Building Re-Tuning Training Guide: AHU Static Pressure Control

Summary

The purpose of the air-handling unit (AHU) static pressure control guide is to show, through examples of good and bad operations, how the static pressure can be efficiently controlled.

When a building's supply fan(s) system is operational, the supply fan's static pressure set point can be automatically adjusted to load conditions that will allow the supply fan to operate more efficiently. When the set point values are consistently at the same values (constant) for a long period of time and during load conditions which otherwise would be advantageous for the set points to change, these conditions should be detected by the reviewing the trend graphs for further investigation. Failure to investigate or correct/mitigate static pressure set point reset, in all likelihood, will lead to increased fan, heating and cooling energy consumption.

Data needed to verify the static pressure control

To analyze and detect AHU static pressure control problems, for single-duct variable-air-volume (SDVAV) air-handling units, the corresponding parameters must be monitored using the trending capabilities of the building automation system (BAS):

- Duct static pressure
- Duct static pressure set point
- Zone damper position signal.

The recommended frequency of data collection is between 5 and 30 minutes. When analyzing the static pressure, the trends to look for include:

- Is there a reset-schedule for the duct static pressure?
- Is the static pressure set point too high or too low?
    - Review trends of damper position of variable air volume (VAV) boxes vs. time
        - Most dampers are nearly closed during cooling—static pressure too high
        - Several (>25%) dampers are fully open during cooling—static pressure too low (starved boxes)

- Look for dampers that aren't modulating with changing conditions, and VAV boxes that are not being controlled or not responding to control signals.

Is there a reset-schedule for the duct static pressure?

Duct static control specifications are taken directly from vendors standard specifications. To maintain the static pressure set point, the supply fan will modulate appropriately, but the set point is usually determined based on design conditions before the building is ever built. After construction, the static pressure set point is often adjusted as needed to satisfy the most demanding zone, which often is a problem area that sets a higher than required set point for the remainder of the system.

An example of bad operation can be seen below in Figure 1, where the system operates without a static pressure reset-schedule. Here, the static pressure is set at a constant 2 inches of water column (in. w.c.) during the day and off only for a few hours at night. Figure 2 shows an example of good operation, where the building uses a static pressure reset-schedule.

