howitworks
THE MECHANICS OF HOME BUILDING

Drain-waste-

BY JUSTIN FINK

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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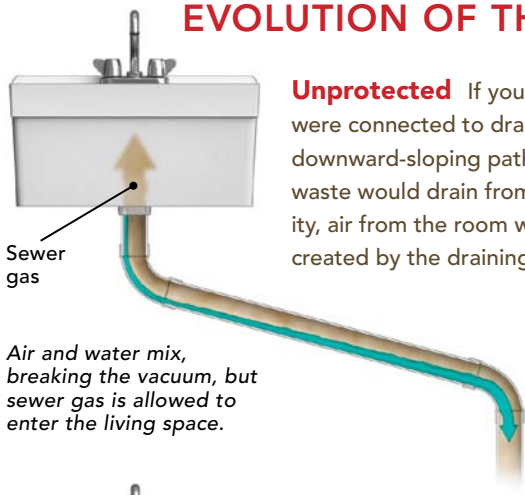
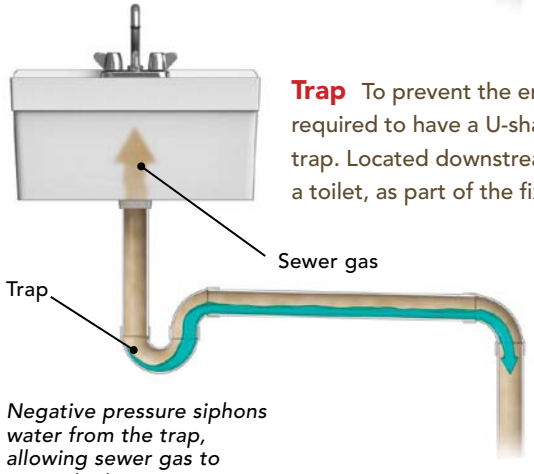
EVOLUTION OF THE MODERN DRAIN



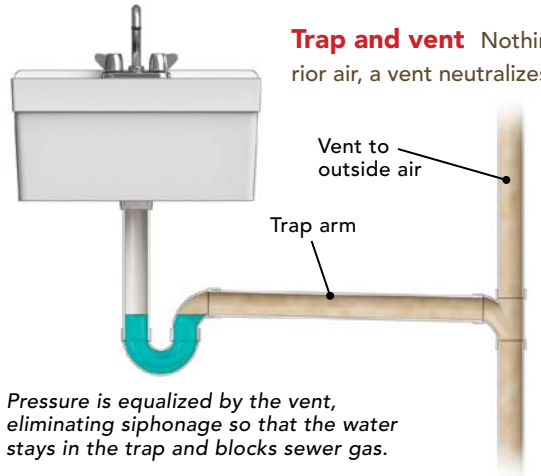
Air and water mix, breaking the vacuum, but sewer gas is allowed to enter the living space.

Unprotected If your sink, bathtub, and other fixtures were connected to drain lines that followed a straight, downward-sloping path to a main sewer outlet, water or waste would drain from each fixture with the help of gravity, air from the room would mix in and relieve the vacuum created by the draining water, and everything would flow without trouble. The problem with this setup is that air being allowed to flow into the drain system means that air also is allowed to flow out and into the room, bringing sewer gas with it.



Negative pressure siphons water from the trap, allowing sewer gas to enter the living space.

Trap To prevent the entry of sewer gas, every fixture is required to have a U-shaped section of piping, known as a trap. Located downstream of the fixture (or in the case of a toilet, as part of the fixture itself), the trap holds water, blocking sewer gas from coming up through the fixture's drain. The problem with a trap is that as water flows through a drain line, it creates a vacuum behind it (negative pressure) and pushes air in front of it (positive pressure). The flow of this "water slug" can cause water to be sucked out of a trap that it's passing near, and it may also cause air to push through and gurgle in nearby traps downstream of its path. To relieve this pressure differential, code requires vents.



Pressure is equalized by the vent, eliminating siphonage so that the water stays in the trap and blocks sewer gas.

Trap and vent Nothing more than a connection to exterior air, a vent neutralizes air pressure within the drain lines. This neutral pressure can be achieved with lots of different configurations: an empty (dry) pipe that connects to the top of a trap arm like a snorkel, a waste (wet) pipe that is oversize in order to provide enough room for both water and airflow, and variations on these setups.

Drawings: Christopher Mills

vent systems

Vent pipes should be pitched to drain accumulated moisture.

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.

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

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.

Toilets have their own traps built in.

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.

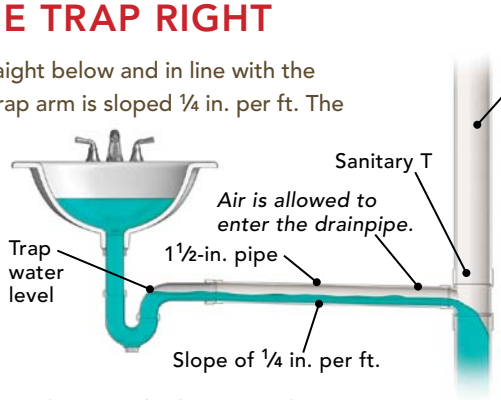
Drain pipes should be sloped ¼ in. per ft. If they are not pitched enough, the flow will be inadequate. If they are pitched too steeply, the water will flow too quickly, leaving behind solid waste or debris.

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

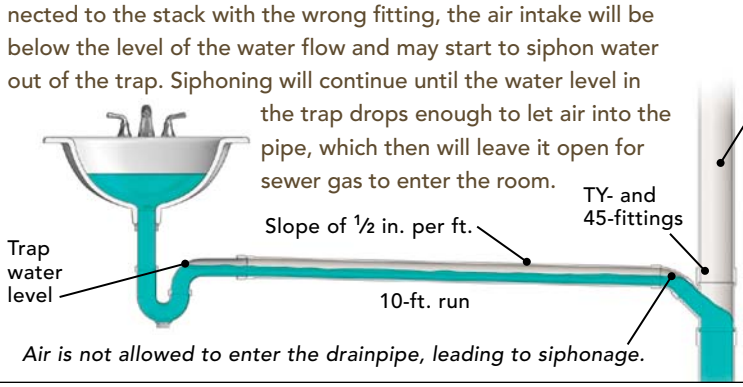
Changes from horizontal to vertical can be abrupt, but changes from vertical to horizontal should have a combination of TY-fittings and 45-fittings to avoid clogs.

GETTING THE TRAP RIGHT

Good The trap is straight below and in line with the fixture drain, and the trap arm is sloped ¼ 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 not allowed to enter the drainpipe, leading to siphonage.