

Storm Drainage Sizing

This section will deal with sizing a storm drainage system. We find more buildings being designed with rainwater harvesting systems. Knowing how to size the storm drainage system will also help in sizing the rainwater harvesting systems.

Before we get into the sizing portion of this section it might be best to review some definitions. The 2003 IPC, Chapter 2, defines...

- **Building Drain**—That part of the lowest piping of a drainage system that receives the discharge from soil, waste and *other* drainage pipes inside and extends 30 inches in developed length of pipe beyond the exterior walls of the building and conveys the drainage to the building sewer.
- **Building Sewer**—That part of the drainage system that extends from the end of the building drain and conveys the discharge to a public sewer, private sewer, individual sewage disposal system or other point of disposal.

The building drain and building sewer breaks down into three separate categories.

- **Combined**—a building drain or sewer that conveys both sewage and storm water or other drainage.
- **Sanitary**—a building drain or sewer that conveys sewage only
- **Storm**—a building drain or sewer that conveys storm water or other drainage, but not sewage.

Piping definitions:

- **Conductor**—a pipe inside the building that conveys storm water from the roof to a storm or combined building drain.
- **Leader**—an exterior drainage pipe for conveying storm water from roof or gutter drains to an approved means of disposal.

Within this section we will be dealing with the sizing of the storm drainage system only. We will be using tables 1106.2, Size of Vertical Conductors and Leaders and 1106.3, Size of Horizontal Storm Drainage Piping. Both of these tables use square footage as a basis for sizing and can be found in Chapter 11, Storm Drainage of the 2003 IPC book.

The square footage of a building, the area, can be found by multiplying its length times its width, $A=L \times W$. A building with a roof that measures 100 feet by 125 feet will have a square footage of 12,500 square feet, figure 1. Unfortunately buildings are not always square or rectangular. When these situations occur we must be able to properly calculate the proper square footage. In figure 2 we have a building with an overall measurement of 100 feet by 125 feet however, this building is U-shaped with a 25 foot by 20 foot section with no roofing. As before if we multiply 100' x 125' we come up with a total square footage of 12,500 square feet but this roof has a 25' x 20' section missing. This

section equals 500 square feet of missing roof section. We then subtract the 500 square feet from the 12,500 square feet which gives us a new total area of 12,000 square feet. Less common are circular roofs, figure 3. The area of these roofs can be found by using the formula, $A = \pi r^2$. As with our first formula A is the area, pi is equal to 3.14 and r is the radius or $\frac{1}{2}$ the diameter of the circle. For the purpose of this section we will only be using roofs that are square or rectangular.

Before we start our calculations we must know what we are looking for and have certain information to find our answers. We must use tables 1106.2 and 1106.3 together when sizing the system. We cannot have a 5" horizontal drain go into a 4" vertical conductor. *Section 1101.5 Continuous Flow*—the size of a drainage pipe shall not be reduced in the direction of flow.

There are two pieces of information that must always be a given, a number we must have. They are the roof size and the rate of rain fall for the area. The size of the roof can be found on the prints and the rate of rain fall for an area can be found in appendix B of the 2003 IPC.

Table 1106.2, Size of Vertical Conductors and Leaders, gives us information on sizing conductors and leaders. In column #1 we have a 4" conductor. At a rain fall rate of 1" per hour this conductor will handle a total of 18,400 square feet of roof area. At a rain fall rate of 2" per hour this same conductor will only handle a roof area of 9,200 square feet. If you were to follow the 4" line all the way down you will come to a rain fall rate of 12" per hour. At this point our 4" conductor will only handle a total of 1,530 square feet of roof. If we were looking for the area of a roof that this conductor could handle in the New Haven area we would divide the 1" rain fall rate roof area by 2.8. We then would find that a 4" conductor will handle a roof area of 6,571 square feet. In figure 1 we have total roof area of 12,500 square feet. How many 4" conductors would be required to handle this roof if it were in New Haven? If we divide 12,500 by the 6,571 we find that it would take two conductors to handle the 12,500 roof area in New Haven. What size conductors would be needed in you have a 12,500 square foot roof in New Haven with 4 conductors? One way to answer this question would first be to establish how many square feet each conductor would handle. This can be found by dividing 12,500 by 4 which equals an area of 3,125 square feet each. If we look at the 3" conductor we see that a 2" rain fall rate can handle 4,400 square feet and at a 3" rain fall rate it will handle 2,930 square feet. By looking at these two numbers we get a clue as to the size conductor we would need. We can then check by dividing 8,800, the 1" rain fall rate by 2.8. This would give us square foot coverage of 3,142 feet. Our answer is a 12,500 square foot roof with four conductors requires 3" conductors.

Table 1106.3, Size of Horizontal Storm Drainage Piping, gives us information on sizing the horizontal piping. Unlike vertical piping, another consideration that must be taken into account when sizing the horizontal piping is its slope. Table 1106.3 contains a section on 1/8" (1%), 1/4" (2%) and 1/2" (4%) slope or pitch. Care must be taken when installing the horizontal drains for storm lines. If a drawing shows a 4" line at 1/4" pitch and a field adjustment must be made to 1/8" pitch, this adjustment may be enough to require that the line be increased in size to compensate for the lessor slope. As with table 1106.2 rain fall rates are given in whole number. In order to make these work for the New Haven area we must divide the 1" rain fall rate by 2.8. As an example, a 4" drain at 1/4" in New Haven will handle 3,517 square feet of roof area, but if we were to change that to a 1/8 slope that same 4"

drain will now only handle 2,686 square feet. In order for that same area to be handled by a line with a 1/8" slope it would have to be increased in size to 5". As you can see this field adjustment could have a large impact on job cost. Not only would there be an increase in size of the horizontal piping, but also the conductor piping, fitting, clamps, insulation, hangers, rods, nuts and washers. Before any changes are made an RFI, request for information, should be sent to the engineer through the general contractor or construction manager.

Many roofs have roof top units that discharge either continuously or semi-continuously onto a roof. In these cases the discharge must be included when sizing the system. Each gallon per minute shall be equal to 96 square feet of roof area.

The first shall be a system with the roof and conductor size given. Using New Haven rain fall rates, the student must give the correct number of conductors.

Problem #1

- Roof Size 200' x 200'
- Conductor size 3"
- Number of conductors required. _____

The second shall be a system with the roof and number of conductors given. Using New Haven rain fall rates, the student must give the correct size of each conductor.

Problem #2

- Roof Size 200' x 150'
- Number conductors -4-
- Minimum Size conductor required. _____

The third shall be a system with the roof size, slope, and number of roof drains given. Using New Haven rain fall rates, the student must find the correct size of the horizontal drains.

Problem #3

- Roof Size 150' x 150'
- Slope 2%
- Number of Roof Drains 6
- Minimum size horizontal drain required. _____

The fourth shall be a system with the roof size, number of conductors, and the number of GPM's of a roof top unit. Using New Haven rain fall rates, the student must give the correct size of the conductors. This could be used by the instructor as a trick question to see if the student realizes that the unit would only be draining to one conductor and that only one area size would be affected by the unit.

Problem #4

- Roof Size 150' x 175'
- Number of conductors 4
- Discharge of 5 GPM in one R/D
- Minimum size of conductors. _____

If there is any remaining time, the instructor can then review Chapter 11.