Although hidden behind walls and in floors and ceilings, the pipes that make up a house’s drain-waste-vent (DWV) system are the balance of the plumbing equation. They are the exit for the water provided through the supply lines, they carry waste from the toilet, and they connect to outside air for venting sewer gas and relieving pressure. These relatively large-diameter pipes rely solely on gravity, but they aren’t easily routed through the structure of a house.

With three chapters in the IRC devoted to DWV systems, not to mention the tables and examples illustrated in the appendix, there is a lot to know about the layout and installation of such a system. Pipe sizes that vary based on usage; routes through framing bays that may already be packed with other mechanicals; pitch tolerances of plus or minus just ¼ in. per ft.; fittings with subtle differences in inlets, outlets, and applicability; and an array of minimums and maximums to consider when it comes to tying everything together are just a handful of the many situations, rules, and restrictions plumbers must understand.

The stakes are high, because an improper DWV setup can lead to slow drains, gurgling fixtures, sewer gas entering the living space, recurring clogs, and potentially hazardous overflows. When installed well, though, a DWV system will go unnoticed, with solids, liquids, and gases flowing smoothly. Here’s how it works.

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Connections in a drain line should be made with a Y-fitting or TY-fitting, never a 90, to ensure a smooth and uninterrupted flow of waste.

For sinks of any kind, the most common branch fitting is the sanitary T. The vent attaches to the top inlet, and the trap arm attaches to the branch inlet.

Drain pipes should be sloped $\frac{1}{4}$ in. per ft. If they are not pitched enough, the flow will be inadequate. If they are pitched too steeply, the water will flow too quickly, leaving behind solid waste or debris.

To avoid bottlenecking and clogging, no component of the drain system can be larger in diameter than the downstream parts that are attached to it.

Cleanouts (and 18 in. of open space for access) are required by code for clearing clogs.

Toilets have their own traps built in.

Every DWV system is required to have at least one 3-in. pipe venting outside.

Evolution of the modern drain

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GETTING THE TRAP RIGHT

Good The trap is straight below and in line with the fixture drain, and the trap arm is sloped $\frac{1}{4}$ in. per ft. The trap arm falls no more than the diameter of the pipe it’s plumbed with, allowing adequate room for air to flow in from the vent pipe as water drains.

Bad If the trap arm is too long, pitched too steeply, or connected to the stack with the wrong fitting, the air intake will be below the level of the water flow and may start to siphon water out of the trap. Siphoning will continue until the water level in the trap drops enough to let air into the pipe, which then will leave it open for sewer gas to enter the room.

Air is allowed to enter the drainpipe, leading to siphonage.

Air is not allowed to enter the drainpipe.

Chances from horizontal to vertical can be abrupt, but changes from vertical to horizontal should have a combination of TY-fittings and 45-fittings to avoid clogs.

Stack vent

Sanitary T

Trap water level

1 1/2-in. pipe

Slope of $\frac{1}{4}$ in. per ft.

Stack vent

Trap water level

TY- and 45-fittings

10-ft. run

Slope of $\frac{1}{2}$ in. per ft.

Stack vent

Cleanouts (and 18 in. of open space for access) are required by code for clearing clogs.