

ENGINEERING COMMUNIQUE

JAY R. SMITH MFG. Co.[®]
MAY, 2015
VOLUME 5
ISSUE 4



From: THE SMITH ENGINEERING GROUP

SUBJECT: 2015 EDITIONS of the IAPMO/UPC & ICC/IPC PLUMBING CODES

The 2015 editions of the IAPMO-UPC and ICC-IPC plumbing codes have been released. The UPC remains the same in the storm drainage section as the 2012 edition. The IPC has changed some of their sizing criteria and deleted the roof square footage sizing charts which may create confusion.

For those of you who fall under the UPC jurisdiction it is status quo for now. For those of you under the IPC jurisdiction, we will attempt to clarify some statements just in the event an engineer questions this revision.

Presently, the AMSE A112.6.4 Roof Drain Standard is being revised by the ASME roof drain committee. The requirement for gallons per minute (GPM) flow through the roof drain will be addressed and a requirement for minimum flows will most likely be inserted at the next release of the standard.

In the last three years much controversy has taken place regarding roof drain flow rates. This was all based on partial testing initiated by ASPE at a third party testing agency and later moved to another third party testing agency. This testing (Note 1) was totally inconclusive, not consistent and did not come close to representing real conditions as too many variables were left unanswered. To quote the old saying "it was not apples for apples". The stated flow rates in this testing are based on particular test piping configurations and dimensions. Actual installed flow rates cannot be stated unless the piping configuration is known and the effects of the drainage piping calculated.

Both major codes (UPC & IPC) debated over proposals, verbiage and so forth in an effort to understand and clarify the confusion.

Some are of the opinion the flow rate through the roof drain dictates the flow for the entire interior storm water

system. This is not accurate as the piping configuration is the major impact on flow. Fact: The storm piping system dictates the flow not the roof drain. The configuration of the storm piping system will alter the GPM flow.

For example per Table 1106.2 (Page 3): A 4" vertical drain will flow 180 GPM but when turned horizontally, it is reduced to 81 GPM @ 1/16" slope per foot and 115 GPM @ 1/8" slope per foot. The horizontal pipe size will have to be increased to 6" for both the 1/16" and 1/8" slopes to compensate for the flow.

Refer to page 3. Shown on this page are three paragraphs (1105.2, 1106.2 & 1106.3) and two tables (Table 1106.2 & Table 1106.3) taken directly from the 2015 IPC Storm Drainage Section - Chapter 11.

1105.2 states the published flow rate and head of water above the roof drain shall be used to size the storm drainage system in accordance with Section 1106. However, 1106.2 states the vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain but then states the flow rate in the storm drain piping shall not exceed that specified in Table 1106.2. Confused, it is understandable! Therefore, 1106.2 lists maximum vertical and horizontal flow rates. The horizontal flow rates are based on the slope of the piping and overrides and limits the roof drain and vertical flow rates.

What does the engineer do since there are no published flow rates? He has two choices: use the square footage charts (Note 2) from the 2012 IPC or size his system based on the maximum flow rates shown in the Tables.

As an example of the Tables determining the maximum flow, refer to page 4. The GPM flow rates at different heads are shown for a 4 outlet/vertical. Only the 4" outlet / 4" head falls under the allowable GPM flow rates. The others exceed the maximum flow rate shown in the table.

FACT:

- ◇ There are no manufacturer's published flow rates.
- ◇ The maximum flow rates in Table 1106.2 overrides any future published roof drain flow rates.
- ◇ Horizontal flow rates overrides vertical flow rates.
- ◇ Using the traditional roof square footage charts, the designer knew how much roof area to discharge to one drain.

Note 1: The test data was based on flow through a roof drain with no piping connected and another test with a pipe connected and immediately turning 90° horizontally, running a short distance and turning 90° vertically. This test data does not establish precise/exact flows. This does not reflect real world conditions.

Note 2:

The square footage chart previously existing in both codes have proven to be adequate in sizing roof drains and interior storm water systems for over 70 years. These charts have safety factors built into them.

Statements were made indicating numerous roof failures have occurred because of the inadequacy of the roof drain to flow the proper GPM or the inability of the designer to correctly size the storm water system because of a lack of flow rates not shown in the manufacturer's catalog/web data. This is an alarmist statement with no basis of validation. There has never been a list released to the public unequivocally identifying the roof drain itself as the culprit in the so-called 'numerous roof failures'. The majority of failures were a result of inadequate roof structure (most prevalence), lack of maintenance in cleaning the debris around the domes, undetected stoppage in the rain leader, lack of sufficient roof drains, undersized roof drains and storm water piping, improperly installed roof drains (page 5), lack of sufficient secondary/emergency roof drains/systems and lack of scupper drains in the parapets.

The most common reason is an abnormal or catastrophic weather occurrence/phenomenon such as a hurricane, tornado, 500 year storm or micro burst.

FACT: STATED FLOW RATES FOR ROOF DRAINS ARE BASED ON PARTICULAR TEST PIPING CONFIGURATIONS AND DIMENSIONS. THE ROOF DRAIN DOES NOT DICTATE THE FLOW THROUGH THE SYSTEM. THE CONFIGURATION OF THE STORM PIPING WILL ALTER THE GPM FLOW.

