TABLE 2. RECOMMENDED RETURN INTAKE FACE VELOCITIES

INTAKE LOCATION	VELOCITY OVER GROSS AREA FPM
Above occupied zone	800 up
Within occupied zone, not near seats	600–800
Within occupied zone, near seats	400–600
Door or wall louvers	500–700
Undercutting of doors (through undercut area)	600

(See Chapter 32 for discussion of permissible room noise levels and noise generated by outlets.)

5. *Room Air Motion.* The factors leading to high air motion are excessive velocity, high air volume per square foot of outlet wall area, overblow, striking of beams causing a spilling of the air into the zone of occupancy, and heating in severe climates by means of ceiling outlets which are directed downward.

6. *Dirt.* Although the primary air may be carefully filtered, dirt from the conditioned space may be deposited on the walls or ceiling wherever there is considerable secondary air motion. With ceiling outlets, dirt streaking may be minimized by carefully streamlining the discharge of the outlets. With wall outlets, dirt streaking may be minimized by not directly impinging the air on any ceiling or room surface. Floor outlets may offer objection as dirt collectors.

RETURN AND EXHAUST INTAKES

Where the air supply causes a relatively large induction effect, only three factors govern the selection and application of return and exhaust intakes: (1) velocity in occupied zone adjacent to intake, (2) permissible pressure drop through intake, and (3) noise.

Velocity

Air handled by an exhaust or return intake is drawn from all directions, the velocity dropping off rapidly in every direction. The only locality where drafts may prove objectionable is adjacent to the intake. To prevent excessive air motion in the occupied space due to the return system, it is advisable to compute the total air motion toward the exhaust opening as outlined in Equation 5 where A is the exhaust wall area in square feet. Recommended return intake face velocities are given in Table 2.

The withdrawal of air from a space through a return intake is a minor factor in control of the room air motion. The control of the room air motion for the maintenance of comfort conditions depends on the proper selection of the supply outlets. Thus the location of the return intake is not critical, nor the use of an elaborate return system necessary, provided the air motion in the occupied zone adjacent to the intake does not exceed comfort limits. A single return intake or a few large intakes will prove satisfactory provided no local high velocity zones are created.

The permissible pressure drop will depend on the choice of the designer. Table 3 gives pressure drop through plain lattice intakes as a function of free area and face velocity.

Noise

The problem of noise generated by return intakes is the same as that generated by supply outlets. In computing resultant room noise levels from the operation of an air conditioning system, the return intake must be included as a part of the total grille area. The only difference between the supply outlets and return intakes is in their frequent installation at

TABLE 3. APPROXIMATE PRESSURE DROPS FOR LATTICE RETURN INTAKES
Inches Water Gage—Standard Air

PER CENT FREE AREA	FACE VELOCITY, FPM						
	400	500	600	700	800	900	1000
50	0.06	0.09	0.13	0.17	0.22	0.28	0.35
60	0.04	0.06	0.09	0.12	0.16	0.20	0.24
70	0.03	0.05	0.07	0.09	0.12	0.15	0.18
80	0.02	0.03	0.05	0.07	0.09	0.11	0.14

the ear level. When located at ear level, it is recommended that the return intake velocity be 75 per cent of the maximum permissible outlet velocity.

Ceiling locations are recommended for bars, kitchens, lavatories, dining rooms, club rooms, etc., where warm air will gravitate to the ceiling level. Ceiling returns are less desirable in spaces with severe winter exposure, and where stratification of cold air may take place at the floor level. During the heating season the air will tend to short circuit between the supply and the ceiling exhaust or return intakes.

Floor Location

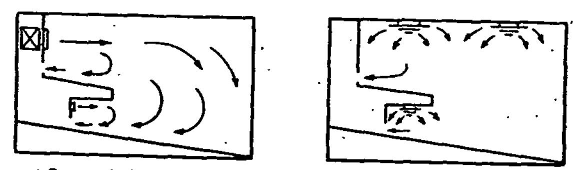
Where ceiling or high sidewall distribution is used for winter heating, floor returns along the exposed wall will tend to improve the heating performance of the system. In general floor locations are collectors of dirt and refuse.

Wall and Door Locations

Depending on their elevation, wall returns have the characteristics of either floor or ceiling returns. In large buildings with many small rooms, the return air may be brought through door grilles or door undercuts into the corridors and then to a common return or exhaust. The pressure drop through door returns should not be excessive (50 per cent of supply outlet pressure); otherwise the air distribution to the room may be seriously unbalanced with the opening or closing of the doors. Outward leakage through doors or windows cannot be counted upon for dependable results. In many cases, particularly in buildings with double glass or hollow glass block walls, forced return and relief systems are essential.

SPECIFIC APPLICATIONS

The two methods shown in Fig. 7 are suitable for application to theaters, churches, and auditoriums. In small or medium size theaters, it is sometimes practical to use sidewall or front wall distribution. For the satisfactory operation of such a system during the winter heating



Rear wall distribution — Ceiling distribution

FIG. 7. AIR DISTRIBUTION METHODS FOR THEATERS, CHURCHES, AND AUDITORIUMS