 gpm	14.44 ft/sec	11½"	-5.129 ft	2 lb/ft
29	Pipe	2"	6"	6"	+Z	151 gpm	14.44 ft/sec	3"	-5.379 ft	2 lb/ft
30	Pipe	2"	9"	9"	+Z	151 gpm	14.44 ft/sec	4½"	-5.749 ft	2 lb/ft
31	Flexible joint (reducer)	2"		0		151 gpm	14.44 ft/sec	9½"	-4.951 ft	0 lb/ft
32	MH-300 (23 to 415 GPM)	3"		0		151 gpm	7.04 ft/sec	1"	-1.857 ft	0 lb/ft
33	Branch	4"		0		466 gpm	11.74 ft/sec	1' 4"	-17.18 ft	7.3 lb/ft
34	45° elbow	4"		0		466 gpm	11.74 ft/sec	7"	-16.58 ft	7.3 lb/ft
35	Pipe	4"	13' 10"	0	+X	466 gpm	11.74 ft/sec	1' 11½"	-14.602 ft	7.3 lb/ft
36	90° radius bend	4"		0		466 gpm	11.74 ft/sec	7½"	-13.959 ft	7.3 lb/ft
37	Pipe	4"	8' 2"	0	+Y	466 gpm	11.74 ft/sec	1' 2"	-12.79 ft	7.3 lb/ft
38	Junction	4"		0		331 gpm	8.34 ft/sec	7½"	-11.104 ft	7.3 lb/ft
39	Pipe	4"	25'	0	+Y	331 gpm	8.34 ft/sec	1' 10"	-9.275 ft	7.3 lb/ft
40	Expansion	3"		0		331 gpm	14.37 ft/sec	7"	-10.836 ft	4.4 lb/ft
41	Pipe	3"	1' 4"	0	+Y	331 gpm	14.37 ft/sec	5"	-10.437 ft	4.4 lb/ft
42	Junction	3"		0		150 gpm	6.51 ft/sec	1' 2½"	-6.694 ft	4.4 lb/ft
43	90° radius bend	3"		0		150 gpm	6.51 ft/sec	2½"	-6.496 ft	4.4 lb/ft
44	Pipe	3"	24' 10"	0	-X	150 gpm	6.51 ft/sec	1' 7"	-4.919 ft	4.4 lb/ft
45	90° radius bend	3"		0		150 gpm	6.51 ft/sec	2½"	-4.721 ft	4.4 lb/ft
46	Pipe	3"	3'	0	+Y	150 gpm	6.51 ft/sec	2½"	-4.53 ft	4.4 lb/ft
47	Pipe	3"	11' 10"	0	+Y	150 gpm	6.51 ft/sec	9"	-3.779 ft	4.4 lb/ft
48	90° radius bend	3"		0		150 gpm	6.51 ft/sec	2½"	-3.581 ft	4.4 lb/ft
49	Expansion	2"		0		150 gpm	14.34 ft/sec	11½"	-5.165 ft	2 lb/ft
50	Pipe	2"	6"	6"	+Z	150 gpm	14.34 ft/sec	3"	-5.419 ft	2 lb/ft
51	Pipe	2"	9"	9"	+Z	150 gpm	14.34 ft/sec	4½"	-5.794 ft	2 lb/ft
52	Flexible joint (reducer)	2"		0		150 gpm	14.34 ft/sec	9½"	-5.006 ft	0 lb/ft
53	MH-300 (23 to 415 GPM)	3"		0		150 gpm	6.99 ft/sec	1"	-1.957 ft	0 lb/ft
54	Branch	3"		0		181 gpm	7.86 ft/sec	10"	-7.367 ft	4.4 lb/ft
55	45° elbow	3"		0		181 gpm	7.86 ft/sec	3½"	-7.062 ft	4.4 lb/ft
56	Pipe	3"	48' 4"	0	+X	181 gpm	7.86 ft/sec	4' 5"	-2.634 ft	4.4 lb/ft
57	90° radius bend	3"		0		181 gpm	7.86 ft/sec	3½"	-2.346 ft	4.4 lb/ft
58	Pipe	3"	15'	0	+Y	181 gpm	7.86 ft/sec	1' 4½"	-0.972 ft	4.4 lb/ft
59	90° radius bend	3"		0		181 gpm	7.86 ft/sec	3½"	-0.685 ft	4.4 lb/ft
60	Pipe	3"	6"	6"	+Z	181 gpm	7.86 ft/sec	½"	-1.139 ft	4.4 lb/ft
61	Pipe	3"	9"	9"	+Z	181 gpm	7.86 ft/sec	1"	-1.812 ft	4.4 lb/ft
62	Flexible joint (expansion)	3"		0		181 gpm	8.44 ft/sec	0	-1.954 ft	0 lb/ft
63	MH-300 (23 to 415 GPM)	3"		0		181 gpm	8.44 ft/sec	1½"	-0.942 ft	0 lb/ft
64	Branch	3"		0		135 gpm	5.86 ft/sec	½"	-11.132 ft	4.4 lb/ft
65	45° elbow	3"		0		135 gpm	5.86 ft/sec	2"	-10.944 ft	4.4 lb/ft
66	Pipe	3"	48' 10"	0	+X	135 gpm	5.86 ft/sec	2' 6½"	-8.416 ft	4.4 lb/ft
67	90° radius bend	3"		0		135 gpm	5.86 ft/sec	2"	-8.256 ft	4.4 lb/ft
68	Pipe	3"	10'	0	-Y	135 gpm	5.86 ft/sec	6"	-7.739 ft	4.4 lb/ft
69	Expansion	2"		0		135 gpm	12.91 ft/sec	9½"	-9.022 ft	2 lb/ft
70	Pipe	2"	9'	0	-Y	135 gpm	12.91 ft/sec	3' 7½"	-5.414 ft	2 lb/ft
71	90° radius bend	2"		0		135 gpm	12.91 ft/sec	9½"	-4.637 ft	2 lb/ft
72	Pipe	2"	6"	6"	+Z	135 gpm	12.91 ft/sec	2½"	-4.937 ft	2 lb/ft
73	Pipe	2"	9"	9"	+Z	135 gpm	12.91 ft/sec	3½"	-5.381 ft	2 lb/ft
74	Flexible joint (reducer)	2"		0		135 gpm	12.91 ft/sec	7½"	-4.743 ft	0 lb/ft
75	MH-300 (23 to 415 GPM)	3"		0		135 gpm	6.29 ft/sec	1"	-2.322 ft	0 lb/ft

Report for "Primary 1-12-21 BR"