2015 IPC CODE STATES:

SECTION 1105 ROOF DRAINS

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 drain 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 on the roof. ②

1106.2 Size of Storm Drain Piping: Vertical and horizontal storm drain piping shall be sized based on the flow rate through the roof drain. **The flow rate in storm drain piping shall not exceed that specified in Table 1106.2.**

1106.3 Vertical Leader Sizing: Vertical leaders shall be sized based on the flow rates from horizontal gutters or the maximum flow rate through the roof drains. **The flow rate through vertical leaders shall not exceed that specified in Table 1106.3.**

TABLE 1106.2					
STORM DRAIN PIPE SIZING					
SLOPE OF HORIZONTAL DRAIN					
PIPE SIZE IN INCHES	VERTICAL DRAIN - GPM①	1/16" PER FOOT GPM	1/8" PER FOOT GPM	¼" PER FOOT GPM	½" PER FOOT GPM
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

TABLE 1106.3	
SIZE OF LEADER IN INCHES	VERTICAL LEADER SIZING – CAPACITY IN GPM①
2	30
3	92
4	192
5	360
6	563
8	1,208

NOTE ①: The vertical flow rates shown in **Tables 1106.2 & 1106.3** are full (bore) flow rates. To achieve full flow, a certain head of water must cover the roof drain. This head of water in relationship to the drain’s ability to discharge a certain GPM is what creates the ponding. Depending on several variables, the head and resulting GPM will vary. Head and flow rates are affected by various factors including rainfall intensity, ambient temperature, wind, slope of the roof and more.

NOTE ②: To determine the ponding depth, the designer must take into consideration the depth of water (head) when the full flow is achieved over the roof drain. By determining the cubic volume of water ponding over each drain, the designer can convert it into pounds and provide the potential load information to the structural engineer. **1105.2** mentions ‘based on head (height) of water above the roof’ and later states ‘based on the maximum anticipated ponding on the roof’. Some will use the ponding depth to determine the volume of water to provide to the structural engineer. This should not be used. The head of water during a severe rain storm will vary. A more practical/safe method is to use the invert on the parapet scuppers to determine your possible head of water during a severe storm.

**APPROXIMATE GALLONS PER MINUTE FLOWS THROUGH A 4" OUTLET ROOF DRAIN
COMPARED TO MAXIMUM ALLOWED FLOWS PER TABLE 1106.3**

OUTLET SIZE	HEAD OF WATER	L/S	GPM ❶	MAXIMUM VERTICAL	MAXIMUM VERTICAL	COMMENT
				ALLOWED PER	ALLOWED PER	
				TABLE 1106.3	TABLE 1106.2	
4" (100 MM)	4" (100 MM)	08.5	135	192 GPM	180 GPM	ACCEPTABLE
4" (100 MM)	6" (152 MM)	13	201	192 GPM	180 GPM	EXCEEDS ❷
4" (100 MM)	8" (203 MM)	17	269	192 GPM	180 GPM	EXCEEDS ❷
4" (100 MM)	10" (254 MM)	18	288	192 GPM	180 GPM	EXCEEDS ❷
4" (100 MM)	12" (305 MM)	22	346	192 GPM	180 GPM	EXCEEDS ❷
4" (100 MM)	14" (357 MM)	26	405	192 GPM	180 GPM	EXCEEDS ❷

- ❶ Estimated vertical full flow rate at maximum head through the roof drain only. Once a horizontal turn is made, the flow is reduced. These are estimated flow rates only.
- ❷ The vertical flow rate through the roof drain exceeds the vertical flow rate in the Tables so the flow rate for the Tables must be used for sizing.



MEMBRANE CUT AT INSIDE DIAMETER OF THE SUMP CORRECTLY



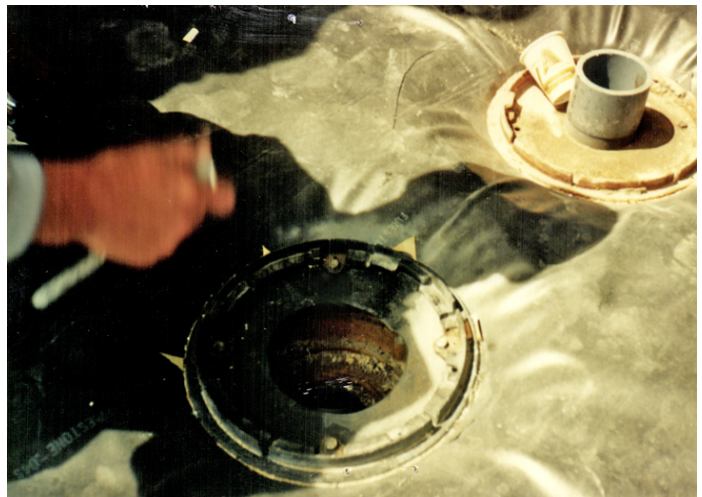
CLAMPING COLLAR INSTALLED

A roof was investigated where excessive ponding had occurred. These were 10" outlet roof drains so the flow rate was of extremely high volume and the drain itself was responsible for draining a massive area of roof. The membrane covered almost the entire sump area with a circular cut hole in the center of the sump but it was only 4" in diameter. Since it was a 10" outlet, the installer created a reduction in the outlet size by reducing the open area diameter by 6 inches. The drain could not flow its anticipated and required GPM flow, therefore; created enormous ponding of water whose weight exceeded the maximum PSI rating for the roof structure and it collapsed. An installation error.

It is common practice for the membrane installer to cover the entire sump area and then cut it back to the inside diameter of the sump. In the case described above, all the installer did was cut a 4" diameter hole in the center of the sump. As noted, it reduced the flow capability by 6" diameter. There is not a photo of the actual installation but imagine in the left photo the membrane only having a 4" hole in the center. This description is typical of what was mentioned in Note 2 regarding improperly installed roof drains.



THE MEMBRANE APPEARS TO BE INSTALLED CORRECTLY WITH THE 1080 ROOF DRAIN UPON REMOVING THE COLLAR, IT WAS BUNCHED UP IN THE ROOF DRAIN SUMP



THE MEMBRANE IS NOT CUT BACK PROPERLY. IT NEEDS SOME ADDITIONAL TRIMMING BACK TO THE SUMP I.D.