Table 5.... Btuh Capacities and Cfm of Individual Ducts in Perimeter Systems Used in Crawl-Space or Basement Construction (*Concluded*)

Section C. For 6-Inch Individual Round Pipe and for Baseboard Diffusers Only

Bonnet Pressure 0.15 in. Static — *Bonnet Temperature 170 F*

No. of Elbows		Actual Length of Pipe from Bonnet to Diffuser—Feet															
		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
0	Btuh						8570	8000	7450	6910	6420	5960	5560	5150	4800	4450	4160
	Cfm						109.0	107.2	105.5	103.7	102.0	100.4	98.8	97.5	96.1	94.8	93.5
1	Btuh					8700	8100	7550	7000	6520	6060	5630	5250	4860	4530	4220	3930
	Cfm					105.5	104.0	102.3	100.7	99.2	97.6	96.2	95.0	93.6	92.3	91.1	90.0
2	Btuh				8890	8270	7700	7160	6660	6200	5750	5350	4980	4620	4300	4000	3700
	Cfm				102.8	101.3	99.8	98.2	96.7	95.3	94.0	92.7	91.5	90.2	89.0	87.8	86.5
3	Btuh				8440	7870	7320	6820	6350	5880	5460	5070	4700	4350	4020	3710	3440
	Cfm				98.4	96.8	95.3	93.9	92.5	91.3	90.0	89.0	88.0	86.9	85.8	84.7	83.5
4	Btuh			8690	8080	7500	6980	6500	6030	5580	5180	4800	4450	4120	3820	3520	3250
	Cfm			95.8	94.4	93.0	91.6	90.3	89.0	87.8	86.7	85.7	84.6	83.7	82.6	81.6	80.5
5	Btuh		8940	8320	7740	7200	6680	6190	5720	5320	4920	4550	4220	3890	3600	3350	3100
	Cfm		93.4	92.2	91.0	89.8	88.5	87.3	86.2	84.8	83.8	82.8	81.7	80.8	79.9	79.0	78.0
6	Btuh		8580	7960	7380	6850	6350	5880	5440	5040	4660	4320	4000	3670	3400	3150	2930
	Cfm		90.0	89.8	87.6	86.5	85.5	84.2	83.1	82.0	80.9	80.0	79.0	78.0	77.3	76.5	76.0

The Equivalent Length Values used and included in calculating this table are: Diffuser and Boot = 100 ft; Plenum Take-off = 20 ft; Each Elbow = 14 ft. For each additional 14 ft equivalent length of boot and diffuser count one additional elbow.

All cfm values are based on standard air.

needed. Section A is for 5-in. duct, Section B is for 6-in. duct using side-wall or floor diffusers, and Section C is for 6-in. duct using baseboard diffusers.

Perimeter Extended-Plenum Systems in Crawl-Space or Basement Construction

The considerations involved in the design of extended-plenum systems are essentially the same as those of the individual pipe system. A simplified design procedure is summarized as follows:

1. Calculate the heat loss of each room or area using the method explained in Chapter 12. Consider the basement or crawl space as a part of the structure and calculate its heat loss. Information in Manual 3[5] supplements that contained in Chapter 12, particularly with respect to crawl-space heat losses.
2. Determine the required furnace-bonnet capacity from the heat loss of the building.
3. Locate the diffusers on the plan. Allow at least one diffuser for each exposed wall in each room or area of building, and preferably beneath window areas. For residential installations limit each diffuser to a maximum of 7,000 Btuh.
4. Determine the required Btuh delivery of each diffuser. Where more than one diffuser is used per room, proportion the heat loss equally among all diffusers.
5. Measure the length of each duct and count number of elbows from the extended plenum to the diffuser. Note whether top or side plenum take-offs are to be used. From Table 6, determine the duct size needed. (Note: Use that section of Table 6, Sections A to F, which applies *both* to the type of plenum take-off and diffuser to be used.)
6. The cfm values in Table 6 are used with Table 7 for sizing the extended-plenum system. No one extended plenum should exceed 35 ft in length.

Design of Return Duct System for Perimeter Installations

With perimeter systems designed in accordance with the foregoing simplified procedures, there is a circulating head of only 0.05 in. water available on the return side of the system. It is therefore necessary that the return ducts be adequately sized and be as short and straight as practicable. The return grilles may be centrally located, and the ducts may be located in the attic or other unheated spaces provided they are adequately insulated. Return air may be taken from basements and crawl spaces, but should not be taken from confined spaces in which the furnace is located.

The following simplified procedure[4] may be used:

1. Lay out the return-air duct system. Measure the length and count the number of 90 deg turns in each return duct.
2. Total the heat loss of the area served by each return duct.
3. Determine the required duct free area from the length of duct, the number of 90 deg turns, and the heat loss using Table 8. Also determine the free area of the return grille from Table 8.

Other Perimeter Systems

Each of the foregoing procedures can be used with approved furnaces that are capable of delivering their rated cfm air volume against a total pressure of 0.20 in. water external to the furnace. This available pressure is usually distributed on the basis of three-fourths (0.15 in. water) on the supply side and one-fourth (0.05 in. water) on the return side. Other systems, such as perimeter crawl-space plenum systems, may be designed by procedures outlined in Manual 4. In addition, procedures for designing 4-in. diameter duct systems are contained[6] in Manual 10 of the National Warm Air Heating and Air Conditioning Association.