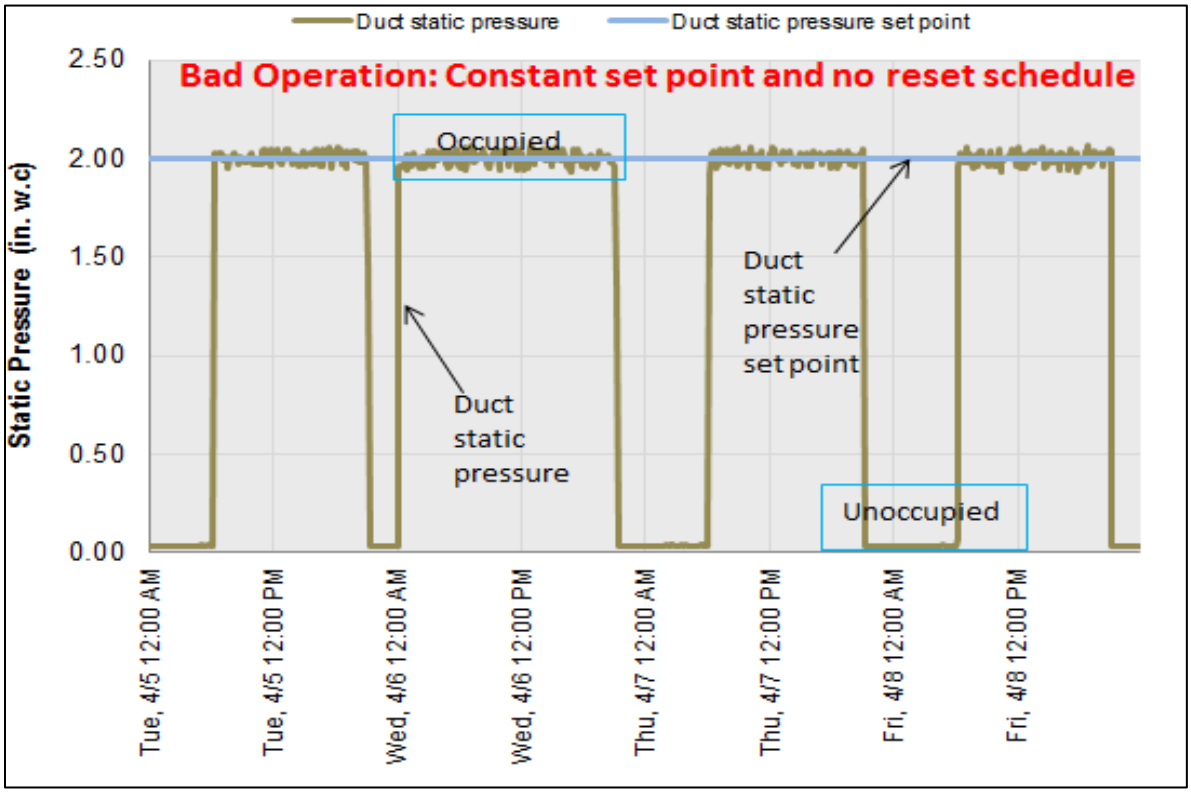

Figure 1: Constant static pressure (no reset).

In Figure 2 below, you can see that the static pressure is reset twice a day during this 2-day span. The system turns off at roughly 7:00 PM on both Wednesday and Thursday night, and turns on at 6:00 AM. When the system turns on, the static pressure is set to 1 inch, and as the building load increases, the static pressure is reset to 1.5 inches. Then, as the building load decreases in the afternoon, the system resets the static pressure back to 1 inch, until finally the system turns off. The reset in Figure 2 is considered a static reset, where the set point is reset at certain times of the day based on the building load. Figure 3 below gives an even better example of good operation, where the static pressure is constantly reset based on the zone conditions.

