Impacts of Static Pressure Set Level on the HVAC Energy Consumption and Indoor Conditions

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The air static pressure defined here is the air static pressure at 2/3 of the distance down the main air duct. The static pressure has to be maintained at a certain level, such as 1 inH2O, to overcome the airflow resistance in the remainder of the air distribution duct and in other flow components, such as the terminal boxes and diffusers. For Variable Air Volume (VAV) systems, the air static pressure is maintained either by adjusting the inlet guide vanes or by adjusting the motor speed. However, excessive air static pressure is often used due to: (1) a malfunctioning control device; and (2) fear of failure to maintain room temperature. For constant volume systems, there is no static air pressure control device for normal operation. The static air pressure is usually in a range of 2.5 inH2O to 6 inH2O for AHUs with 25 hp or larger motors.

The impact of static air pressure level on the fan power has been recognized and the use of a static air pressure reset schedule has been investigated. The excessive static pressure can also cause excessive airflow through older dampers. An excessive static pressure at the hot air damper not only initiates a higher hot air flow but also increases cold airflow to compensate. Likewise, an excessive static pressure at the cold air damper also increases the hot airflow to compensate for the excessive cold airflow (this assumes the flow controller is also bad and will permit excessive flow).

The excessive airflow can cause a number of problems in building operations: (1) increased heating and cooling energy consumption, and increased fan and pump electricity consumption; (2) lack of capacity to maintain comfortable conditions during extreme hot or cold periods; (3) “hot” and “cold” complaints in some rooms; and (4) an unacceptable noise level in some rooms.

The static air pressure can be either controlled or influenced by the following measures: (1) installing a hot deck damper in the air handing unit to control the hot duct pressure at the minimum level (retrofit); (2) installing a Variable Frequency Drive (VFD) on the supply fan to control the static pressure in the cold duct at the minimum level (retrofit); and (3) decreasing the hot air temperature to increase hot airflow rate - thus lowering the pressure. Note that when the static pressures are controlled at the minimum level, the cold deck and hot deck temperature schedules can be optimized and the simultaneous heating and cooling energy consumption can be reduced substantially.