[3] An Analysis of Winter Temperatures for One Hundred and Twenty Cities, by Clark M. Humphreys (*Carnegie Institute of Technology Bulletin* 1939).

[3] 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).

[4] Performance of a Hot-Water Heating System in the I=B=R Research Home at the University of Illinois, by A. P. Kratz, W. S. Harris, M. K. Fahnestock, and R. J. Martin (*University of Illinois Engineering Experiment Station Bulletin* No. 349).

[5] A Study of Radiant Baseboard Heating in the I=B=R Research Home, by A. P. Kratz and W. S. Harris (*Engineering Experiment Station Bulletin* No. 358).

[6] Performance of a One-Pipe Steam System in the I=B=R Research Home, by W. S. Harris (*University of Illinois Engineering Experiment Station Bulletin* No. 383).

[7] A.S.H.V.E. Research Report No. 1011—Tests of Three Heating Systems in an Industrial Type of Building, by G. L. Larson, D. W. Nelson, and John James (A.S.H.V.E. Transactions, Vol. 41, 1935, p. 185).

[8] Methods of Moisture Control and Their Application to Building Construction, by F. B. Rowley, A. B. Algren and C. E. Lund (*University of Minnesota, Engineering Experiment Station Bulletin* No. 17).

[9] A.S.H.V.E. Research Report No. 1213—Heat Loss Through Basement Walls and Floors, by F. C. Houghten, S. I. Taimuty, Carl Gutberlet and C. J. Brown (A.S.H.V.E. Transactions, Vol. 48, 1942, p. 369).

[10] Measurements of Heat Losses from Slab Floor, by R. S. Dill, W. C. Robinson and H. E. Robinson (*U. S. Department of Commerce, National Bureau of Standards*, Building Materials and Structures Report BMS 103).

[11] Temperature and Heat Loss Characteristics of Concrete Floors Laid on the Ground, by H. D. Bareither, A. N. Flemming and B. E. Alberty (*University of Illinois, Small Homes Council Technical Report*).

[12] Concrete Floors for Basementless Houses (*University of Illinois, Small Homes Council Circular* No. F 4.3).

[13] Heat Requirement Tables for Intermittently Heated Buildings (*Engineering Experiment Station Bulletin* No. 60, *A. and M. College of Texas*, College Station, Texas) contains a set of tables applicable to either intermittent heating or cooling. Further information may be found in a paper, A Method of Compiling Tables for Intermittent Heating, by Elmer G. Smith (A.S.H.V.E. Journal Section, *Heating, Piping and Air Conditioning*, June, 1942, p. 386).

CHAPTER 12

COOLING LOAD

Cooling Load Calculations; Design Conditions; Instantaneous Heat Load; Solar Radiation; Periodic Heat Flow; Tables for Calculating Solar Heat Gain Through Walls, Roofs and Glass; Instantaneous Heat Gain vs. Cooling Loads; Load from Interior Partitions, Ceiling and Floors; Load from Outside Air, Ventilation and Infiltration; Effect of Outside Air on Load; Heat Sources Within Conditioned Space; Moisture Transfer Heat Load; Miscellaneous Heat Loads; Required Air Quantity Through Conditioning Equipment; Minimum Entering Air Temperature; Example Cooling Load Calculation

THE variables affecting cooling-load calculations are numerous, often difficult to define precisely, and always intricately inter-related. Most of the components of the cooling load vary in magnitude over a wide range during a 24-hour period, and as the cyclic changes in load components are not usually in phase with each other, careful analysis is required to establish the resultant maximum cooling load for a building or zone. A zoned system must often handle peak loads in different zones at different hours.

Economic considerations must be of particular influence in the selection of equipment for cooling season operation in comfort air conditioning, and this fact, coupled with present inadequacies in available data and knowledge of the air-conditioning art, places a premium on the experienced judgment essential to successful design or practice. Variations in the weather, building occupancy, and other factors affecting load, necessitate carefully coordinated controls to regulate simultaneously the components and the equipment in order to maintain the desired room conditions.

The calculation procedures presented in this chapter deal with the various instantaneous rates of heat gain, both sensible and latent, in a conditioned space. There may be an appreciable difference between the *net instantaneous rate of heat gain* and the *total cooling load* at any instant. This difference is caused by the storage and subsequent release of heat by the structure and its contents. This thermal-storage effect may be quite important in determining an economical cooling equipment capacity. The lack of any adequate means of treating this storage quantitatively in its entirety for a complete structure, must be recognized in judging the procedures and data presented for calculating individual components of the net rate of instantaneous heat gain.

Solar heating calculations involve the same principles as cooling load calculations. Many of the data on solar radiation given in this chapter can be used in calculations for solar heating.

COOLING LOAD CALCULATIONS

Summer cooling load calculations, whether for industrial or comfort applications, require consideration of the following factors:

A. *Design Conditions:* (1) indoor conditions; (2) outdoor conditions; (3) ventilation rate.

B. *Instantaneous Heat Load, Sensible and Latent:* (1) load from solar radiation,