Siphonic Roof Drainage

Inside Secrets

By Peter Kraut

There have been an abundance of articles and seminars on the topic of siphonic roof drainage. They have been somewhat informative, cursory and often promotional. What they don't address is the question you all keep asking "How do I design a system?" Although this cannot be taught in a few pages, this article will endeavor to give you some insight to laying out and sizing systems.

Roof slopes, cricketing and catchment areas should remain the responsibility of the architect. Sometimes, direction is needed or requested by the architect. A siphonic roof drain system can work with most roof layouts. Due to the higher flow rates in smaller pipes, siphonic systems adapt well to larger roof areas. Avoid small areas near the downpipe as these are subject to the greatest suction pressures and will be hard to balance without significant flows. Small high roofs such as stair towers and elevator overruns should spill to the lower roofs via conventional pipes or downspouts. It is easier to add these small flows to the flows in the main roof.

Once the roof slope, ridges and valleys have been determined, the drains can be located at the low points and catchment areas can be determined through measurements. Cricketing will often redirect water in the valleys towards the drains. It is often preferred in siphonic roof drainage to eliminate the cricketing since this will allow several drains to share the same volume of water, thereby reducing the critical nature of balancing the system. Be sure that this is acceptable to the architect and the roofing manufacturer as this may be in conflict with the roof warranty. Also, be aware that deflection of the roof may lead to ponding on the roof. If in doubt, consider a gutter or leave the cricketing in place.

It is important to understand that rain seldom falls vertically. It is more often blown in one direction or another. For this reason, most codes and good engineering practice require that you add some catchment area for vertical walls above the roof. You probably know to add 50 percent of the vertical height for one wall and 35 percent of the height for two perpendicular walls. You probably also know that two opposing parallel walls will cancel each other out since rain won't blow from opposite directions simultaneously. What about in a siphonic system?

It is very important that you do not connect siphonic drains at the base of a vertical wall with those that are not. The flow rate of these drains is very unpredictable. The best practice is to create a catchment area equal in width to 50 percent of the adjacent height. Then, collect the drains at the base of the wall in a separate independent system. The drains next to the wall may be flowing at 200 percent if the rain is blowing towards the wall. On the other hand, they may be completely dry if the rain is blowing away from the wall. Combining these with other drains could lead to insufficient flow rates or worse yet, air entering the system.

Connecting roof drains from different elevations can often lead to problems as well. If the pipe connection occurs in an area of positive pressure, water can actually discharge onto the lower roof. If it occurs in an area of negative pressure, air can be drawn in when rainfall is shielded from the lower roof.

Multiply your catchment area by the rainfall rate in inches and then by 0.0104 to get gallons per minute. Use this value to select a drain from the manufacturer.

Sumps around drains serve an important role in siphonic or conventional systems. They allow for the build up of a head water around the drain without ponding vast areas. This saves hundreds or thousands of pounds on the structure. Two inches is generally deep enough for most applications, but you will need to consult the drain manufacturer for more specific information. Snow melt around drains should be dealt with in the same fashion as a conventional system. Solutions include heat trace, eliminating roof insulation, eliminating pipe insulation or nothing at all. Each has their own pros and cons. Consult your architect or roofing manufacturer.

Now that we're inside the building, the pipe work needs to be laid out. Start with a minimum 24" long tailpiece. If ceiling heights require shorter lengths, some careful analysis needs to be made which is outside the scope of this article. Tailpieces should turn horizontal and run parallel before connecting into the horizontal collector. A few feet is often enough to reduce pipe sizes or otherwise balance the system later. All connections should be made in the side of the collector. If the tailpiece needs to be larger than the drain outlet, obtain documentation from the man-

