

In all types of ceiling air distribution the following should be noted:

If cold air is used it must be brought to the proper temperature by mixing with room air before entering the zones of occupancy.

Air slightly above room temperature will usually be properly distributed by outlets selected for cooling.

When delivering warm air the same may be projected downward and the amount of dispersal of the jet varied to obtain proper mixing and control.

2. Drop. The outlets should be located so that the air stream at the termination of the blow is not less than 5 or 6 ft above the floor level. As illustrated in *B* of Fig. 5 the maximum permissible blow for a given ceiling height may be obtained by locating the outlet low on the wall, arching the blow, and sweeping the air across the flat ceiling. The air, as it traverses the room, will adhere to the ceiling. The objection to this method is the possible streaking of the ceiling with dirt.

3. Room Air Motion. Various features may cause room air motion to exceed acceptable standards. Some of these are: Excessive air discharge velocities; high air volume per cu ft of space (often referred to as number of air changes per hour); premature drop of cold air into the occupied zone; overblow causing spilling of high velocity air into the occupied zone; heating in severe climates by means of downward projection of hot air. It should be realized that these factors will not equally affect all types or designs of outlets at different temperature differentials, mounting heights, etc. For instance, certain outlets may safely handle more air per cubic foot of space at higher discharge velocities than others, and downward projection of supply air will sometimes not be considered excessive if the supply air temperature is substantially higher than the room temperature.

4. Capacity. The quantity of air to be handled is determined by the heating, cooling, or ventilating requirements. Manufacturers' rating sheets are usually consulted for selection of the proper number, size and type of outlets for a given air quantity. The basis of rating used should be carefully noted to make certain that resulting velocities are suitable for the application.

5. Temperature Differential. This is one of the most important factors affecting outlet performance. The quality of the temperature control, or the extent of the control problem, is directly a function of temperature difference. Obviously a system which carries under design conditions only a 5 deg difference between supply air stream and room temperature would require no control at all, for even a 50 per cent change in load could only effect a $2\frac{1}{2}$ deg change in room temperature under the worst conditions. Because of the self-equalizing nature of most load factors, even this extreme is never realized. It is obvious that the greater the temperature differential between supply air and room temperature, the greater will be the change in room temperature for a given change in load. The use of outlets that give rapid mixing permits greater temperature differentials. These principles apply in both heating and cooling practice.

6. Dirt. Although the primary air may be carefully filtered, small particles of dirt and dust will not be captured by mechanical filters and may finally be deposited on the walls or ceiling. With ceiling outlets, dirt streaking may be minimized by carefully controlling the discharge of the outlets. With wall outlets, dirt streaking may be minimized by preventing direct impingement of the air on any ceiling or room surface. Floor outlets may offer objection as dirt collectors.

7. Noise. The increase of noise level caused by an outlet is primarily a function of its air discharge velocity and its size. The maximum accept-

able noise level in a space may dictate completely the selection of the permissible outlet velocity. In addition, however, noise may be caused by excessive restriction of free outlet area due to outlet design; by unnecessary turbulence due to one sided air flow through the outlet; or by the impingement of high velocity air on sharp edges. Such high frequency noises due to excessive turbulence are especially annoying (see Chapter 42 for discussion of permissible room noise levels and noise generation by outlets).

TYPES OF AIR OUTLETS

Two types of air supply outlets are commonly used; side wall and ceiling. A variety of designs has been developed for both types and the final selection depends to a large degree upon the specific problems arising in the air distribution system to be used.

In addition to the comments on use and application of outlets which follow, reference should also be made to sections of this chapter on Outlet Location and Selection as well as on Specific Applications.

Wall Outlets

Wall type openings in general use are: perforated grilles, vane outlets, registers, slotted outlets, ejector nozzles, and wall diffusers.

1. Perforated Grilles. Due to the non-adjustability and small vane ratio these outlets, although inexpensive, have not met with favor as wall type supply openings. They are useful primarily where directional air control is unnecessary, and for return air intakes.

2. Vane Outlets. Outlets equipped with either vertical and horizontal adjustable vanes or both are particularly suited to sidewall distribution. For proper control over the air flow, the vane ratio should be from 1 to 2. Outlets with non-adjustable vanes may be employed but they should only be used where the performance is not critical or can be adequately predicted. Vanes should be properly designed to prevent an increase of noise above permissible level.

3. Registers. Perforated grilles or vane outlets equipped with a vane damper are termed registers. They are used primarily for residential heating systems, where the outlet distribution is not critical and low cost is of importance.

4. Slotted Outlets. Slotted outlets essentially consist of either flat steel plates containing a number of long narrow slots or a single long narrow slot. In order to give a good conversion from static pressure to velocity pressure, the sides of the slots are rounded to give a venturi effect. Due to their high aspect ratio, the slotted outlets have a greater induction effect than the comparable vane outlets of equal area and consequently the throw is reduced. They are primarily useful where an unobtrusive means of distribution is desired, and where it is desirable to submerge the outlets into the room decoration and to minimize the effect of obstructions in the line of discharge. They are adaptable to narrow rooms having low ceilings. In this case the slots should extend the full length of the room. In all applications air quantity and distribution must be carefully planned as correction after installation is difficult.

5. Ejector Nozzles. These are outlets operating at high static pressure. They give a high conversion from static in the duct to velocity pressure in the outlet, and have a high induction effect due to their high outlet velocity. They are chiefly used for long throw and industrial process installations, such as drying, freezing, cooking, etc. Another type of ejector is