

TABLE 8. BUILDING LOAD FACTORS AND DEMANDS OF SOME DETROIT BUILDINGS

BUILDING CLASSIFICATION	LOAD FACTOR	LB OF DEMAND PER HOUR PER 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

with caution, for its use implies a meaning not commonly associated with the word efficiency and consequently is frequently misleading.

The input of heat to a building consists not only of the energy in the fuel but that from occupants, the sun, appliances, processes, and all other sources. In many cases these make up, over a period, an important percentage of the total heat required, and if they are not taken into account a calculation of efficiency can show a figure over 100 per cent.

For this and other reasons the actual seasonal efficiency is a difficult thing to determine. Published data are widely scattered and insufficient. From the available published material it is found that the seasonal efficiency varies over a wide range, depending on the fuel used, and it varies widely even for a given fuel. For example, in a recent survey of 30 houses in one locality there was found a variation of from 45 to 75 per cent in the utilization efficiency depending on the fuel⁷.

REFERENCES

- ¹—Graphical Method of Calculating Heat Losses, by Paul D. Close (A.S.H.V.E. TRANSACTIONS, Vol. 49, 1943, p. 345).
- ²—Standard Gravity Code for the Design and Installation of Gravity Warm Air Heating Systems (11th edition), and the Technical Code for the Design and Installation of Mechanical Warm Air Heating Systems (National Warm Air Heating and Air Conditioning Association).
- ³—See Industrial Gas Series, House Heating (third edition), published by the American Gas Association.
- ⁴—Received from U. S. Weather Bureau September, 1943.
- ⁵—Report of Commercial Relations Committee, Proceedings, National District Heating Association, 1932.
- ⁶—The Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 171).
- ⁷—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).

Gravity Warm Air Systems

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

WARM air heating systems of the gravity type are described in this chapter¹. 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 mechanical type a fan may supply all or part of the motive head.

In general, a 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 top or sides near 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 run in the inside partitions of the building are called stacks. The heated air is finally 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 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 runs.

In the Standard Code for Installation of Gravity Warm Air Heating Systems, the design was originally based on the heat carrying capacities per square inch of leader pipe area with register air temperatures of 175 F. In a recent 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 advisable 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, and from this point there should be a uniform upgrade of at least 1 in. per foot of run. 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 pipe except one, this latter leader preferably being connected to a room heated at all times, such as a living room.