Generated in 0.0468482 seconds

Bill of Materials

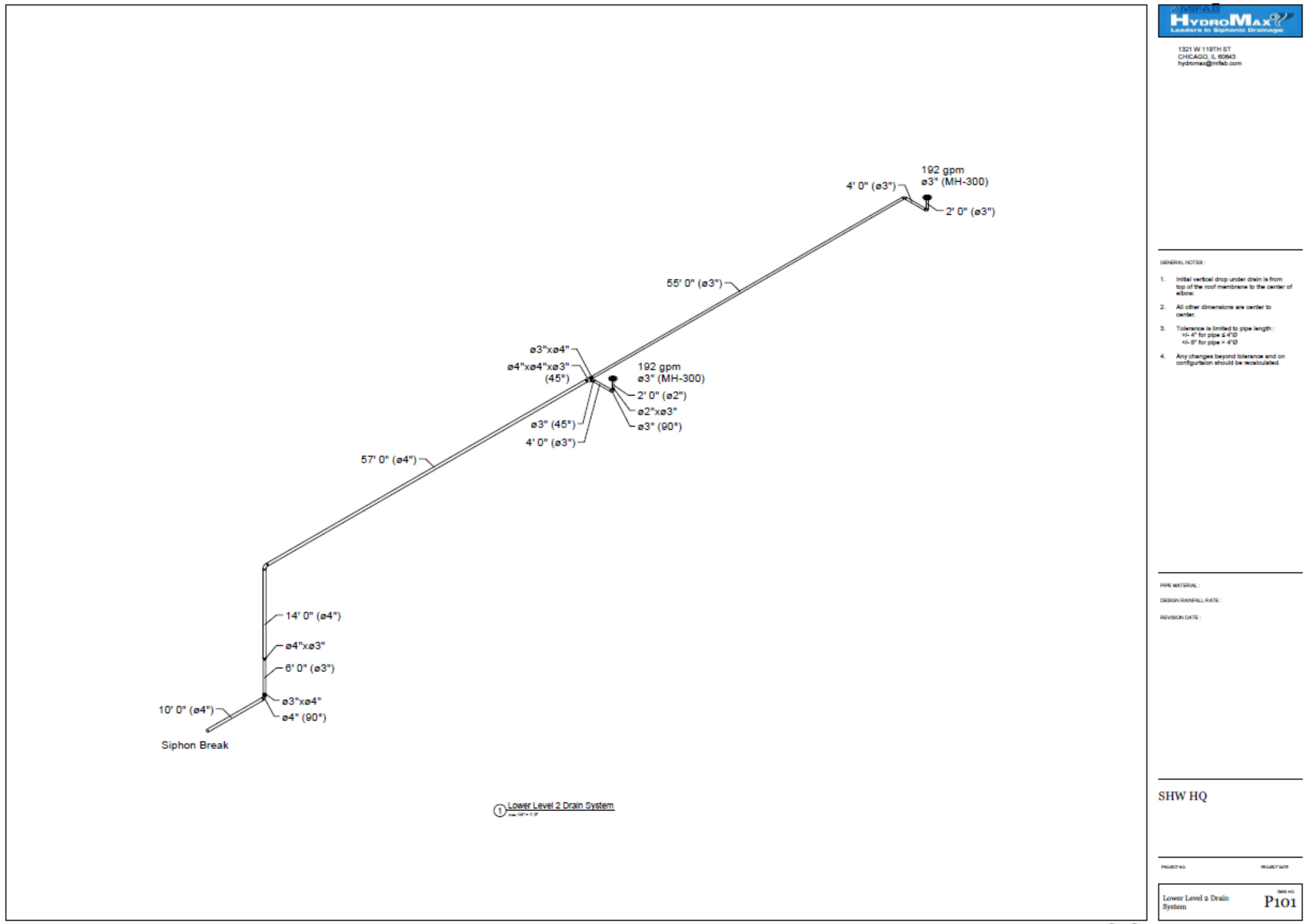
Export to Excel

Mifab HydroMax

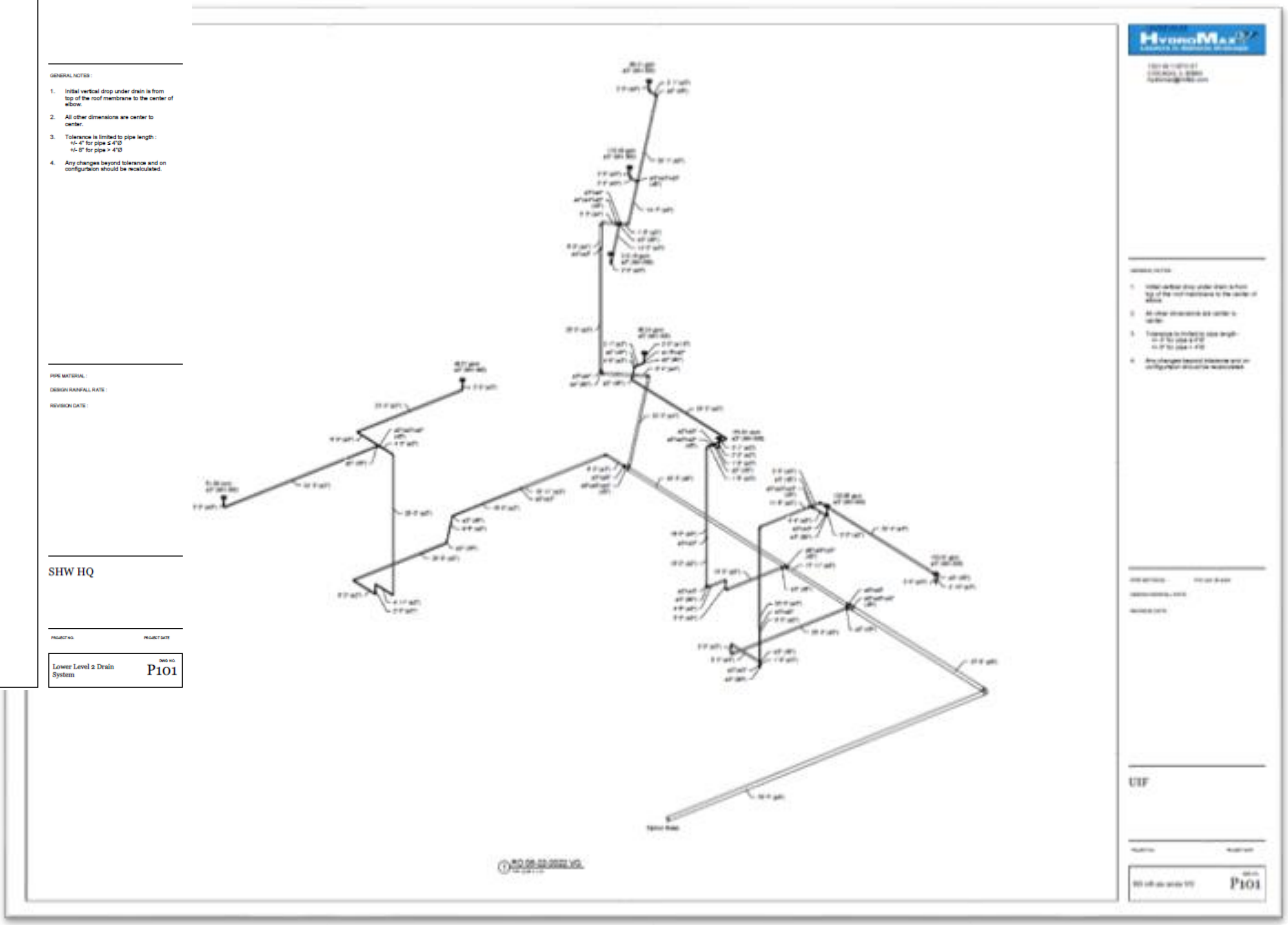
Material	Description	Diameter (inches)	Quantity	Rate	Value
			feet-inches"	/foot	
PVC sch 40 solid	Pipe PVC Schedule 40 2"	2	40	0.00	0.00
PVC sch 40 solid	Pipe PVC Schedule 40 3"	3	260	0.00	0.00
PVC sch 40 solid	Pipe PVC Schedule 40 4"	4	200	0.00	0.00
			each	/item	
PVC sch 40 solid	45° bend 3"	3	2	0.00	0.00
PVC sch 40 solid	45° bend 4"	4	4	0.00	0.00
PVC sch 40 solid	Coupling 2"	2	3	0.00	0.00
PVC sch 40 solid	Coupling 3"	3	11	0.00	0.00
PVC sch 40 solid	Coupling 4"	4	6	0.00	0.00
PVC sch 40 solid	Conc Reducer 3/2"		1	0.00	0.00
PVC sch 40 solid	Conc Reducer 4/3"		2	0.00	0.00
PVC sch 40 solid	Ecc Reducer 3/2"		2	0.00	0.00
PVC sch 40 solid	Ecc Reducer 4/3"		2	0.00	0.00
PVC sch 40 solid	45° Y branch 3/3"		1	0.00	0.00
PVC sch 40 solid	45° Y branch 4/3"		1	0.00	0.00
PVC sch 40 solid	45° Y branch 4/4"		1	0.00	0.00
PVC sch 40 solid	Access Point 4"	4	1	0.00	0.00
PVC sch 40 solid	90° Radius Elbow 2"	2	3	0.00	0.00
PVC sch 40 solid	90° Radius Elbow 3"	3	7	0.00	0.00
PVC sch 40 solid	90° Radius Elbow 4"	4	5	0.00	0.00
CI no-hub	Coupling 3"	3	4	0.00	0.00
	3" 3" Bearing Pan MH-300-BP	3	4	1.00	4.00
	3" Underdeck Clamp MH-300-UDC	3	4	1.00	4.00
CI no-hub	MH-300 (23 to 415 GPM)		4	0.00	0.00

