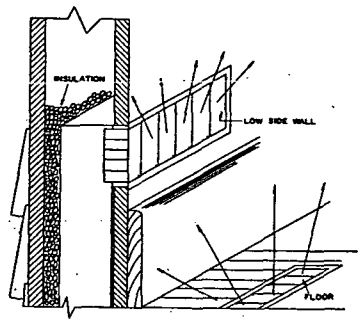


[a] *Registers set to direct air upward along the wall at as wide an angle as possible.*

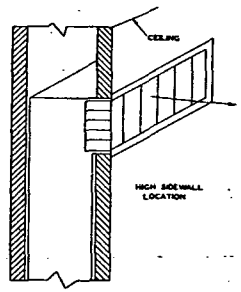
Fig. 1.... Floor or Low Side-wall Perimeter Outlets[a]

cold air which usually descends along a cold surface. Furthermore, since delivery of the air outward into the room, rather than upward, is likely to impinge upon the occupants it should be avoided. With certain types of perimeter diffusers, the air velocity at the diffuser face is limited only by the pressure available at the diffuser and the noise characteristics of the outlet.

Tests with *inside wall* supply systems conducted in Warm Air Heating Research Residence No. 1 have indicated that results obtainable with either high side-wall or baseboard registers are comparable if proper registers and air velocities are selected.

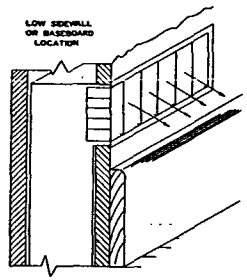
Baseboard registers should be of a deflecting-diffuser type that will direct the air downward toward the floor and diffuse it at the same time. For baseboard registers, air velocities over 500 fpm should be avoided as they may cause discomfort.

High side-wall registers should be of a type that will deliver the air horizontally or in a slightly downward direction, and should be so located as to avoid impingement of air on ceiling or wall. Directional flow diffusing type registers should be used to insure best results. Register air velocities should be such that the air velocity will be about 50 fpm three-quarters of the distance from the register to the opposite wall.



[a] *Horizontal vanes, in back or front, to give downward deflections not to exceed from 15 to 22 deg.*

Fig. 2.... Recommended Type of High Side-wall Installation on Warm Wall[a]



[a] *Vertical bars with adjustable deflection, or fixed vertical bars with deflections to right and left not exceeding about 22 deg. For low side-wall location, the deflection for horizontal, multiple vane registers should not exceed 22 deg. For baseboard locations, the deflection for horizontal, multiple vane registers should not exceed about 10 deg.*

Fig. 3.... Recommended Type of Baseboard and Low Side-wall Installation on Warm Wall[a]

Velocities through registers may be reduced by the use of registers larger than the connecting ducts. Diffusers should be used to spread the air uniformly over the register face. Basic rules for the location and selection of registers, together with explanations of factors affecting operation, are given in Section 6 of Manual 4, Sections 3 and 4 of Manual 10, or Section B of Manual 7, published by the National Warm Air Heating and Air Conditioning Association.[4, 5, 6]

Registers should be well proportioned and decorated to harmonize with the trim. Air supply registers should be equipped with dampers, and all registers should be sealed against leakage around edges. The register types shown in Figs. 1, 2, and 3 have been recommended as standard by the National Warm Air Heating and Air Conditioning Association.

Return-air grilles may be located in hallways, near entrance doors, under windows, in exposed corners, or inside walls, depending on location of supply outlets. Baseboard returns are preferable to floor grilles. It is usually considered desirable to have them located in or near outside walls when supply outlets are located on inside walls. With this type of system, it is desirable to locate return grilles in as many rooms as possible. When perimeter systems are used, returns may be centrally located, provided means for permitting air to flow from rooms without returns are included. Nevertheless, the use of individual room return intakes is desirable. In basementless structures, it is usually convenient to locate the return openings either high in the wall or in the ceiling. So far as the heating is concerned, however, this is merely a matter of convenience because low returns have been found to work equally well. It is usually not recommended in residential systems that any one return serve an area having a heat loss of more than 60,000 Btuh.

