Office Comfort

“I’m too hot! I’m too cold! ” Have you heard these complaints in your office? Adverse thermal comfort and air quality issues in the office will impact employee productivity, efficiency, comfort, and morale. It will increase costs unless properly addressed. The primary causes of such issues can often be addressed and solved by understanding work and HVAC system conditions and how they contribute to such problems. Once the risk factors relating to these conditions are understood, solutions to the issues often become apparent.

Cashins & Associates experience with hundreds of investigations in office and commercial buildings has found that modifications, adjustments and maintenance of HVAC systems most often provide rapid solutions to most indoor air quality (IAQ) and allied thermal comfort issues.

This article will provide you an overview of common causes and solutions to IAQ and thermal comfort issues in the office environment. It will also provide guidance on rapid and effective solutions to many of the more common problem initiators. Of course, where professional assistance is required, Cashins & Associates is always available to our valued clients.

Thermal Comfort: “I’m too hot!” “I’m too cold!”

A survey by the *International Facilities Manager Association* found thermal comfort issues, too hot and too cold, as the #1 and #2 office complaints. Due to the complexity of modern HVAC systems, simple adjustments to thermostats do not necessarily solve the complaints. If they did, thermal concerns would not be such a common issue.

We have found that well intentioned, but improper, system adjustments made to address thermal complaints often leads to system imbalances and poor air flow. Such adjustments, in turn, often lead to more widespread thermal complaints. Additional adjustments can, in the longer term, lead to air flow restrictions. Such restrictions often lead to air quality complaints.

Recognizing, evaluating and addressing the base cause of thermal complaints will often lead to a permanent solution not only to the thermal comfort issue but prevent potential ensuing office IAQ problems.

Many factors influence thermal comfort and the perception of thermal conditions. Such factors include temperature, radiation, humidity, air movement, vertical and horizontal temperature differences, temperature drift, personal activity and clothing.

Temperature, temperature drift, and humidity factors are most often fairly well controlled by simple building system adjustments. Radiation, that is, solar window loading, is

normally addressed and readily controlled by window treatments such as blinds and curtains. Activity levels and clothing are occupational and personal choice factors. However, air movement and air distribution are areas that are commonly overlooked. These factors, when not properly adjusted can cause thermal discomfort.

For most individuals, comfort can be maintained when the following conditions are met in the office:

- Air temperature between 73 – 77 F.
- Relative humidity between 30 - 60%
- Maximum air flow of 50 fpm (cooling) and 25 fpm (heating)
- A 5 F. maximum temperature gradient from the floor to 6 foot level

The above assumes sedentary to slightly active individuals, appropriately and seasonably dressed.

Unwanted air flow, or drafts, can be controlled and corrected if their source is identified. Because of draft or air flow's important influence on skin temperature, skin wetness, convective and evaporative heat loss, and thermal sensation, it has always been incorporated into thermal comfort standards. In current standards, the minimizing of draft is addressed by placing rather low limits on the allowable mean air speed as a function of air temperature. These limits are difficult to maintain.

Controlling drafts can significantly control incidence of thermal discomfort complaints. A major source of drafts in office environments is a phenomenon known as "cold air dumping."

One of the most frequent causes of drafts in clinics and offices is a condition known as "cold air dumping." Conditioned room air is commonly delivered to occupied spaces via ceiling diffusers. The usual delivery temperature is in the 55 F. to 60 F. range. A ceiling diffuser is a supply air outlet located in the ceiling.

Ceiling diffusers have pattern deflectors arranged to promote the mixing of supply air with the room air to produce a horizontal air pattern. This horizontal air flow, called "surface effect," causes the inducement of room air into the air stream. When the outlet discharges air directly parallel with and against the ceiling, the air then tends to flow along the ceiling, gradually mixing with the room air. The supply air temperature warms via inducement or entrainment and the velocity (draft) slows as it is delivered to the occupied space. A high degree of surface effect is required, especially for VAV (variable air volume) systems, because it helps to reduce the "dumping" of cold air. This "dumping" of cold air will result in employee thermal complaints.

One feature of "cold air dumping" is a localized draft. Occupants in quite proximate areas could well be at odds on perceptions of personal comfort with co-workers several feet away. Typical thermometer or temperature-relative humidity measurements will not reveal the source of problem; that is cold drafts. In such circumstances, we can see how

a ‘perception’ of discomfort (sometimes viewed as whining) is, in reality, a valid thermal discomfort issue.

A common intuitive action when such cold air dumping is noted is to further reduce air flow or exit velocity. However, as indicated above, the most appropriate action would be to increase air velocity from the diffuser. Optimally, most VAV box minimum flows should be proximate to 20 – 40% of maximum. This minimizes “cold air dumping” and prevents deficiencies in total air delivery.

A fairly common phenomenon similar to “cold air dumping” is “cold air bounce.” This can occur when walls or obstructions are placed too close to supply air outlets. Here, the cold air from the diffuser strikes the obstruction and dumps down onto a nearby work station. Again, this draft causes localized discomfort. Such conditions often occur following office re-stacking when partition walls are moved.

Other cause of dumping can include:

- Pattern deflectors are partially obstructed, missing or improperly aligned.
- A supply air terminal has an exit velocity set too low.
- A supply duct, diffuser, or terminal is obstructed.
- A supply fan malfunctions or the fan’s belt slips
- An improperly positioned terminal with pattern deflectors sends air to strike against nearby walls or other obstructions -- AKA “Cold Air Bounce.”

What can be done to correct such problems?

- Check to determine if the box (VAV) is reducing too far
- Evaluate VAV box minimum setting
- Check to see if the diffuser is too large and check installation
- Check if the diffuser pattern or throw is incorrect causing drafts,
- Check proper alignment of vane deflectors
- Assure temperature sensor is located incorrectly or needs calibration
- Check for obstructions
- Check fan belts, if any

We have found the following actions to be quite successful in quickly controlling office thermal discomfort:

1. Assure there are no drafts exceeding or 50 fpm for cooling or 25 fpm for heating in the areas of complaint.
2. Place a temperature - relative humidity data logger alongside a thermal comfort chart in a visible position in area of complaint; this after assuring draft is within above criterion.

3. If the chart indicates that the environment is within criterion, show the results to those concerned. The occupants will most often accept the results and adjust appropriately.
4. If the chart results are outside the criterion, the system can then be objectively adjusted.

We have received feedback from several customers who have implemented the above action steps. All have reported a dramatic, upwards of 90%, reduction in thermal complaint response calls.

If the above solutions prove less than fully effective, consider having the air distribution system balanced by a professional air balance contractor. We recommend balance contractors who are members of AABC (Associated Air Balance Council @ http://www.aabchq.com) or NEBB (National Environmental Balancing Bureau @ http://www.nebb.org)