Calculation Report provides ASPE 45 Compliance for IPC or UPC approval

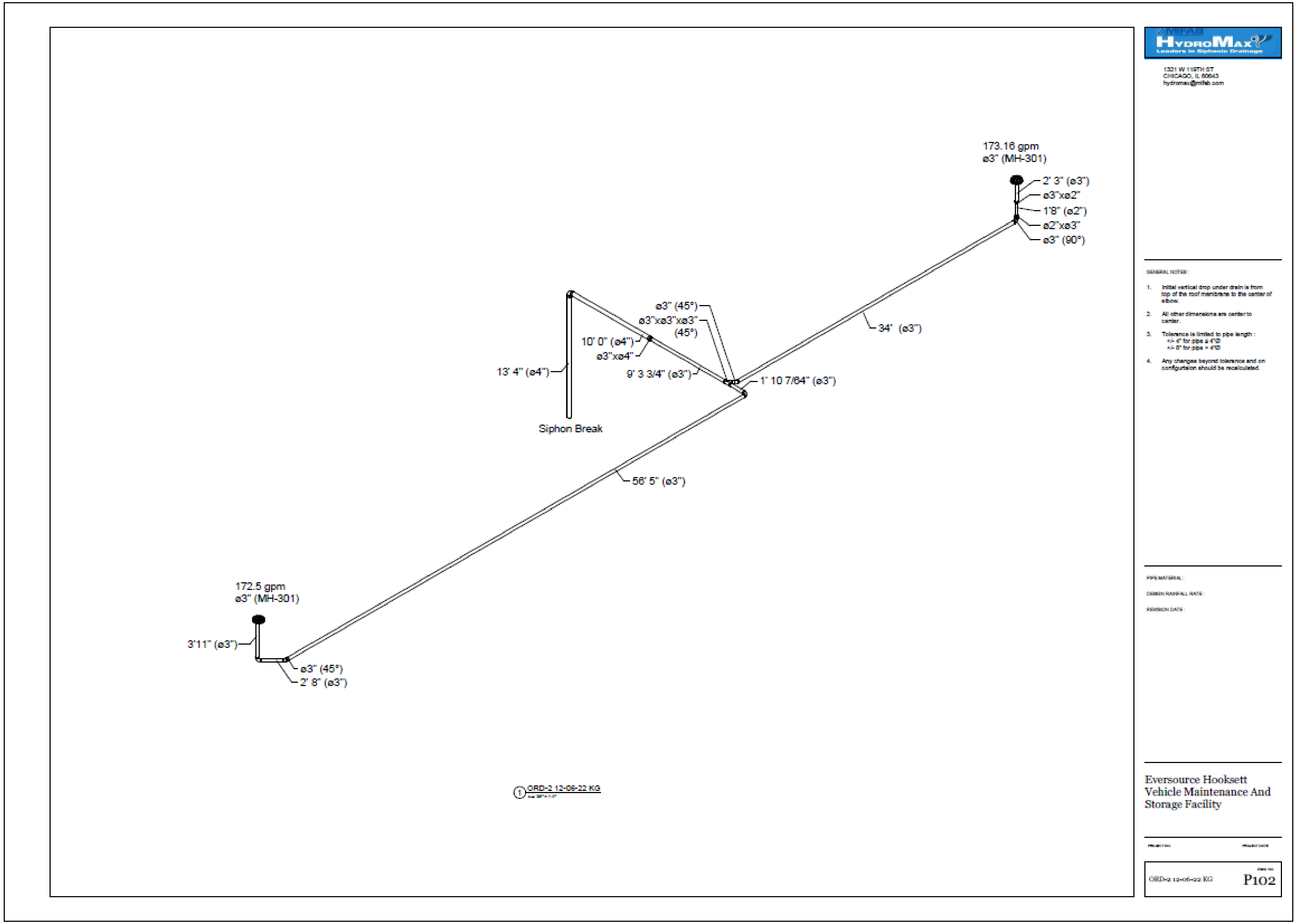
Install ISOs



Revit file available free of charge



Install ISOs



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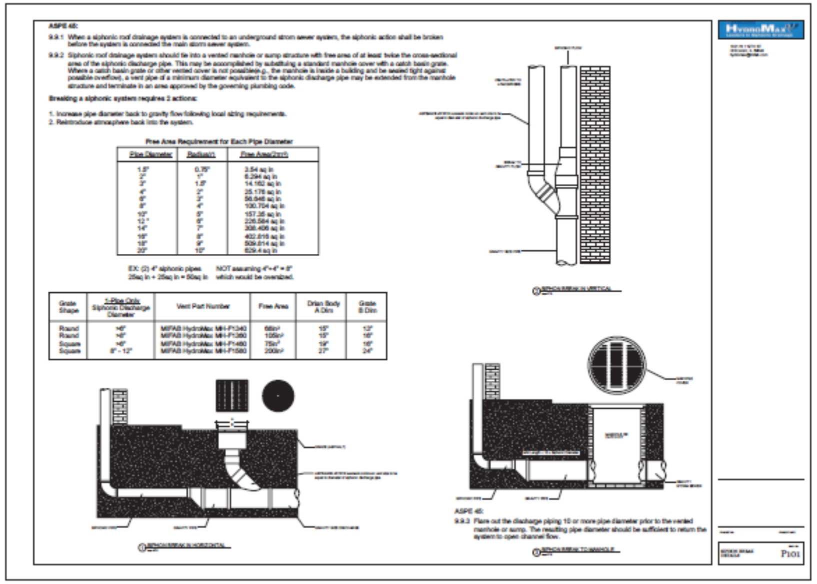
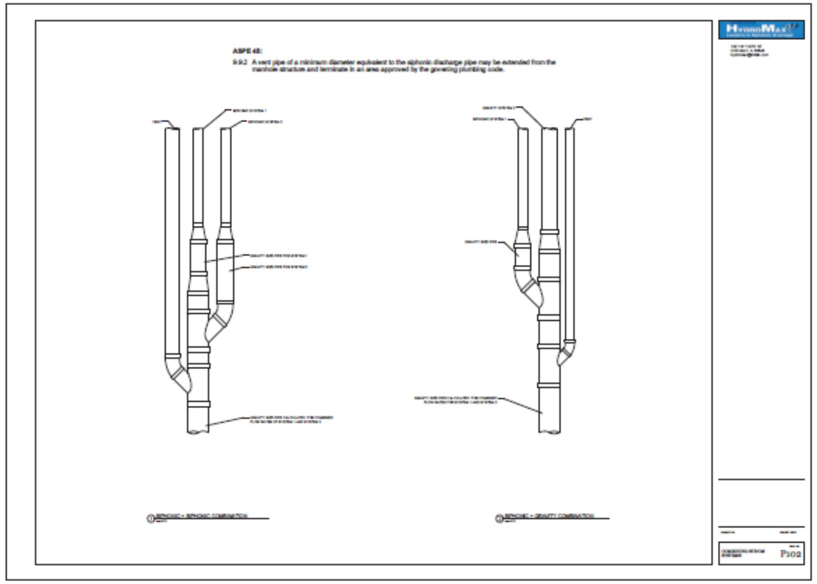
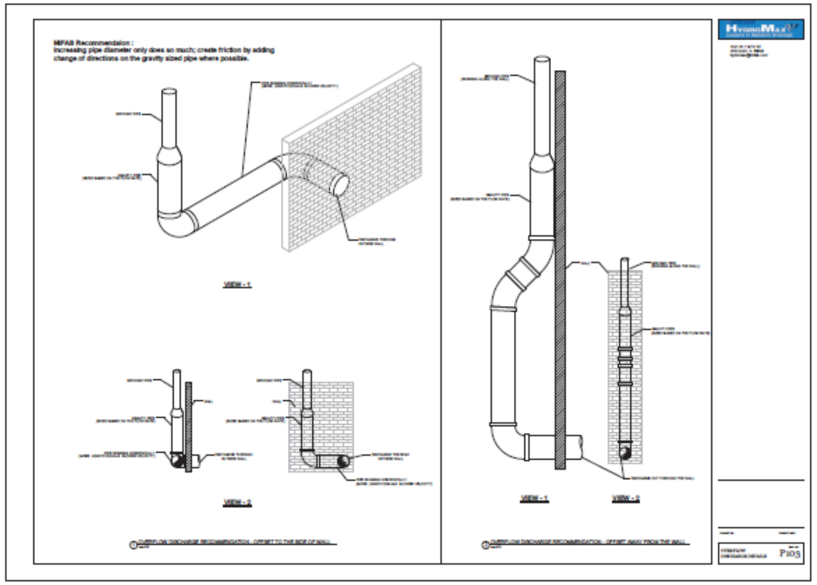
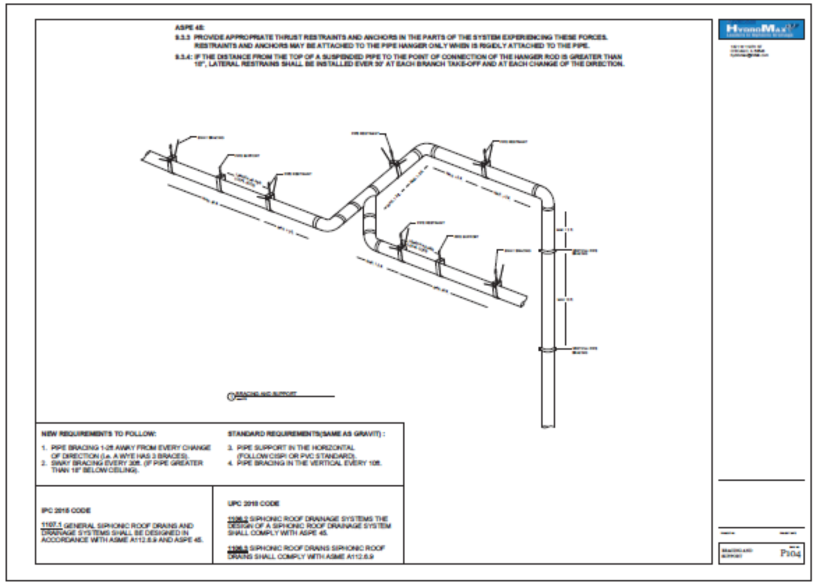
Siphonic Blueprint Guide









