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CHAPTER 12

HEATING LOAD

General Procedure, Design Outdoor Weather Conditions, Indoor Temperatures, Attic Temperatures, Temperatures in Unheated Spaces, Ground Temperatures, Basement Temperatures and Heat Loss, Heat Losses from Floor Slabs, Transmission Heat Loss, Infiltration Heat Loss, Selection of Wind Speeds, Auxiliary Heat Sources, Intermittently Heated Buildings, Residence Heat Loss Problems

PRIOR to designing a heating system, an estimate must be made of the maximum probable heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. The heat losses may be divided into two groups, namely: (1) the transmission losses or heat transmitted through the confining walls, floor, ceiling, glass, or other surfaces; and (2) the infiltration losses or heat required to warm outdoor air which leaks in through cracks and crevices, around doors and windows, or through open doors and windows, or heat required to warm outdoor air used for ventilation.

GENERAL PROCEDURE

The general procedure for calculating heat losses of a structure is:

1. Select the design outdoor weather conditions: temperature, wind direction, and wind speed. The data on climatic conditions given in Tables 1 and 2 will be helpful, but should be used with judgment as suggested in the section Design Outdoor Weather Conditions.
2. Select the indoor air temperature that is to be maintained in each room during the coldest weather. (See Table 3.)
3. Estimate temperatures in adjacent unheated spaces and the attic. (See section Attic Temperatures.) The attic temperature need not be estimated if the combined roof and ceiling coefficient is used.
4. Select or compute the heat transmission coefficients for outside walls and glass; also for inside walls, floors, or top-floor ceilings, if these are next to unheated space; include roof if next to heated space. (See Chapter 9. If the design wind speed is appreciably different from 15 mph, the appropriate change in the heat transmission coefficients in Tables 5 to 15 of Chapter 9 can be found in Table 20 of that chapter.)
5. Determine net area of outside wall, glass, and roof next to heated spaces, as well as any cold walls, floors, or ceilings next to unheated space. Such measurements are made from building plans, or from the actual building, using inside dimensions.
6. Compute the heat transmission losses for each kind of wall, glass, floor, ceiling, and roof in the building by multiplying the heat transmission coefficient in each case by the area of the surface in square feet, and the temperature difference between the indoor and outdoor air. (See Items 1, 2, and 3.)
7. Select unit values and compute the heat equivalent of the infiltration of cold air taking place around outside doors and windows. These unit values depend on the kind or width of crack, wind speed, and the temperature difference between the indoor and outdoor air; the result expresses the heat required to warm up the cold air leaking into the building per hour. (See Chapter 11.)
8. When positive ventilation using outdoor air is provided by an air-heating or an air-conditioning unit (see Table 1 of Chapter 6, Table 3 of Chapter 13, and air quantities given in Chapter 48 for various conveyances), the heat required to warm the outdoor air to room temperature must be provided by the unit. If mechanical exhaust from the room is provided, in amount equal to the outdoor air drawn in by the unit, the natural infiltration losses must also be provided for by the unit. If no mechanical exhaust is used, and the outdoor air supply equals or exceeds the amount of natural infiltration that would occur without ventilation, the natural infiltration may be neglected.
9. The sum of the heat losses due to transmission (Item 6) through the outside walls and glass, as well as through any cold floors, ceilings, or roof, plus the heat equivalent (Item 7) of the cold air entering by infiltration, or required to replace mechanical exhaust, represents the total heat loss equivalent for any building.
10. In buildings that have a reasonably steady internal heat release of appreciable magnitude from sources other than the heating system, a computation of this heat release under design conditions should be made for deduction from the total of the heat losses computed in Items 1–9. This is especially important for heating systems of high initial cost or those for which a demand charge is based on installed capacity.

DESIGN OUTDOOR WEATHER CONDITIONS

The ideal solution to the basic problem which confronts the designer of a heating system is to design a plant that has a capacity at maximum output just equal to the heating load which develops when the most severe weather conditions for the locality occur.

In most cases, economics interferes with the attainment of this ideal. Studies of weather records show that the most severe weather conditions do not repeat themselves every year. If heating systems were designed with adequate capacity for the maximum weather conditions on record, there would be considerable excess capacity during most of the operating life of the system.

The weather records of principal cities of the United States[1] have been analyzed to determine the probability of occurrence of certain low temperatures. The results of this analysis appear in Table 1. Data for Canadian cities obtained by a different analytical method appear in Table 2.

Five probabilities of outdoor temperatures are offered for American cities and four for Canadian cities. The analytical methods used for determining the several design temperatures cited in Table 1 for U. S. and Table 2 for Canadian cities are described in the footnotes of the tables.

In many cases, occasional failure of a heating plant to maintain a pre-selected indoor design temperature during brief periods of severe weather is not critical. However, the successful completion of some industrial or commercial processes may depend upon close regulation of indoor temperatures. These are special cases and require extra study before assigning design temperatures.

Before selecting an outdoor design temperature from

(*Text continued on p. 165*)