

Air Distribution System for Cooling

The total cooling and dehumidifying load to be supplied by the central system is determined from the several components of the design load listed under Item 3. The entering air temperature is determined by selecting the proper relationship between the quantity of air to be handled, the heat gain in the conditioned space, and the location of the air inlets. In cooling applications it is desirable that the difference between the temperature of air currents in the space frequented by occupants and the average temperature in such space, be not greater than 2 F for air velocities of 40 linear feet per minute and over and not greater than 3 F for velocities of less than 40 linear feet per minute.

There is a fairly wide range of permissible entering air temperatures. With high velocity jets or diffusing nozzles, located at some distance from the occupied space, entering air temperatures may be as much as 30 F below room temperature. Where the air is introduced through supply inlets fairly close to the occupied zone the entering air should be within 10 to 15 F of a desired room temperature. The problem of preventing drafts in summer air conditioning is important as air, cooler than room air, tends to fall without diffusing and proper design must consider the relationship between temperature and diffusion to secure satisfactory results.

The quantity of air circulated for cooling may be determined from Equation 1 which was given previously for heating. However, in this case H is the total sensible heat gain of the space to be conditioned. Having established the entering dry-bulb air temperature and quantity, the relative humidity is then determined. If there is no moisture gain in the room (i.e., no latent heat gain) the dew-point of the entering air will be the same as that of the room air, as all of the necessary air cooling will be used for removing the sensible heat. If there is a latent heat load to be absorbed in the room then a procedure as outlined herewith may be used for determining the entering air wet-bulb temperature:

Total all the latent heat gains in the room and convert them to equivalent grains of moisture. Divide the total grains of moisture by the number of pounds of air delivered to the room which will give the difference in weight of moisture between the entering air and room air conditions. Subtract this amount from the grains of moisture corresponding to the dew-point temperature in the room and refer it to psychrometric charts or tables to establish the required dew-point temperature of the entering air. The intersection of this new dew-point condition with the dry-bulb temperature line of the entering air at the supply inlet to the room will establish the entering wet-bulb temperature condition.

The temperature rise from the air cooling equipment to the supply inlet may be determined from Equation 2. Obviously, the dry-bulb air temperature leaving the apparatus must be lower than the supply inlet temperature by the difference in temperature rise calculated. These duct gains will usually be from 1 to 3 F and if greater than 3 F special consideration should be given to the application of insulation.

With the dew-point of air leaving the air cooling apparatus as previously determined and the dry-bulb air temperature as established from the temperature rise in the duct system, a wet-bulb temperature of air leaving the apparatus may be determined from a psychrometric chart which also shows the total heat of the air. In some instances, a conventional air

washer or simple cooling coil will not produce the desired combination of dry-bulb and dew-point temperatures for the air leaving the apparatus. The relative amount of dehumidification can be increased by reducing the air velocity through the dehumidifier, and by reducing the temperature of the dehumidifier. In some cases, it is necessary to add a reheating coil in order to obtain the desired combination of dry-bulb and dew-point temperatures.

The design of a duct distribution system for cooling is accomplished in the same manner as that previously described for heating installations. For cooling spaces prior to occupancy, it is also desirable to design the return air ducts of sufficient area to convey 100 per cent of the air handled by the fan and the same recommendations with regard to the outside air duct as referred to in the heating design would be applicable for summer air conditioning.

CORRELATION OF SUMMER AND WINTER DESIGN

Frequently the quantity of air required for the central system in summer conditioning is considerably greater than the quantity required for winter conditioning. In practice, volume control should be provided using a speed regulator on the fan, or dampers, so that the air quantity may be changed for the cooling and heating cycles. Sometimes a recalculation using different entering air temperatures will permit using the same quantity of air all year round. There is no fixed rule or method for determining the most practical design for air quantity and the engineer should use discretion to a large extent in working out a balanced system.

When air is introduced above room temperature it tends to rise, while incoming air below room temperature tends to fall. It is therefore common to introduce air for heating only through baseboard or low air inlets; and air for cooling is introduced through high side-wall inlets or ceiling inlets. Uniform diffusion is the important part of the design, and successful installations have been made introducing cold air from low outlets and warm air from high outlets. An overall air change in the treated space of once in 5 to 8 min prevents stratification. In a system designed for all year-round operation, the overhead diffusing openings are used for supply air with very satisfactory results. Particular care is taken in locating the exhaust or recirculating grilles to prevent short-circuiting of the supply air directly to the exhaust. Special care is also taken to prevent cold down-drafts from outside windows sweeping across a room during the heating season. This subject is covered more thoroughly in Chapter 28.

SELECTION OF EQUIPMENT

The system to be used is selected to meet the requirements of the installation. There are numerous modifications which can be made to any of the systems mentioned. Recirculating air is used in both heating and cooling for the sake of economy. However, in many cases the system is designed for 100 per cent outside air with no recirculation and an exhaust system added to remove the air to complete the circuit. In planning any system, it should be remembered that there is always some exfiltration through door cracks, windows, and even through building