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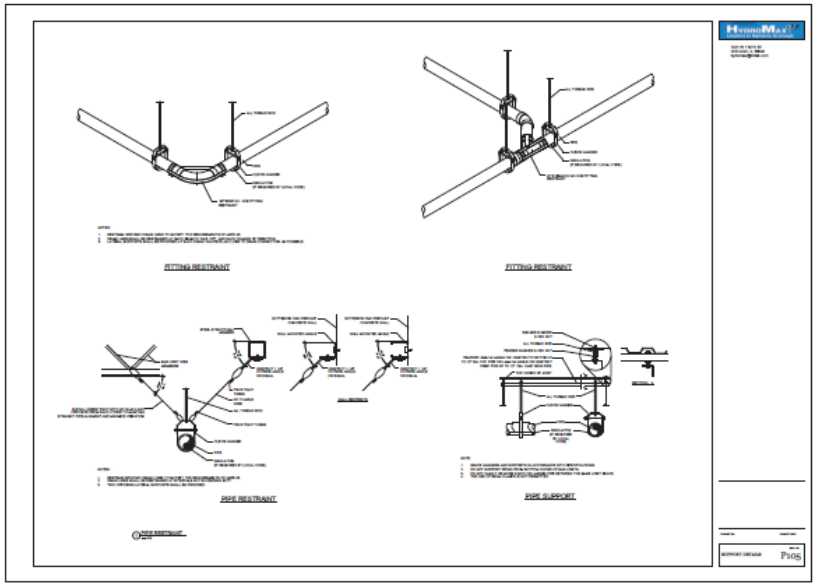
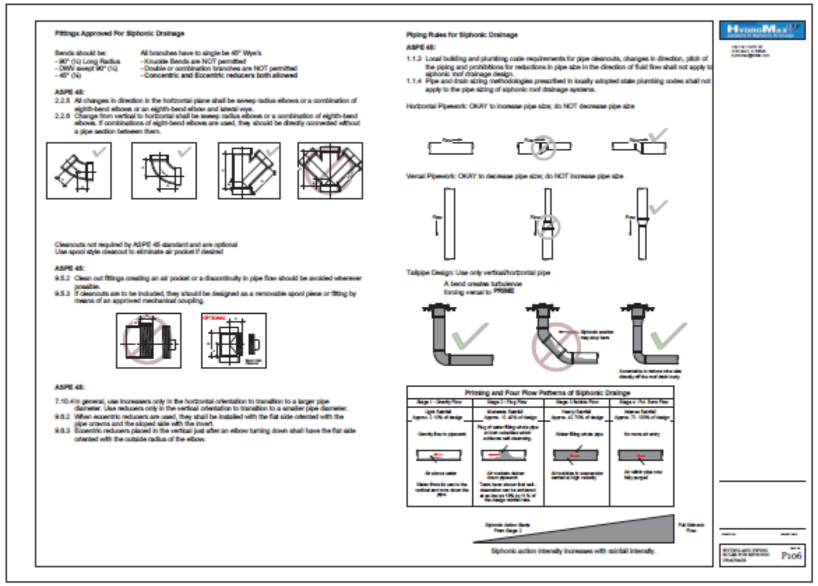
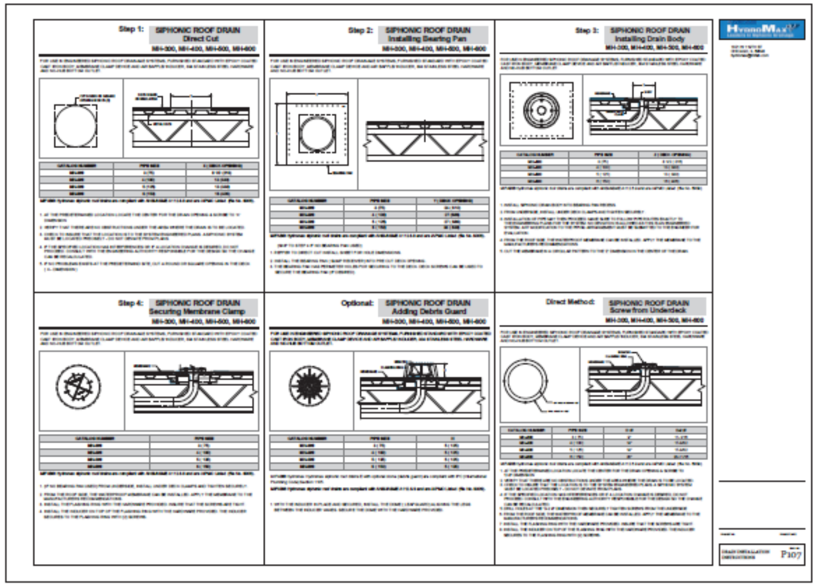
Siphonic Blueprint Guide







CSI Spec and Contractor Pre-Install Call

SECTION 15148 (22 14 00)

SIPHONIC STORM DRAINAGE

Display hidden notes to specifier. (Don't know how? Click Here)

** NOTE TO SPECIFIER ** MIFAB, Inc.; siphonic roof drains.
This section is based on the products of MIFAB, Inc., which is located at:
1321 W. 119th St
Chicago, IL 60643
Toll Free Tel: 800-465-2736
Tel: 773.341.3030
Fax: 773-341-3047
Email: request info (sales@mifab.com)
Web: http://www.mifab.com
[Click Here] for additional information.
Manufacturer of Commercial and Industrial Plumbing and Drainage Products.
Serving all the USA, Canada, Australia, and the Middle East, MIFAB can provide you with the quality, engineered plumbing and drainage solutions you need. Innovative product designs save the