[8] State Building Construction Code Applicable to One- and Two-Family Dwellings, *State Building Code Commission*, 1740 Broadway, New York 19, N. Y.

[9] Predetermining Airation of Industrial Buildings, by W. C. Randall and E. W. Conover (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 605).

[10] Dairy Barn Ventilation, by F. L. Fairbanks (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 181). Cow Barn Ventilation, by Alfred J. Offner (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 149). For additional information on this subject refer to *Technical Bulletin, U. S. Department of Agriculture* (1930), by M. A. R. Kelley. Also see Air Conditioning of Farm Buildings, by F. L. Fairbanks (*Agricultural Engineering*, November, 1937, p. 485), Dairy Stable Ventilation (Revision of 1949) by F. L. Fairbanks and A. M. Goodman (Cornell University, *Cornell Extension Bulletin* No. 151) and The Ventilation of Poultry Laying Houses (Revision of 1950) by F. L. Fairbanks and A. M. Goodman (Cornell University, *Cornell Extension Bulletin* No. 315).

[11] Code of Minimum Requirements for Heating and Ventilating Garages (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 30). Airation Study of Garages, by W. C. Randall and L. W. Leonhard (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 233). A.S.H.V.E. RESEARCH REPORT No. 874—Carbon Monoxide Concentration in Garages, by A. S. Langsdorf and R. R. Tucker (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 511). A.S.H.V.E. RESEARCH REPORT No. 935—Carbon Monoxide Distribution in Relation to the Ventilation of an Underground Ramp Garage, by F. C. Houghten and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 439). A.S.H.V.E. RESEARCH REPORT No. 934—Carbon Monoxide Distribution in Relation to the Ventilation of a One-Floor Garage, by F. C. Houghten and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 424). A.S.H.V.E. RESEARCH REPORT No. 967—Carbon Monoxide Distribution in Relation to the Heating and Ventilation of a One-Floor Garage, by F. C. Houghten and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 395). Carbon Monoxide Surveys of Two Garages, by A. H. Sluss, E. K. Campbell and Louis M. Farber (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 263).

BIBLIOGRAPHY

Garage ventilation

Experimental Studies on the Effect of Ethyl Gasoline and its Combustion Products, by R. R. Sayers, A. C. Fieldner, W. P. Yant and B. G. H. Thomas (*U. S. Bureau of Mines Monograph* No. 2, 1927).

Ventilation of Vehicular Tunnels, by A. C. Fieldner, Yandell Henderson, J. W. Paul, R. R. Sayers, et al (A.S.H.V.E. JOURNAL SECTION, *Heating Piping and Air Conditioning*, Jan.–Dec. 1926)

Use of Diesel Engines in Tunnels, by S. H. Ash and L. L. Naus (*U. S. Bureau of Mines Information Circular* No. 7222, 1942).

Ventilation Involved in the Use of Gasoline Powered Equipment in Enclosed Spaces, by L. B. Berger (*U. S. Bureau of Mines Information Circular* No. 7404, 1947).

Diesel Engines Underground: Composition of Exhaust Gas from Engines in Proper Mechanical Condition, by J. C. Holtz, L. B. Berger, M. A. Elliott and H. H. Schrenk (*U. S. Bureau of Mines Report of Investigations* No. 3508, 1940).

Diesel Engines Underground: Use of Diesel Locomotives in Construction of the Delaware Aqueduct: Effect of Exhaust Gases upon Quality of Tunnel Air, by L. B. Berger, M. A. Elliott, J. C. Holtz and H. H. Schrenk (*U. S. Bureau of Mines Report of Investigations* No. 4032, 1947).

CHAPTER 12

HEATING LOAD

General Procedure, Design Outdoor Weather Conditions, Inside 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 Velocities, 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 inside 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 outside air which leaks in through cracks and crevices, around doors and windows, opening of doors and windows, or heat required to warm outside 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 velocity. The data on climatic conditions given in Table 1 and the isotherms of average design temperature in Fig. 1 will be helpful, but should be used with judgment as suggested in the section Design Outdoor Weather Conditions.

2. Select the inside air temperature, which is to be maintained in each room during the coldest weather. (See Table 2).

3. Estimate temperatures in adjacent unheated spaces and the attic. 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 velocity is appreciably different from 15 mph, the appropriate change in the heat transmission coefficients in Tables 6 to 9 and 15 to 19 of Chapter 9 can be found in Table 21 of that chapter.)

5. Measure 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 inside and outside 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 velocity, and the temperature difference between the inside and outside 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, the heat required to warm the outside air to room temperature must be provided by the unit; if mechanical exhaust from the room is provided, in amount equal to the outside 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