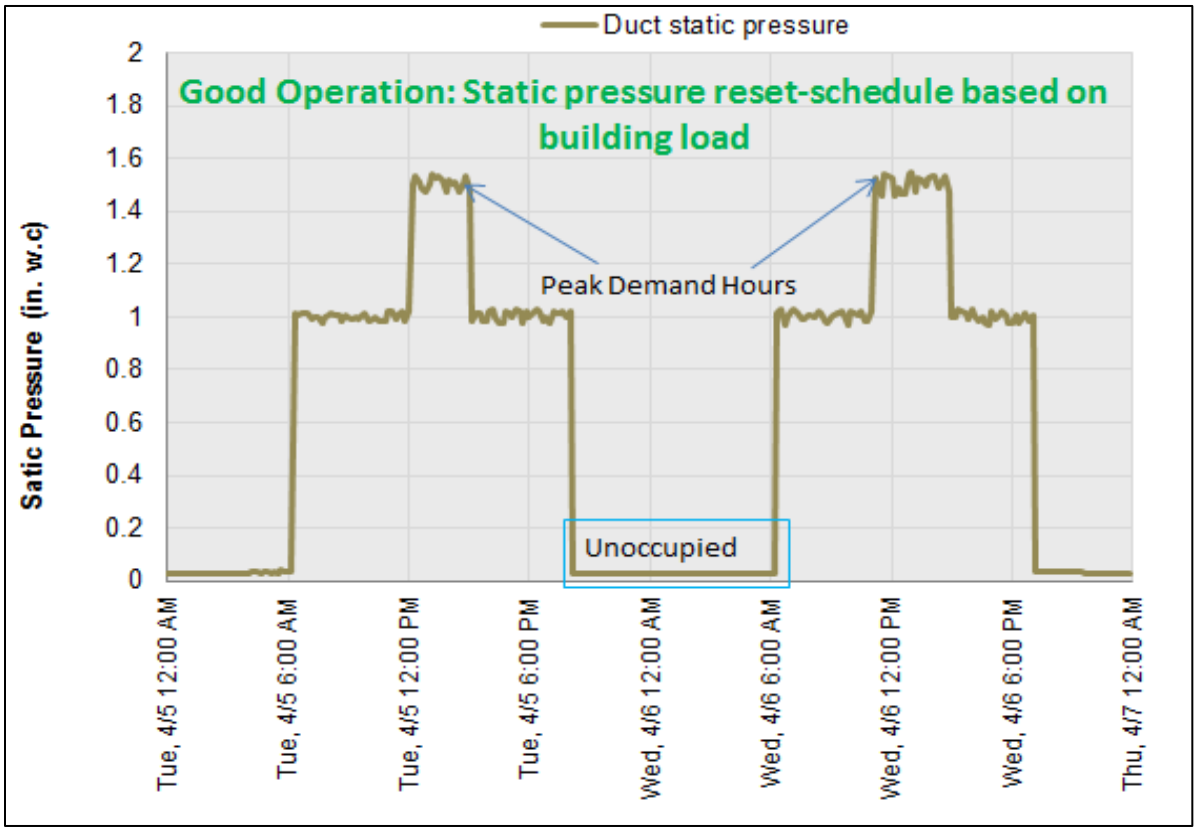

Figure 2: Static pressure reset-schedule in place.

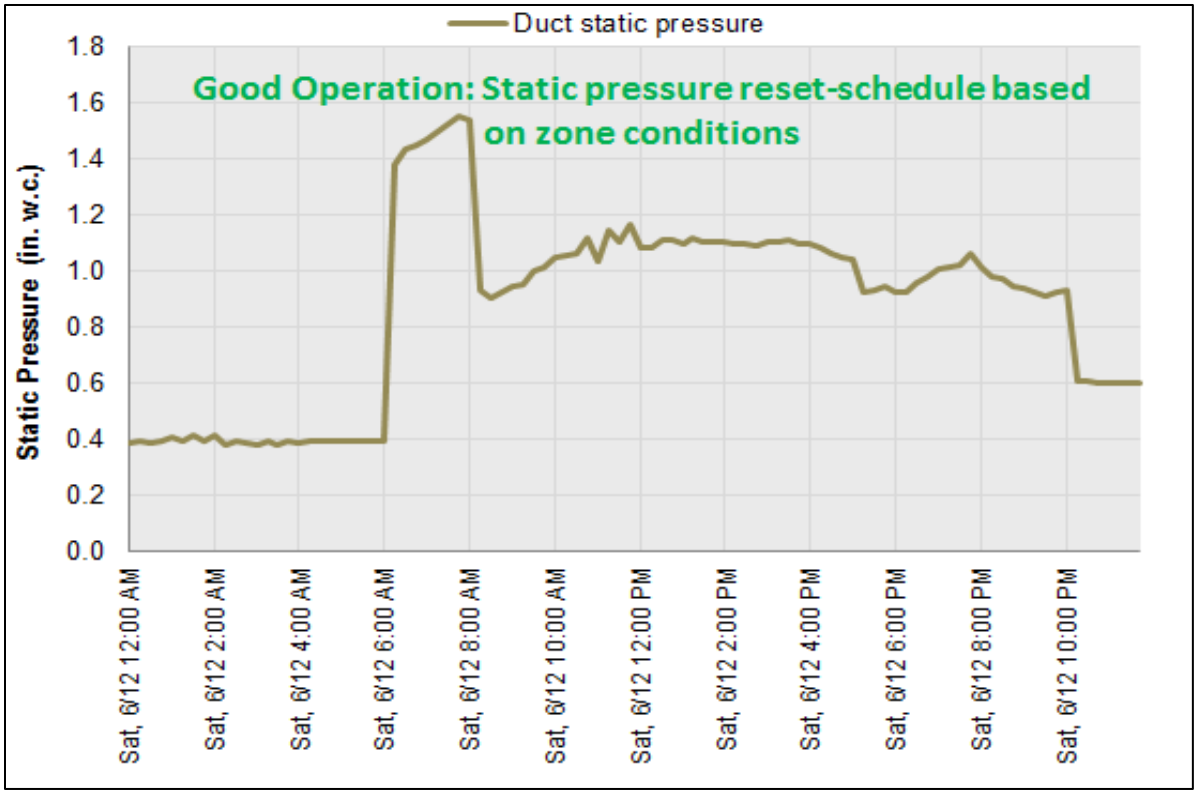

Figure 3: Static pressure reset based on zone conditions.