installer time and material cost and provides the owner with higher quality cast stainless steel drains and cleanouts for the same cost as the industry standard nickel bronze.

PART 1 GENERAL

1.1 SECTION INCLUDES

** NOTE TO SPECIFIER ** Delete items below not required for project.

A. Siphonic primary roof drains.
B. Siphonic overflow roof drains.
C. Storm drainage piping, buried.
D. Storm drainage piping, above grade.
E. Pipe flanges, unions, and couplings.
F. Pipe hangers and supports.

1.2 RELATED SECTIONS

** NOTE TO SPECIFIER ** Delete any sections below not relevant to this project; add others as required.

A. Section 22 05 03 - Pipe, Pipe Fittings, Pipe Hangers and Valves
B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
D. Section 22 07 19 - Plumbing Piping Insulation.
E. Section 22 08 00 - Fire Stopping.

HydroMax Leaders in Siphonic Drainage

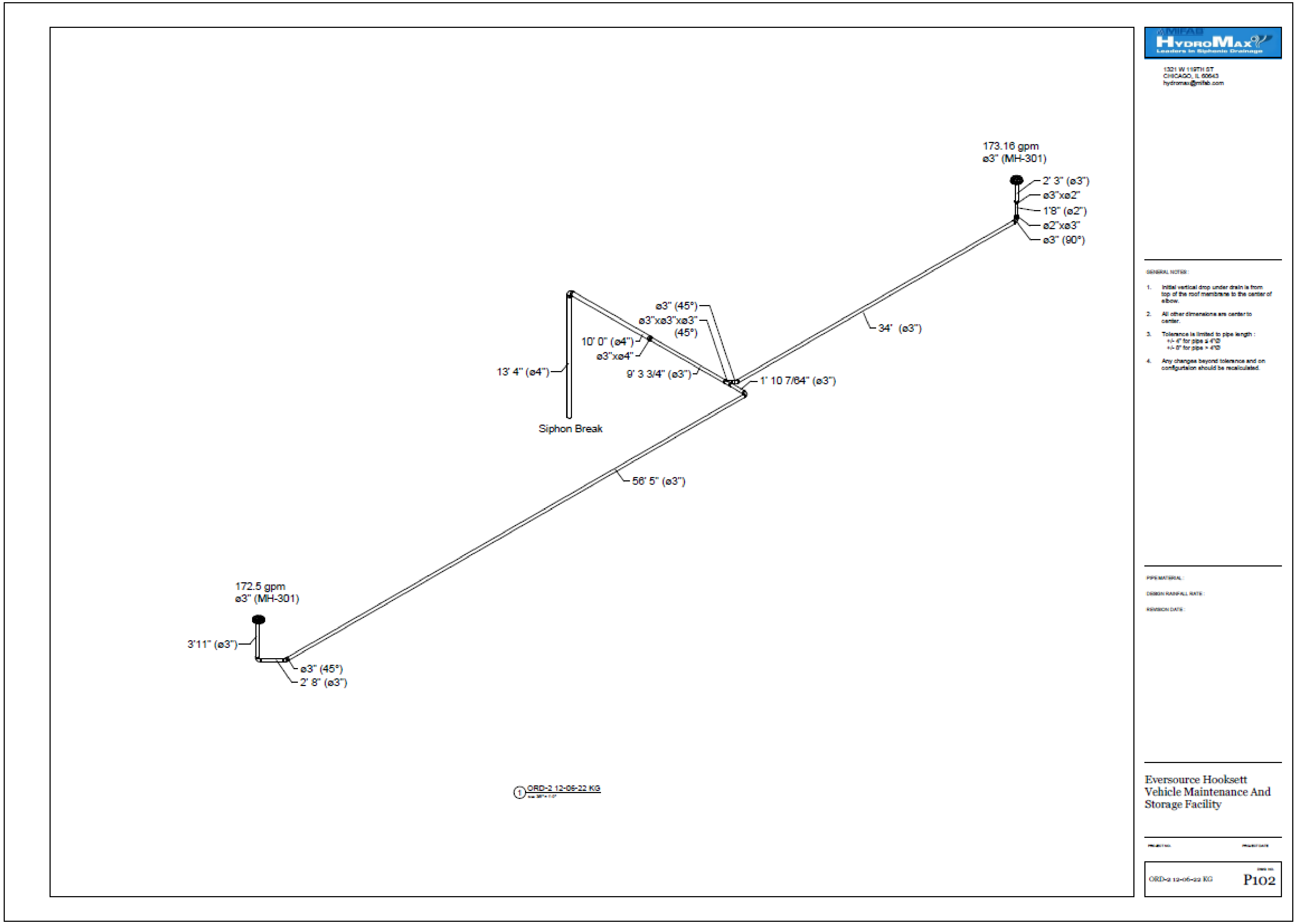
MIFAB Siphonic Drainage Contractor Pre-Install Call

