TABLE 10. BUILDING LOAD FACTORS AND DEMANDS OF SOME DETROIT BUILDINGS

BUILDING CLASSIFICATION	LOAD FACTOR	LB OF DEMAND PER (HOUR) (SQ FT OF EQUIVALENT INSTALLED RADIATOR SURFACE)
Clubs and Lodges	0.318	0.184
Hotels	0.316	0.207
Printing	0.287	0.217
Offices	0.263	0.209
Apartments	0.255	0.225
Retail Stores	0.238	0.182
Auto Sales and Service	0.223	0.248
Banks	0.203	0.158
Churches	0.158	0.152
Department Stores	0.138	0.145
Theaters	0.126	0.151

The load factor of a building is the ratio of the average load to the maximum load and is an index of the utilization. Thus, in Table 10, the theaters, operating for short hours, have a load factor of 0.126 as compared with the figure of 0.318 for clubs and lodges.

REFERENCES

[1] *Comfort Heating* (*American Gas Association*, 1938).

[2] Are Automatic Air Shutters Justified on a Gas-Fired Conversion Burner? by W. M. Myler, Jr. and H. W. Nelson (A.S.H.V.E. TRANSACTIONS, Vol. 55, 1949, p. 111).

[3] Efficiency of Bituminous-Coal-Burning Space Heater, by J. W. Tieman and F. L. Bagby (A.S.H.V.E. TRANSACTIONS, Vol. 57, 1951, p. 89).

[4] Heat Losses and Efficiencies of Fuels in Residential Heating, by R. A. Sherman and R. C. Cross (A.S.H.V.E. TRANSACTIONS, Vol. 43, 1937, p. 185).

[5] The Stoker-Fired Warm-Air Furnace in the Research Residence, by S. Konzo (*University of Illinois, Engineering Experiment Station, Circular* 39, 1939, p. 98).

[6] Performance of a Hot Water Heating System in the $I = B = R$ Research Home at the *University of Illinois* (*University of Illinois, Engineering Experiment Station, Bulletin* No. 349, Jan. 4, 1944).

[7] Fuels and Burners (*University of Illinois, Small Homes Council*, Circular G3.5, July 1949).

[8] Investigation of Oil-Fired Forced-Air Furnace Systems in the Research Residence, by A. P. Kratz and S. Konzo (*University of Illinois, Engineering Experiment Station, Bulletin* No. 318, Nov. 7, 1939).

[9] Graphical Method of Calculating Heat Losses, by Paul D. Close (A.S.H.V.E. TRANSACTIONS, Vol. 49, 1943, p. 345).

[10] *House Heating* (Industrial Gas Series, *American Gas Association*, Third Edition).

[11] Report of Commercial Relations Committee (*Proceedings, National District Heating Association*, 1932).

[12] The Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 171).

CHAPTER 19

GRAVITY WARM AIR SYSTEMS

Warm Air Leaders, Stacks, and Registers; Return Air Grilles, Ducts, and Connections; Outline of Design Procedure

WARM air heating systems of the *gravity* type are described in this chapter.[1] In these systems the motive head producing flow depends upon the difference in weight between the heated air leaving the top of the casing and the cooled air entering the bottom of the casing, while in the forced air type a fan may supply all or part of the motive head.

A gravity warm-air furnace heating plant consists of a fuel-burning furnace or heater, enclosed in a casing of sheet metal, which is placed in the basement of the building. The heated air, taken from the bonnet on the top of the furnace casing, is distributed to the various rooms of the building through sheet metal warm air pipes. The warm air pipes in the basement are known as leaders, and the vertical warm air pipes which are installed in the inside partitions of the building are called stacks. The heated air is discharged into the rooms through registers which are set in register boxes placed either in the floor or in the side wall, usually at or near the baseboard. A sectional view of a typical plant showing good installation practice is given in Fig. 1.

The air supply to the furnace is usually taken entirely from inside the building through one or more recirculating ducts, although in some cases an outside air supply duct is provided.

WARM AIR LEADERS, STACKS, AND REGISTERS

In a gravity circulating warm air furnace system, the size of the leader pipe to a given room depends upon the heat loss from the room, the equivalent length of the leader, and the temperature of the warm air entering the room at the register. For most successful operation, the furnace should be centrally located with respect to register and stack positions so that the leaders will be of uniform length and as short as possible, in which case the frictional resistance to air flow and the temperature loss from the ducts will be about the same for all leaders and stacks.

Originally, the design was based on the heat carrying capacities per square inch of leader pipe area with register air temperatures of 175 F. Later, in the revision of the entire design procedure, as shown in the section entitled, Outline of Design Procedure, the carrying capacities of leader pipes have been expressed directly in terms of Btu per hour.

In general, it is necessary to use two or more leader pipes to rooms requiring more than the capacity of a 12 in. round pipe. The tops of all sizes of leader pipes should be cut into the furnace bonnet at the same elevation. Leaders over 12 ft in length, or having a large number of elbow fittings should be avoided if possible. In cases where such leaders are necessary, it is recommended that smooth transition fittings be used, and that duct insulation be applied. Asbestos paper, unless of the corrugated type, should not be considered as insulation. To assist in balancing the air distribution of the system, a damper should be placed in each leader