Determine whether the static pressure set point is too high or too low

To determine if the static pressure set point is too high or too low, review the VAV box damper positions versus time. Ideally, VAV dampers should run in the 50% to 75% range (when the system is operating at non-design conditions). A discharge static pressure reset-schedule should maintain the average of the 3rd highest to the 7th highest VAV damper positions to about 75% open. When calculating this, failed VAV dampers or outliers shouldn't be included. If most of the VAV dampers are closed during cooling, the static pressure set point is too high. If most of the VAV dampers are wide open during cooling, the static pressure set point is too low. Figure 1 above shows a static pressure set point of 2 inches, which is constant. Figure 4 below shows the corresponding VAV box damper positions versus time for this air handler.

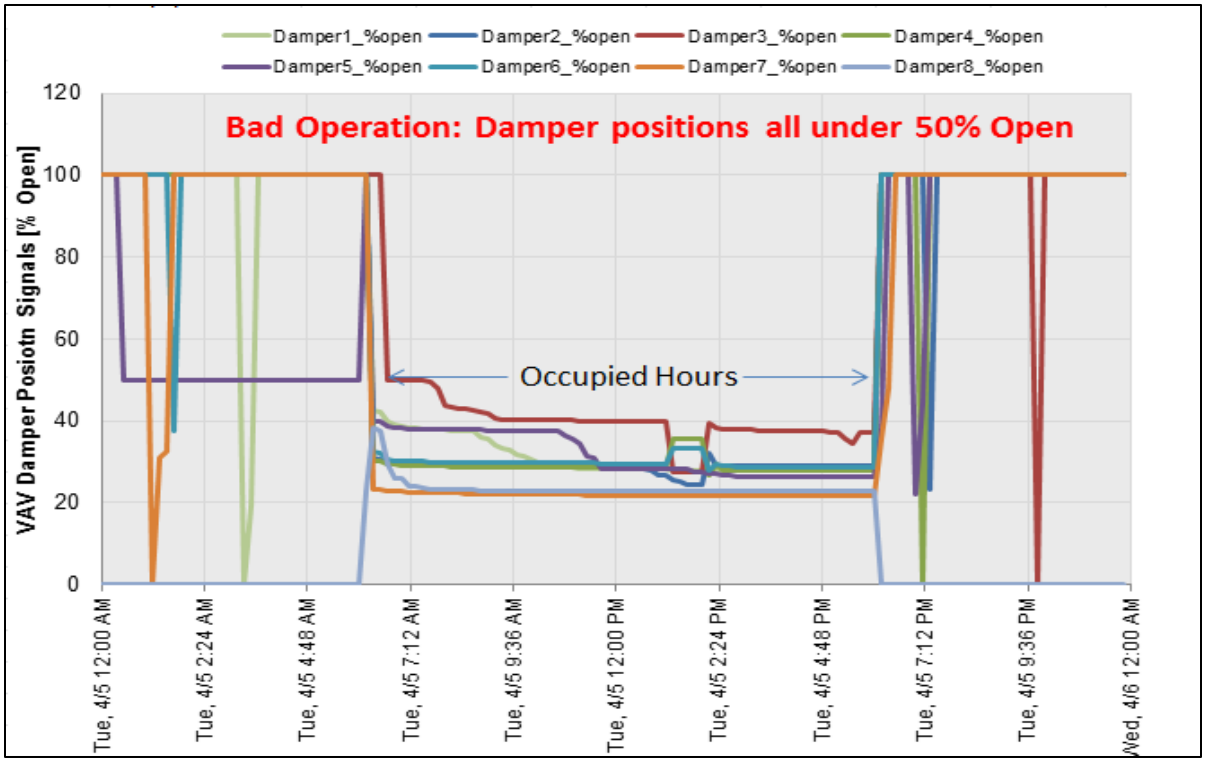

Figure 4: VAV damper positions vs. time (too high duct static pressure set point).