- ☐ CONTACT ENGINEER OF RECORD **PRIOR** TO ANY DIMENSIONAL CHANGES OR ROUTE DEVIATION
  - ☐ These changes will be quickly resolved, but must be identified by the contractor prior to pipe insulation
- ☐ How does Siphonic drainage work
- ☐ Horizontal piping installed with No Pitch
- ☐ Can NOT collect multiple roof levels on same siphonic line
- ☐ Reduction in vertical & increase in horizontal permitted
- ☐ **PIPE RESTRAINT IS CRITICAL** (improperly restrained pipe will move):
  - ☐ Pipe restraints located 1' from fitting on each change of direction (i.e. a wye branch to have 3 restraints)
  - ☐ Sway bracing needed every 30 foot
  - ☐ PVC pipe hangers support per local code
  - ☐ Cast Iron pipe hangers support per local code/CISPI
  - ☐ Pipe bracing in vertical every 10 foot
- ☐ Tail pipe connections enter horizontal pipe on the side, not drop-in from the top
- ☐ Concentric vs. Eccentric Reducers: Pipe crown stays flat in eccentric; Concentric is measured to centerline of pipe
- ☐ **Pipe lengths in HydroTechnic program are center of fitting to center of fitting**
  - ☐ **Only exception, roof line to center-of-fitting for the drain**
- ☐ Long/short sweep 90's, 45 WYE's, 1/8bend 45's can be used
- ☐ Knuckle bends, crosses, or TEE's can NOT be used
- ☐ Cleanouts ARE NOT REQUIRED. If desired, they should be removable spool pieces DWV style, no extended T branches to create air pocket
- ☐ Outside dimension of the roof hole opening is critical on deck mount installations (install sheets available)
- ☐ Trim roof membrane to fit inside of clamping ring
- ☐ **Venting is required** where Siphonic system breaks to gravity
  - ☐ Review location of manhole relative to footprint of the building
- ☐ Clean construction debris from drainpipe work; make sure baffle plates are installed
- ☐ CONTACT ENGINEER OF RECORD **PRIOR** TO ANY DIMENSIONAL CHANGES OR ROUTE DEVIATION

Any changes to routing:
HydroMax Inside Team
hydromax@mifab.com

All other questions:
Brennan Doherty
bdoherty@mifab.com
312-241-5224

Process for Field Changes



OVER 8,000 Siphonic Roof Drain Systems

SUCCESSFULLY designed by **HydroMax™**

100% SUCCESS RATE

ZERO System Design Failures

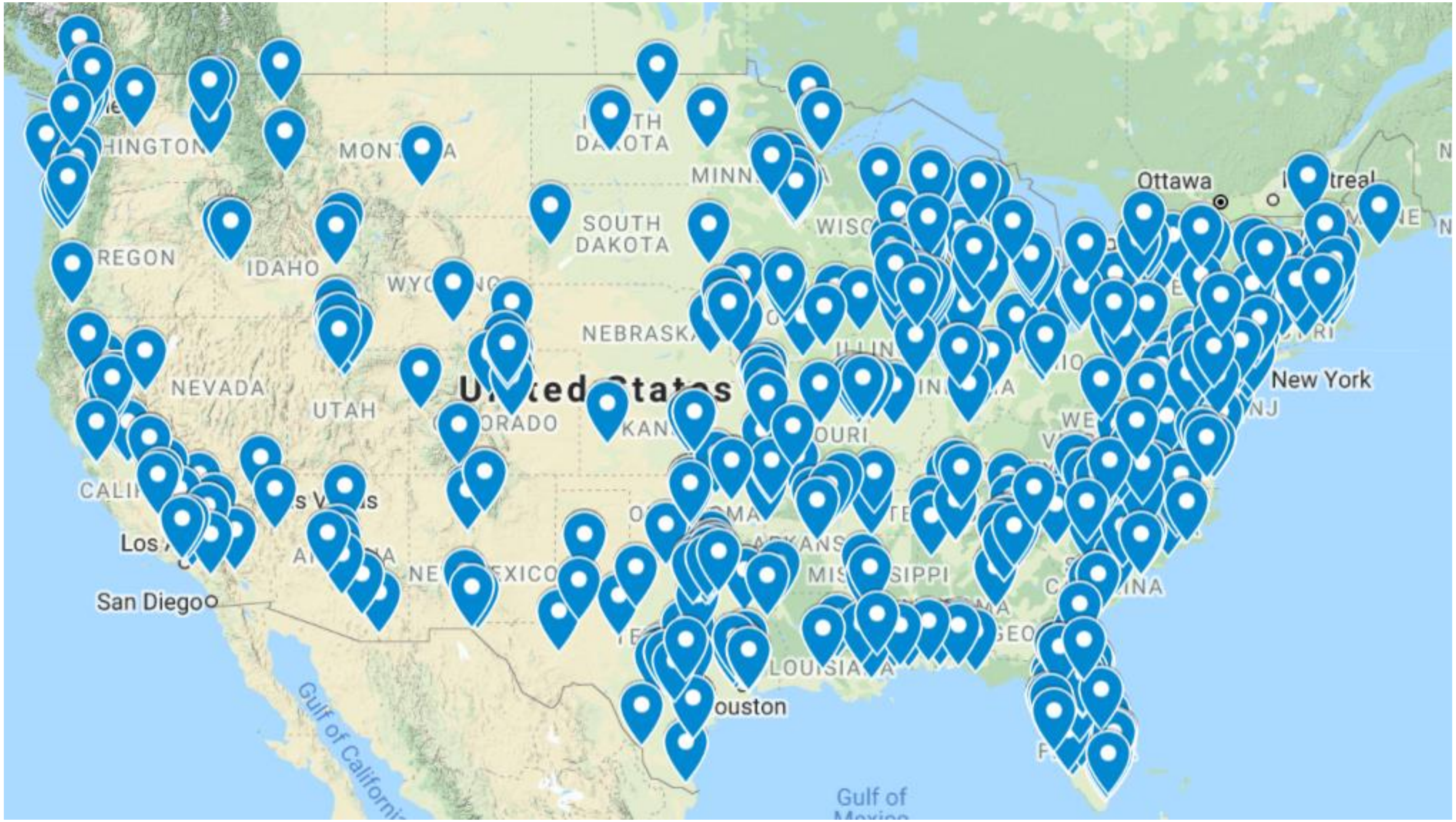
TRIED - TESTED - PROVEN

ASPE
American Society of Plumbing Engineers™

Extra Topics:
Siphonic Anti-Clog

Walmart – 1,000+ US Installs

Zero Roof Failures, Clogs, or Leaks



Curb Inlets Outside

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Issue with Gravity Drains

CAST IRON
SOIL PIPE AND FITTINGS
HANDBOOK

Revised and Edited
under the direction of the
TECHNICAL ADVISORY GROUP
of the
CAST IRON SOIL PIPE INSTITUTE

