

COMMERCIAL COMFORT= ZONING

Discover why zoning is needed; determining design parameters; zoning components and operation; and troubleshooting control and air-flow issues.

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All Images Courtesy of ZONEFIRST.

The top two complaints in most offices are that employees are either too hot or too cold. The good news for HVACR contractors is that this problem can be solved. Typically, there is only one thermostat for the HVAC unit, often located in a central hallway or interior space away from where all the complaints occur; or better yet, it is in a room or office where one person's comfort level is everyone else's discomfort. So how can everyone have control when there's only one unit?

The old answer was to install a VAV system, but that can be costly. A newer answer is a multi-zone mini-split, however this can be expensive as well, especially running a refrigerant line and new electric around and through walls in the office. It also will be very disruptive to the office as each unit is mounted. There is a simple, time-proven solution that also is low cost, eliminates the need for added power and is minimally disruptive—a zone damper system.

The problem with the system is that the air needs to be balanced. Instead of trying to adjust manual dampers for air volume, why not use thermostats to balance based on temperature? The thermostats automatically open and close the zone dampers to solve the problem of zones becoming too hot while others are too cold. If there is a good HVAC system on the roof and the duct work is designed properly, why not use what is there and make it better?

Zoning, by having thermostats in each zone, can automatically compensate for changing loads by controlling the automatic dampers to simply direct the air to the zones that need it, while shutting off the zones that do not.



⤴ Various motorized dampers that are available.

Building design and loads

So many buildings have perimeter and interior offices on the same HVAC unit with just one thermostat somewhere in between. It is virtually impossible to keep every part of the office at a consistent, comfortable temperature, especially when one thermostat controls all four sides of the building. In the morning the eastern side is heated by the radiant heat of the sun and the northern and western exposures end up being colder. In the afternoon the situation changes as the solar gain moves to the opposite side. The amount of glass also affects much of the temperature in those perimeter offices.

The loads in a building also can change just as much and without notice. Office areas that may have had five people may be down to one, or vice versa. Conference rooms are



« A three-zone control panel being wired to add zoning to existing system, mounted next to furnace.

seldom used rooms but are always being conditioned. When no one is in the conference room why heat or cool it? When everyone is in the conference room no one is in the offices, so the load has shifted. Manual balancing dampers do not always cut it, and VAV systems can be slow to respond, which is why a simple zone-control system can do the best job.

System survey

When beginning to survey the system, first and foremost is to ensure the duct system, both supply and return, are adequate for the HVAC unit's rated cfm. While it is not required to damper any of the return ducts, it is important to make sure the return is adequately sized so the supply air and zoning system are not affected. Oftentimes older HVAC units are changed without regard to the existing duct system and can be oversized or even undersized. Providing the basic system conforms to being a quality installation, designing a zoning system can begin.

Next—and probably the toughest part of the job, especially if a set of the duct plans is not available—is to sketch out where the ducts go and determine each duct's size. Without this, contractors/technicians will never know what is needed for dampers. Once this is done, the total number of dampers and the sizes needed for each zone can be calculated. Most dampers may control a common duct with several outlets for

one zone. Some zones may need individual dampers for each outlet, and may need to be slaved together to be controlled by the same zone. New plug-in dampers come with their own wire. This greatly simplifies this process because one wire plugs into one motor, then another wire simply plugs into the next and so on, for dampers on the same zone. No stripping wires for screw terminals or wire nuts required (see image on pg. 18).

Another part of the survey is to ensure adequate air flow and avoid noise issues, as zone dampers open and close. Once all of the zones dampers and their respective sizes have been determined, each zone must be compared to the total cfm of the HVAC Unit, when it is the only one that is open. The excess air the zone cannot handle must be dealt with by bypassing the excess air (discussed later).

Zone dampers are easily installed in the duct runs to each zone or room. Square, rectangular and small round metal ducts can easily have dampers inserted and typically take less than 10 minutes per damper to install. Most commercial systems have the ducts running through the false ceiling space, affording easy access for installation and the damper wiring. To save time on running the thermostat wires, think of using wireless thermostats. Just install the wireless receivers near the zoning panel and figure about 5 minutes max to wire each receiver. (See image on pg. 16).