Figure 4 shows the system coming on around 6:00 AM on Tuesday, April 5. There are eight zones that this air handler serves, and all of the dampers are less than 50% open during this day. This is an indicator that the static pressure set point is too high (2 inches from Figure 1) because the zones aren't demanding much ventilation. Figure 5 below shows another example of bad operation, this time for an air handler that has too low duct static pressure (during normal operation, not on a design day). In this figure, all of the damper positions are above 95% open, which indicates that the boxes are starved for air. If the majority of the boxes have damper positions above 80%, they are probably starved, and the duct static pressure set point should be increased because the set point is too low. Finally, Figure 6 offers an example of what the zone conditions should look like for an air handler operating with the proper duct static pressure set point.

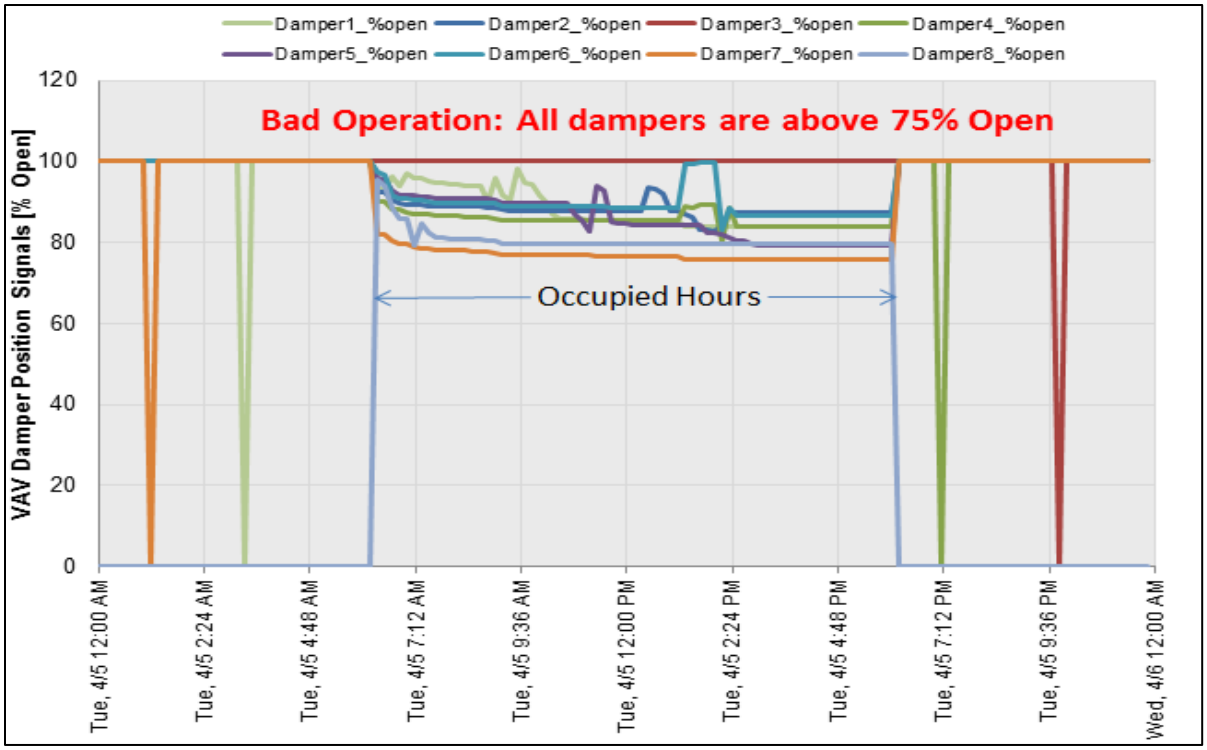

Figure 5: VAV damper positions vs. time (too low duct static pressure set point).