CAST IRON SOIL PIPE INSTITUTE
5959 Shallowford Road, Suite 419
Chattanooga, Tennessee 37421
(423) 892-0137
www.cispi.org

CISPI Written Text (Gravity)

Table 1 is provided to assist in the design of cast iron soil pipe sanitary systems. It indicates the slopes required to obtain self-cleansing or scouring velocities at various rates of discharge. A *self-cleansing velocity*, or a velocity sufficient to carry sewage solids along the conduit, permits the system to operate efficiently and reduces the likelihood of stoppages. A minimum velocity of two feet per second is the generally prescribed norm consistent with the removal of sewage solids, but a velocity of 2.5 feet per second can be used in cases where an additional degree of safety is desired.

ASPE 45 Written Text (Siphonic)

7.7.5.4 In fully primed flow (i.e., full-bore flow), the velocity in the stack shall be greater than 2.2 m/s (7.2 ft/s) for stacks 150 mm (6 in.) and smaller. For pipes larger than 150 mm (6 in.), refer to appropriate testing data from drain manufacturers. Minimum velocity is a function of pipe diameter.

7.9.3 Minimum velocity in horizontal and tailpiece piping sections shall be 0.9144 m/s (3 ft/s).

Issue with Gravity Drains

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TABLE 1
Slopes of Cast Iron Soil Pipe Sanitary Sewers
Required to Obtain Self-Cleaning Velocities of 2.0 and 2.5 Ft./Sec.
(Based on Mannings Formula with N = .012)

Pipe Size (In.)	Velocity (Ft./Sec.)	¼ Full Slope (Ft./Ft.)	¼ Full Flow (Gal./Min.)	½ Full Slope (Ft./Ft.)	½ Full Flow (Gal./Min.)	¾ Full Slope (Ft./Ft.)	¾ Full Flow (Gal./Min.)	Full Slope (Ft./Ft.)	Full Flow (Gal./Min.)
2.0	2.0	0.0313	4.67	0.0186	9.34	0.0148	14.09	0.0186	18.76
	2.5	0.0489	5.84	0.0291	11.67	0.0231	17.62	0.0291	23.45
3.0	2.0	0.0178	10.77	0.0107	21.46	0.0085	32.23	0.0107	42.91
	2.5	0.0278	13.47	0.0167	26.82	0.0133	40.29	0.0167	53.64
4.0	2.0	0.0122	19.03	0.0073	38.06	0.0058	57.01	0.0073	76.04
	2.5	0.0191	23.79	0.0114	47.58	0.0091	71.26	0.0114	95.05
5.0	2.0	0.0090	29.89	0.0054	59.79	0.0043	89.59	0.0054	119.49
	2.5	0.0141	37.37	0.0085	74.74	0.0067	11.99	0.0085	149.36
6.0	2.0	0.0071	43.18	0.0042	86.36	0.0034	129.54	0.0042	172.72
	2.5	0.0111	53.98	0.0066	107.95	0.0053	161.93	0.0066	214.90
8.0	2.0	0.0048	77.20	0.0029	154.32	0.0023	231.52	0.0029	308.64
	2.5	0.0075	96.50	0.0045	192.90	0.0036	289.40	0.0045	385.79
10.0	2.0	0.0036	120.92	0.0021	241.85	0.0017	362.77	0.0021	483.69
	2.5	0.0056	151.15	0.0033	302.31	0.0026	453.46	0.0033	604.61
12.0	2.0	0.0028	174.52	0.0017	349.03	0.0013	523.55	0.0017	698.07
	2.5	0.0044	218.15	0.0026	436.29	0.0021	654.44	0.0026	872.58
15.0	2.0	0.0021	275.42	0.0012	550.84	0.0010	826.26	0.0012	1101.68
	2.5	0.0032	344.28	0.0019	688.55	0.0015	1032.83	0.0019	1377.10

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Anti-Clog Drain

Siphonic vs. Sand Clog

4 Stages of Siphonic Flow

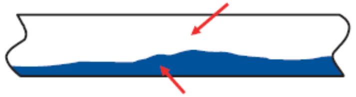
Four Flow Patterns of Siphonic Drainage

Priming of Main Pipe Work

Stage 1

Light Rainfall - Wavy or Gravity flow

Air above water



Gravity flow in pipework

Stage 2

Plug flow

Plug of water filling whole pipe at high velocities which achieves self-cleansing.

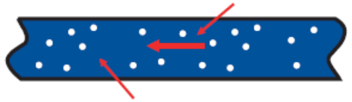
Air pockets driven down pipework

Tests have shown that **self-cleansing** can be achieved at as low as **10% to 15%** of the design rainfall rate.

Stage 3

Bubble flow

Water filling whole pipe



Air bubbles in suspension carried at high velocity

Stage 4

Full-bore flow

No more air entry – Air within Pipe now Fully Purged

Water filling whole pipe

Siphonic Action Starts at Stage 2

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Extra Topics: Sound, Benefits

Sound in a Siphonic System

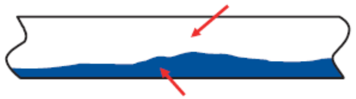
Four Flow Patterns of Siphonic Drainage

Priming of Main Pipe Work

Stage 1

Light Rainfall - Wavy or Gravity flow

Air above water



Gravity flow in pipework

0%

Stage 2

Plug flow

Plug of water filling whole pipe at high velocities which achieves self-cleansing.

Air pockets driven down pipework

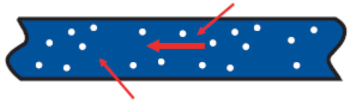
Tests have shown that **self-cleansing** can be achieved at as low as **10% to 15%** of the design rainfall rate.