⤴ This is a plug-in damper motor with modular cord and second jack to slave up to 10 dampers together, on the same zone.

Zone controls

The best solution for managing varying loads is a simple zone-control system. Ever heard of the “Keep It Simple Stupid” (or KISS) expression? This is a good expression for zone control. Zoning is so simple that a contractor/technician does not need to learn more than what they already know.

Zone control systems use standard thermostats (wired or wireless) that wire to a central control panel and indirectly control the HVAC unit. When a zone calls for heating or cooling, the system turns on and the motorized dampers either open or close, directing the air to the zones calling for it, which is different than modulating. If the HVAC and is on or off, why vary or modulate the zone dampers? Since the zone dampers are a relatively small size, it is more important to get the air to the zone first; modulating a damper restricts more air flow and requires more air management such as a bypass to relieve air.

A bypass is typically required, just like in VAV systems, as the total air flow required is often less than the air flow produced by the HVAC unit. Just like VAV systems, excess air that cannot go through the zone duct is typically bypassed into the false ceiling, which often is used as a common return. The amount of bypass air is controlled by a modulating damper that is controlled by a static pressure device sensing the supply duct pressure. When the static sensor senses a rise in the duct pressure, the bypass damper modulates to maintain a specific static pressure. This ensures the air gets to the open zones as well as bypassing only the excess.

Basically, zoning is a less expensive and simpler VAV system. As a zone calls for air, the damper for that zone stays open—since all dampers normally start from an open position; the dampers to the zones not calling for air close, and the heating or cooling is brought on. This all happens simultaneously within seconds, provided there are no time delays. Any other zones that call for the same mode, their zone dampers would simply open and remain open until all zones are satisfied. If an opposite call comes in—say the perimeter zones are calling for heating and a call from an interior zone calls for cooling—the zone-control panel logic typical-

ly allows the first calling mode to try and satisfy the zones. If it cannot after a certain time period (20 minutes in most instances), the heat would shut off and the system purges the residual heat for a couple of minutes into the zones that last called for it. Then the system would switch over to cool mode, open the calling zone and close the zones not calling for cooling.

If an opposite call comes in (for cooling) when there are still calls for heating, the control panel will typically continue heating for a period of time (typically 20 minutes). If the heating call is still not satisfied, the system will then drop the heating call and switch over to try and satisfy the cool call. Since there can be opposite calls and not all of the heating or cooling load is needed at the same time, there is ample capacity to satisfy the calling zones, even if at design temperatures.

Once installed, a simple commissioning should be performed to ensure proper performance of the HVAC system and that adequate air flows and noise levels are not objectionable. First, make all zones call for either heating or cooling, depending upon outdoor conditions. With all zones open, the performance of the HVAC system—refrigerant pressures, temperature rise, etc.—should be as stated for the efficiency of the unit. Next, begin to close each zone one by one, starting with the largest and going to the smallest. As each zone thermostat is satisfied, the zone damper closes. Be sure the satisfied zone damper is closed and that no more than an acceptable amount of leakage may be entering. On the open zone there should be a slight increase in air flow, but not so much that it increases beyond an acceptable level of noise. The bypass can be adjusted to either push more air to the open zones or relieve more air.

Pricing zones

For contractors and technicians not familiar with or who have never installed a zoning system, pricing may sound daunting. However, when the alternatives are considered and the costs examined, zoning is a lot less expensive than installing a separate system or even a mini-split). Zoning typically can be bought for less than \$300/zone; this includes a motorized zone damper, thermostat, control panel and bypass. Add this cost to a few hours of labor and it will still cost less than the alternatives—plus there is no need to add extra power, run piping or get permits.

Look for a new Zoning Manual (ZR) from ACCA, most likely in the spring, for more technical information on designing zoning systems. 🌐

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