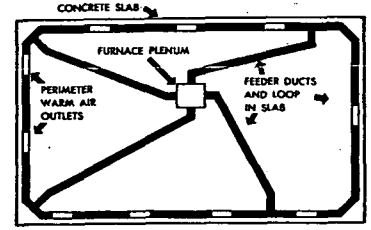


Fig. 4.... Perimeter-Loop System with Feeder and Loop Ducts in Concrete Slab

Dampers

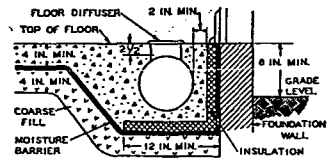
Suitable dampers for air direction or volume control are essential to any duct system. Special care must be used in the design of any system, to minimize resistance. Sharp elbows, angles, and offsets should be avoided. Three types of dampers are commonly used. *Volume dampers* are used to completely cut off or reduce the flow through ducts. *Splitter dampers* are used where a branch is taken off a main trunk. *Squeeze dampers* are used for adjusting the volume of air flow and resistance through a given duct. A damper with positive locking device should be provided for each main or duct branch. Labels placed on ducts should indicate the room being served. Damper positions should be marked to indicate proper summer and winter settings, and to reveal tampering.

DUCT CONSTRUCTION

The ducts may be either round or rectangular in cross section. The centerline radii of elbows should preferably be not less than one and one-half times the pipe diameter for round pipes. The throat radius of a turn in a rectangular duct should be at least one-half the duct dimension in the plane of the turn. Warm air ducts passing through cold spaces or located in exposed walls, should have 1 to 2 in. of insulation.

Ductwork must be permanent, rigid, non-buckling, and non-rattling. Joints in ductwork should be airtight. Galvanized-iron or aluminum sheet are usually used in the construction of ducts, but other materials may be used under the proper circumstances. Standard 90B[7] of the National Board of Fire Underwriters specifies the type of duct materials that may be used. In general, supply ducts should be constructed entirely of noncombustible material equivalent in strength and durability to those recommended in Table 1. Supply ducts serving a single-family dwelling need not meet this requirement, except for the first three feet from the unit, provided they are used in conjunction with listed heating units, are properly constructed from a base material of metal or mineral, and are properly applied. Furthermore, combustible material which is otherwise suitable for the application[a] can be used as supply ducts which are completely encased in concrete. Ducts for separate air cooling systems and return air ducts need not meet these requirements, except within two feet of a furnace or other heat producing equipment.

Supply ducts must be securely supported by metal hangers, straps, lugs, or brackets. No nails should be driven through duct walls and no unnecessary holes should be cut in them.



The minimum thickness of concrete over the loop duct should be 2½ in. and continuous mesh reinforcing not less than 6 x 6–10 gage and 18 in. wide should be placed in the concrete and centered over the duct.

Fig. 5.... Cross-Section of Slab Construction Containing Perimeter Duct Made of One Type of Material.[4]

Supply air stacks should not be installed in outside walls unless it is impracticable to do otherwise. If it is necessary to do this, the stack must be effectively insulated against exposure. Failure to do this will materially reduce the heating or cooling capacity of the branch duct and will probably result in unsatisfactory conditions in the room with regard to comfort.

No supply air duct should come in contact with masonry walls. All supply ducts which pass through a masonry wall should be covered with at least ½ in. of insulation where they pass through the wall.

All supply ducts or outlets should be equipped with an adjustable, locking type damper for air volume control. The damper should be installed in the branch duct whenever it is accessible. Splitter dampers for volume control are not recommended.

Return systems having more than one return intake may be equipped with balancing dampers. This is particularly desirable with systems having the supply outlets on the inside wall or in the ceiling of the conditioned rooms.

Special attention should be given to the problem of noise

Table 1.... Recommended Thickness for Duct Materials

Round Ducts Diameter, In.	Minimum Thickness: Galv. Iron, U.S. Gage	Minimum Thickness: Aluminum B&S Gage	Minimum Weight of Tin-Plate
Less than 12	30	26	IC (107 lb)
12 or more	28	26	IX (135 lb)

Rectangular Ducts Width, In.	Minimum Thickness: Galv. Iron, U.S. Gage	Minimum Thickness: Aluminum B&S Gage	Minimum Weight of Tin-Plate
Ducts Enclosed in Partitions			
14 or less	30	26	IC (107 lb)
Over 14	28	26	IX (135 lb)
Ducts Not Enclosed in Partitions			
Less than 14	28	26	—
14 or more	26	24	—

Note: The table is in accordance with Standard 90B of the National Board of Fire Underwriters.[7] Industry practice is to use heavier gage metals where maximum duct widths exceed 14 in. (See also NBFU No. 90A).[8]