+5%

Stage 3

Bubble flow

Water filling whole pipe



Air bubbles in suspension carried at high velocity

-5%

Stage 4

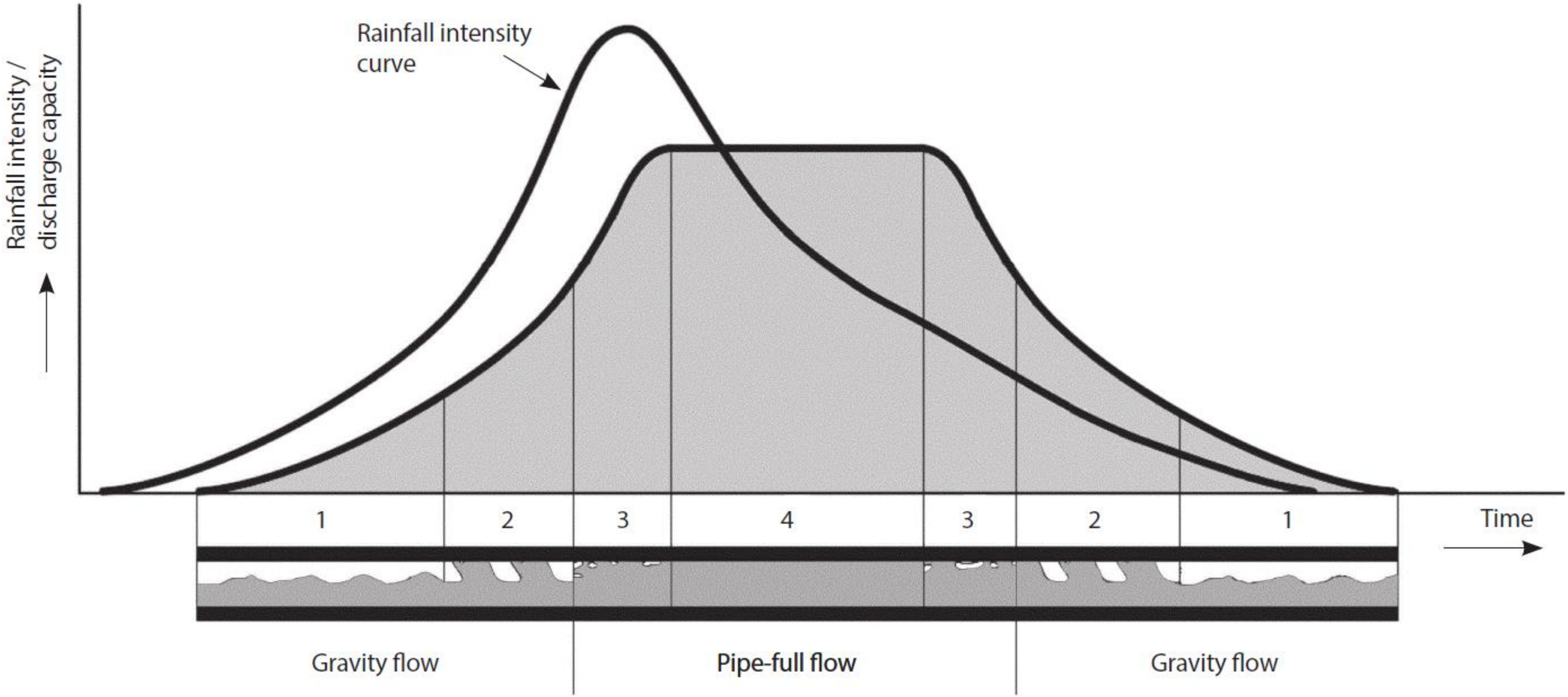
Full-bore flow

No more air entry – Air within Pipe now Fully Purged

Water filling whole pipe

-7%

4 Stages of Siphonic Flow



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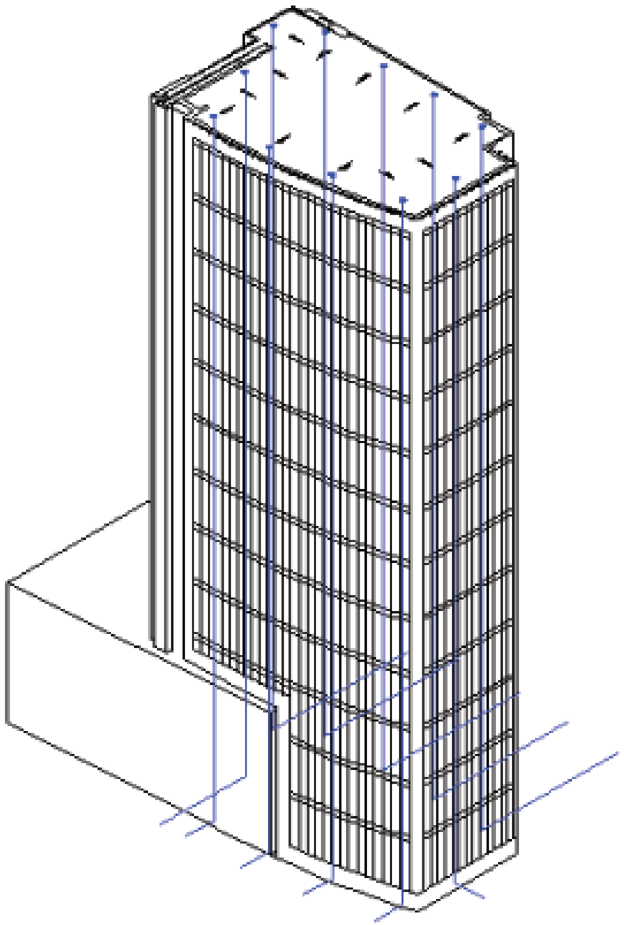
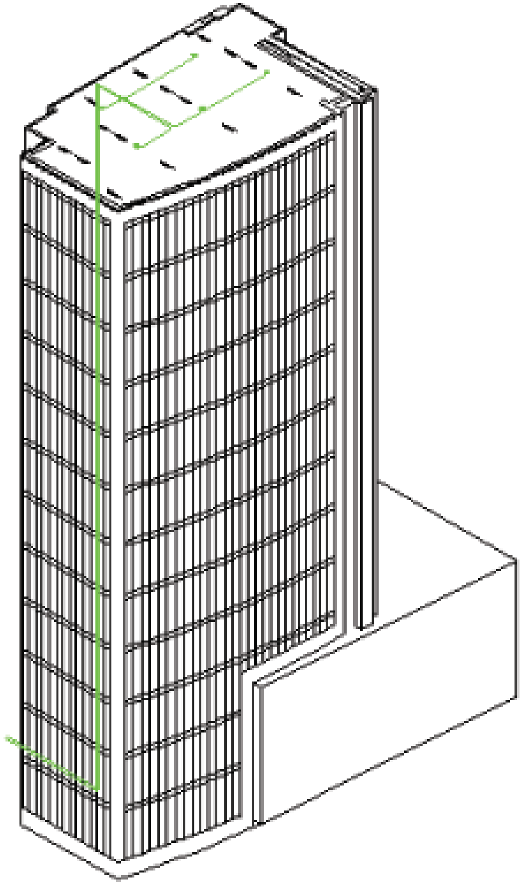
5 Ways Siphonic Saves

1. Eliminate vertical risers
2. Continue the diameter savings in the vertical
3. Eliminate civil pipework and connections
4. Run pipe flat to desired discharge location
5. Extend the siphonic pipe into civils



Multiple civil connections dictated by gravity



1 civil connection using most efficent route

Top Cost Savings Benefits of Siphonic Roof Drainage

#1 Smaller Diameter pipe = - Smaller Fittings - Smaller Couplings - Smaller Hangers - Smaller Insulation	**#3** **Anti-Clog Drain** with **Less Ponding**
#2 Horizontal pipes are installed without **PITCH – Flat Level** **Easy co-ordination** of services for BIM modelling **Higher Ceilings** – More Real Estate	**#4 Less Pipework = Less Labor** - Less Penetrations - Less Coordination - Less Construction Time - Less Manholes - Less Trenching - Less Conflicts

BRENNAN DOHERTY

Director of Siphonic Drainage

bdoherty@mifab.com

312-241-5224