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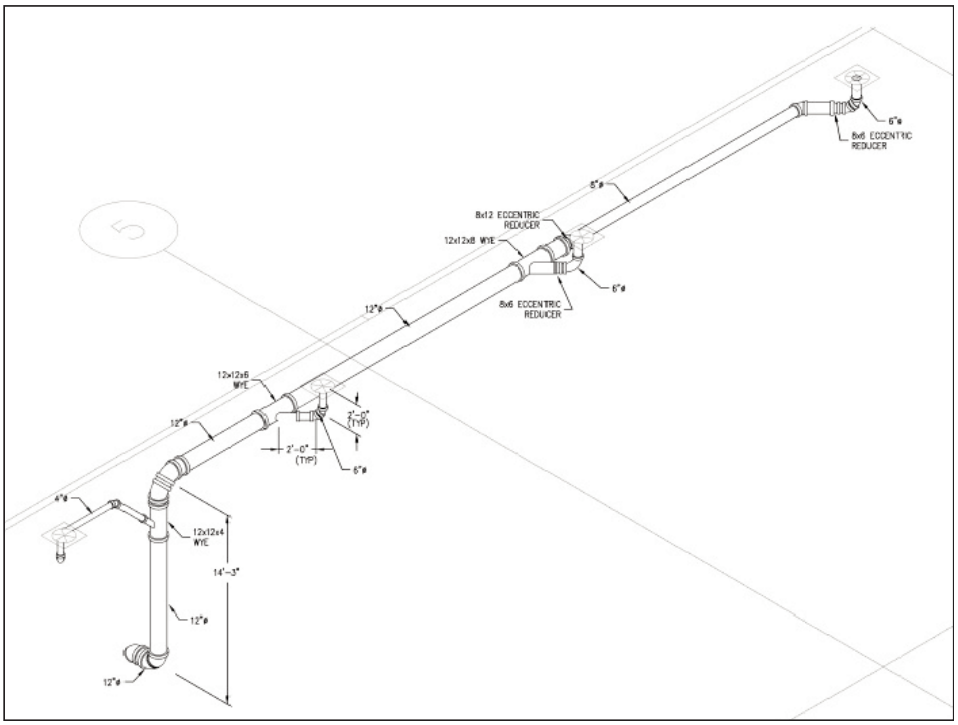
ufacturer that it will prime. If not, specify a larger drain.

It will be necessary to increase and even reduce pipe sizes to balance the system. Eccentric reducers should be used whenever they are available. They should be placed with the flat surface at the top of the pipe. Placing them in the conventional orientation will delay or prevent the siphon from forming. When used in the vertical at the top of a riser, they should be placed with the flat side on the inside of the bend. Never increase a pipe size in the vertical. The one exception would be if you plan on breaking the siphon. This is often done in high rises after a few floors to prevent the pressures from exceeding the pipe capacities.

Sizing the pipework and balancing the system starts with a good first guess. A reducer is typically placed at the top of the riser, immediately after the system goes vertical.



Siphonic systems require a level of detail in construction documents typically seen in shop drawings.

This increases the velocity as discussed later. But what about the rest of the system? I have often heard that conventional sizing charts using 1/8" per square foot can be cut in half for siphonic. A 6" pipe becomes a 3" pipe. This may be a good generalization for selling the system, but it will lead to hours and hours of re-balancing. Make a sketch of the pipe routing and try this instead:

Take the height of your system and divide it by the length of the system from the downpipe to the furthest drain. Multiply by 100. You can then size the system using a constant friction loss in feet per 100 feet. I like to use Bell & Gossett's System Sizer wheel, but any water pipe sizing chart will do. If your system is 30 feet tall and the furthest drain is 450 linear feet away (including a fitting allowance), you would select pipe sizes at 6.7 ft. of head (2.9 psi) per 100 feet. Use the drains flow rate to size each tailpiece and the combined flow rate to size each pipe segment. For this example, the required pipe size for 200 gallons per minute falls between 3" and 4". Make the segment with half of each pipe size. If the required pipe size is closer to 4", use that size for 75 percent of the segment length. For drains closer to the downpipe, recalculate available friction based on the shorter branch. In the end, you will notice that given similar flow rates, the drains closer to the downpipe will be smaller pipe sizes.

As you work, keep an eye on velocity, especially in the larger of the two pipe sizes. Horizontal pipes must be flowing at 3 feet per second or more. In general, vertical pipes must be flowing at 7 feet per second or more; this varies by pipe size. Dimension your sketch and then input the data into the manufacturer's sizing software. If you followed the suggestions above, there should only be a little balancing left. If the residual head at any given drain is negative, you need less friction. Try moving the reducer on that branch to make more 4" pipe and less 3" pipe. If groups of drains or the whole system needs adjustment, focus on the collector pipe sizes and their reducer placements. Your goal is to have +0.1 to +3.0 feet of residual head at each drain and the imbalance between them to be less than 1.5 feet of head. Buildings shorter than 15 feet should have a residual head no greater than 10% of the building height.

There are plenty of resources for engineers. Rely on the advice of the experts that the manufacturers offer, but don't give in to the temptation to stamp and sign their work. As the engineer of record, you should be in responsible charge of the work from beginning to end. You need to decide if this system is appropriate for your application and you need to ensure that the system is installed according to your design. When the installed system deviates from your design, you alone must determine if the system is still in balance and will function properly. Don't wait for the 100-year storm to find out! For more information, refer to ASPE Technical Standard 45. ■

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