Other systems of a proprietary nature but utilizing the perimeter concept of diffuser placement are in common use. These systems should be designed and installed in strict accordance with the manufacturer's recommendations. Such systems usually utilize smaller ducts (4 in. or less) and higher pressures (above 0.20 in. water). They also may require special streamlined, low resistance fittings and special diffusers. Some systems also employ higher bonnet temperatures. When either higher bonnet pressures or temperatures, or both, are to be used, care must be taken to ascertain that the furnace employed is capable of meeting the required conditions.

Table 6.... Heating Capacities and Cfm of Branch Ducts in Extended-Plenum Perimeter Systems

Section A. Side Take-off to 5-Inch Round Pipe for Side-wall, Floor, and Baseboard Diffusers

Extended-Plenum Pressure 0.15 in. Static at 160 F — *Furnace-Plenum Pressure 0.15 in. Static at 170 F*

No. of Elbows		Actual Length from Extended-Plenum to Diffuser—Feet											
		5	10	15	20	25	30	35	40	45	50	55	60
0	Btuh	8960	8100	7310	6550	5900	5310	4800	4330	3900	3510	3170	2850
	Cfm	97.2	93.1	89.4	86.0	83.0	81.2	77.7	75.5	73.1	71.1	69.3	67.8
1	Btuh	8070	7290	6580	5950	5400	4880	4400	3980	3550	3200	2900	2620
	Cfm	88.4	85.2	82.2	79.3	76.9	74.6	72.5	70.7	68.9	67.1	65.7	64.2
2	Btuh	7340	6650	6020	5460	4950	4500	4070	3680	3300	2980	2680	2410
	Cfm	81.1	78.6	76.0	73.9	71.9	70.0	68.2	66.6	64.1	63.7	62.3	61.0
3	Btuh	6810	6180	5600	5070	4610	4200	3800	3420	3080	2770	2480	2230
	Cfm	75.0	73.0	71.0	69.2	67.3	65.8	64.4	63.1	61.7	60.2	59.0	58.2
4	Btuh	6350	5750	5210	4740	4300	3900	3530	3180	2870	2570	2300	2070
	Cfm	70.4	68.8	67.0	65.4	64.0	62.5	61.1	60.0	58.8	57.7	56.7	55.9
5	Btuh	5970	5400	4900	4440	4040	3670	3330	2990	2770	2410	2160	1930
	Cfm	65.2	64.8	63.2	62.0	60.7	59.4	58.3	57.4	56.2	55.3	54.4	53.7
6	Btuh	5660	5120	4630	4190	3800	3430	3100	2800	2520	2270	2040	1800
	Cfm	63.0	61.5	60.2	59.1	58.0	56.9	55.9	55.1	54.0	53.0	52.2	51.8

Note: Where any of the first three runs from the extended-plenum exceeds 20 ft and 3 elbows, count 3 extra elbows for that run.
The Equivalent Length Values used and included in calculating this table are: Diffuser and Boot = 35 ft; Each Elbow = 12 ft; Side Take-off = 20 ft.
Tapered Extended-Plenum Starting Collar.

Section B. Top Take-off to 5-Inch Round Pipe for Side-wall, Floor, and Baseboard Diffusers

Extended-Plenum Pressure 0.15 in. Static at 160 F — *Furnace-Plenum Pressure 0.15 in. Static at 170F*

No. of Elbows		Actual Length from Extended-Plenum to Diffuser—Feet											
		5	10	15	20	25	30	35	40	45	50	55	60
0	Btuh	7070	6400	5800	5260	4800	4350	3940	3550	3190	2870	2580	2310
	Cfm	77.8	75.6	73.4	71.4	69.5	68.0	66.4	64.8	63.4	62.0	60.6	59.5
1	Btuh	6570	5970	5400	4890	4430	4010	3640	3290	2950	2650	2380	2140
	Cfm	72.6	70.8	68.9	67.2	65.6	64.2	62.8	61.5	60.3	59.0	58.0	57.0
2	Btuh	6180	5610	5080	4590	4160	3770	3410	3080	2770	2480	2210	2000
	Cfm	68.4	66.8	65.2	63.7	62.3	61.1	60.0	58.7	57.6	56.4	55.3	54.4
3	Btuh	5800	5250	4750	4310	3900	3540	3200	2890	2600	2340	2100	1870
	Cfm	64.4	63.1	61.8	60.5	59.3	58.3	57.1	56.3	55.5	54.7	53.9	53.2
4	Btuh	5490	4960	4500	4080	3700	3340	3020	2720	2440	2200	1970	1750
	Cfm	61.2	60.0	58.8	57.8	56.7	55.8	54.9	54.1	53.3	52.6	51.9	51.1
5	Btuh	5200	4710	4280	3870	3510	3180	2880	2580	2310	2060	1830	1640
	Cfm	58.5	57.5	56.5	55.5	54.5	53.7	52.9	52.1	51.4	50.7	50.0	49.5
6	Btuh	5000	4520	5100	3700	3350	3010	2700	2440	2160	1910	1700	1551
	Cfm	56.0	55.0	54.0	53.4	52.4	51.7	51.0	50.5	59.7	49.1	48.6	48.1

Note: Where any of the first three runs from the extended-plenum exceeds 20 ft and 3 elbows, count 3 extra elbows for that run.
The Equivalent Length Values used and included in calculating this table are: Diffuser and Boot = 35 ft; Each Elbow = 12 ft; Top Take-off = 50 ft.
Tapered Extended-Plenum Starting Collar.

INSIDE WALL DELIVERY SYSTEMS

The concept of warm-air perimeter heating is relatively new. The older methods of introducing warm air into spaces use other outlet locations. One of the most common of these has been the use of register locations on a warm or inside