TABLE 8. RETURN AIR—CARRYING CAPACITY—BTU SERVICED

| RETURN AIR COMBINATION NO. | DUCT DIA IN. | TYPE A BTU PER HR | TYPES B AND C BTU PER HR | TYPE D BTU PER HR | TYPE E BTU PER HR | TYPE F BTU PER HR | RETURN AIR COMBINATION NO. |
|---|---|---|---|---|---|---|---|
| 31 | 10 | 11,300 | 9,500 | 7,800 | 5,000 | 7,800 | 31 |
| 32 | 12 | 16,300 | 13,700 | 11,300 | 7,200 | 11,300 | 32 |
| 33 | 14 | 22,200 | 18,700 | 15,300 | 9,800 | 15,300 | 33 |
| 34 | 16 | 29,000 | 24,400 | 20,000 | 12,800 | 20,000 | 34 |
| 35 | 18 | 36,700 | 30,800 | 25,300 | 16,200 | 25,300 | 35 |
| 36 | 20 | 45,300 | 38,000 | 31,300 | 20,000 | 31,300 | 36 |
| 37 | 22 | 54,800 | 46,000 | 37,800 | 24,100 | 37,800 | 37 |
| 38 | 24 | 65,200 | 54,800 | 45,000 | 28,700 | 45,000 | 38 |

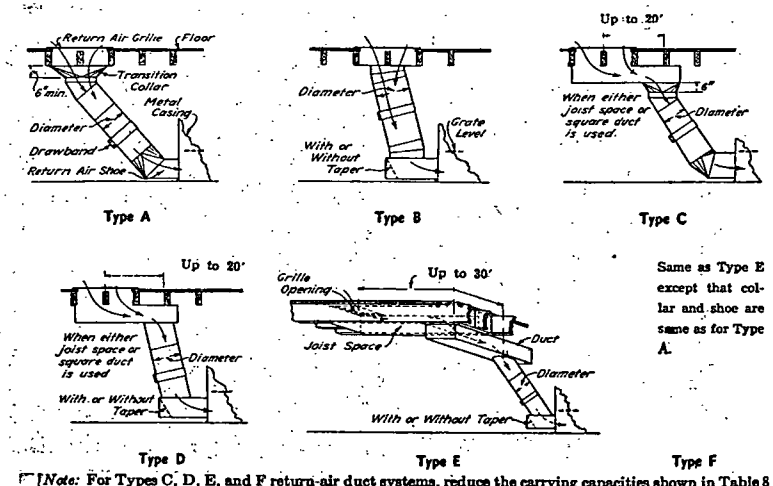
## Design Procedure

The steps to be taken in designing a gravity warm air duct system are:

1. Calculate the heat loss from each room as explained in Chapters 9, 10 and 11.

2. Prepare a layout showing (*a*) furnace, (*b*) chimney connection, (*c*) warm air registers (whether floor, baseboard or wall), (*d*) return air grilles.

3. Indicate on each warm air run (using symbols shown in Fig. 6): (*a*) whether the room to be heated is on the first or second story, (*b*) the approximate length of leader pipe in the basement, (*c*) the number of right angle elbows and equivalent elbows (Table 5) required, including the elbow at the boot connection (see Fig. 2), (*d*) whether the register is to be located in the floor, in the baseboard, or in the wall.




*Note:* For Types C, D, E, and F return-air duct systems, reduce the carrying capacities shown in Table 8 by 1 per cent for each 4 ft additional length in the horizontal run.

FIG. 5. TYPICAL ARRANGEMENTS OF RETURN-AIR DUCT SYSTEMS



4. Show the number and proposed locations of return air grilles and the type of return air system (see Fig. 5).

5. From Table 6, for first story, or from Table 7 for second story, select the combination number for the warm air system which will supply the heat required to each room, with the number of elbows and length of leader pipe previously determined. Then, using the combination number as found, read directly in Tables 1, 2, or 3 the leader, stack, and register sizes required.

6. From Table 8 select the combination number for the return air system to correspond with the Btu serviced and the type of return air system. Then from Table 4 select the duct and grille sizes, etc., corresponding to the same combination number.

7. Select a furnace having a register delivery, in Btu per hour, equal to the total heat loss from the structure.

Standard work sheets to facilitate design according to the above recommended procedure, are available from *N.W.A.H. & A.C.A.*

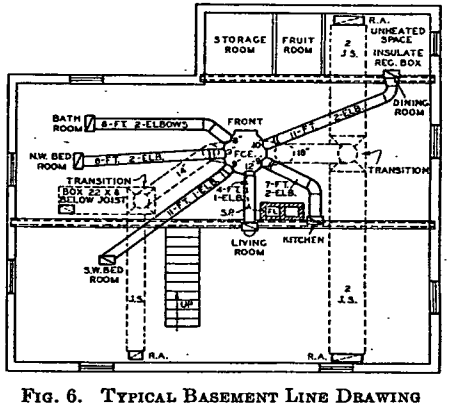



FIG. 6. TYPICAL BASEMENT LINE DRAWING

## Design Examples

*Examples 1 and 2* will illustrate the use of the tables in selecting warm air and return system sizes.

*Example 1.* For a room which has a heat loss of 22,500 Btu per hr, select the size of first story warm air system. There are three elbows, and the leader is approximately 10 ft long.

*Solution:* Since 22,500 Btu is beyond the capacities shown in Table 6, it is necessary to select two units of 11,250 each. From Table 6 in 10 ft leader column, and in section for three elbows, find 11,400 as nearest capacity which corresponds to Combination Number 4 in first column. Refer to Combination Number 4 in Table 1 and find that the leader should be 12 in. in diameter, and should be used with a 12 × 14 in. floor register or a 13 × 11 in. baseboard register with a 5½ in. extension.

*Example 2.* What is the size of a return system of Type D which is to service 35,000 Btu per hr?

*Solution:* From Table 8 find Combination Number 37 which will service 37,800 Btu per hr. Refer to Table 4 to find that Combination Number 37 will require a 22-in. diameter duct, a shoe area of 420 sq in., a metal grille 18 × 30 in., a duct 42 × 10 in. or 36 × 12 in. If joist lining is used the minimum depth should be 15 in. for two 2-joist spaces 14 in. wide, or 10 in. for three joist spaces.