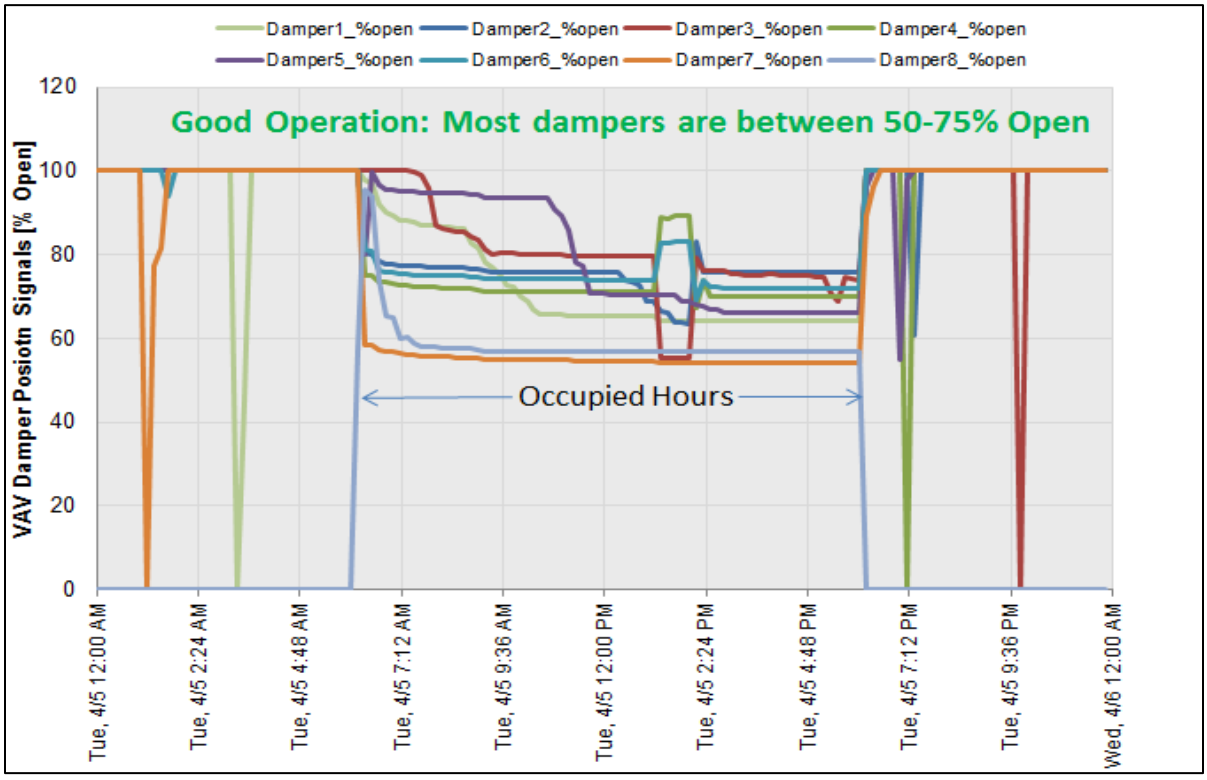

Figure 6: VAV damper positions vs. time (proper duct static pressure set point).

Suggested Actions

Zone information is critical in determining if the static pressure set point is too high or too low. If the damper positions vs. time are all below 50% open during occupied hours, try decreasing the static pressure set point for occupied hours, and trend more zone data for analysis. Tune the static pressure set point until most of the zones are between 50 and 75% open (this is a trial and error approach). Be aware of special zones (i.e., zones that demand more or less ventilation). For these types of zones, remove them from the average damper position vs. time calculation. Generally, you want to average the damper positions for the 3rd highest to 7th highest dampers to be roughly 75% open. For the case when the majority of the damper positions are too high (i.e., all above 75%), try increasing your static pressure to reduce the average damper position, again keeping in mind any special zones. If you have multiple air handlers, be aware of which air handler serves which zones to properly control the duct static pressure set point.