Location of Temperature Sensors is the Key to Comfort

By Amrish Chopra

In most comfort cooling applications, any complaint of over-cooling or over-heating is generally attributed to controls not working and the controls' manufacturer is summoned to site. It is important to know that factors such as improper installation of components as well as incorrect location are the most common reasons for such complaints, apart from the occasional defect in the control component itself.

The two main components in a temperature control loop are the control valves regulating the flow of water to the cooling-coil and the temperature sensor/controller or thermostat. We are all familar with a typical airside schematic. A fan draws return-air from the conditioned space and fresh-air through a fresh-air opening. The two streams of air get mixed before entering the coil. The air gets cooled and dehumidified while passing over the coil and is then sent back to the conditioned space.

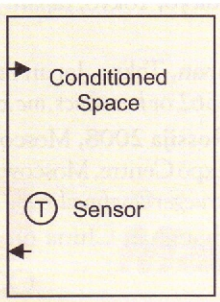

Figure 1 : Conditioned space is a single room.

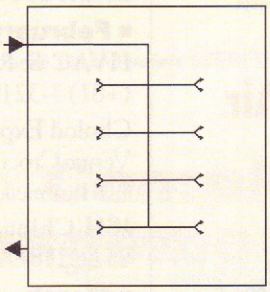
Figure 2 : Conditioned space is a large hall.

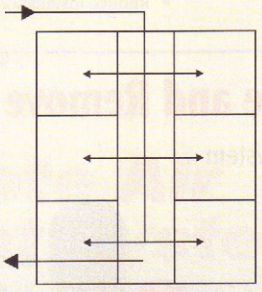
Figure 3 : Conditioned space is a set of rooms.

Conditioned spaces have different sizes, layouts and loads. It may be a single room such as in *Figure 1*, with a single supply-air and return-air grille, or a large hall (*Figure 2*) with distribution duct work and multiple grilles/ diffusers or a set of rooms (*Figure 3*) each with its own supply-and return-air grille.

All these cases have one thing in common. All the areas are being conditioned using one AHU and one control loop, i.e. one sensor/controller and one control valve. The aim is to achieve most comfortable conditions, in most of the area/s, most of the time, at an economical cost.

The limitation of using one sensor is that conditions can be maintained at one location only, where the sensor is installed, and to ensure comfortable conditions all-over this location must be carefully selected. The conditions at sensor location must represent most of the conditioned space.

For example, in *Figure 1*, the temperature sensor should ideally be located in the center of room to sense the average room temperature. It may sense lower temperature if located near supply-air outlet and higher temperature if located near return-air opening.

In *Figure 2*, in addition to the points raised above, air balancing also plays an important role. Improper balancing may result in hot or cold pockets and if the temperature sensor is located in one of these pockets, the other areas may experience wide temperature fluctuations.

In *Figure 3*, if the sensor is located in one of the rooms, it will try to maintain conditions in that particular room. Conditions in other rooms may vary if the airflows are not properly balanced or wide fluctuations in load take place. If the sensor is located in a room away from external weather influences, the room nearer to external walls may become uncomfortable during extreme weather conditions.

To overcome these problems, the sensor may be located in the AHU room. However, care must be taken to install it in the return-air path, before the fresh-air mixes with return-air, otherwise conditions maintained in the area will be very different from the set-point due to the influence of the fresh-air.

In general, care should also be taken to install the sensor away from :

- walls directly exposed to external weather conditions
- heat sources-such as lamps, equipments etc.
- direct throw of supply air

To sum up, with single control loop, different areas will experience different temperature conditions, but the difference can be substantially reduced by ensuring proper air-balancing and judicious selection of sensor location. ❖