mission heat losses of 20.9 per cent are relatively small. The infiltration losses (12.8 per cent) are also comparatively small in this case because the storm windows serve substantially the same purpose as weatherstripping. In this problem, the wall, ceiling and floor transmission losses comprise 66.3 per cent of the total.

Example 6. Calculate the heat loss of residence shown in Fig. 2 based on the same conditions as in *Example 5* but having construction improved or insulated to obtain coefficients as follows:

Walls, 0.13; *Walls of Dormer over Garage*, 0.12; *Attic Walls*, 0.28; *Walls Adjoining Garage*, 0.18; *Basement Walls (Recreation Room)*, 0.10.

Roof, 0.53.

Ceiling (Second Floor), 0.15.

Windows (Same as in *Example 5*).

Floor (Bedroom D), 0.18.

Solution: The procedure for calculating the heat losses is similar to that for *Example 5*. A summary of the results is given in Table 6.

TABLE 6. SUMMARY OF HEAT LOSSES OF INSULATED RESIDENCE

Heat losses given in Btu per hour

Room or Space	Walls	Ceiling and Roof	Floor	Glass and Door	Infiltration	Totals
Bedroom A	2670	2370	-------	1440	1010	7,490
Bedroom B	1750	1570	-------	1440	1010	5,770
Bedroom C	1280	1170	-------	970	500	3,920
Bedroom D	1320	1170	690	720	500	4,400
Bathroom 1	340	540	-------	500	500	1,880
Bathroom 2	820	340	220	320	420	2,120
Living Room	3580	-------	-------	1800	1120	6,500
Dining Room	1860	-------	-------	3880	870	6,610
Kitchen	1400	-------	-------	950	760	3,110
Lavette	1460	-------	-------	1100	530	3,090
Entrance Hall	440	850	-------	640	560	2,490
Garage	−400[a]	-------	−1190[b]	3410	2700	4,520
Recreation	840	-------	570	720	490	2,620
Totals	17,360	8,010	290	17,890	10,970	54,520
Percentages	31.9	14.7	0.5	32.8	20.1	100.0

[a]Wall loss of 1050 Btu minus gains of 590, 320 and 540 Btu. [b]Heat gains; 690, 220 and 280 Btu.

REFERENCES

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

[2]—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).

[3]—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).

[4]—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).

[5]—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).

[6]—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).

[7]—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 15

Cooling Load

Design Outside Temperatures, Components of Heat Gain, Normal Heat Transmission, Solar Heat Transmission, Solar Radiation Through Glass, Heat Introduced by Outside Air, Heat Emission of Appliances, Moisture Through Walls

LOAD calculations for summer air conditioning are more complicated than heating load calculations. Due to the variable nature of some of the contributing load components and the fact that they do not necessarily impose their maximum effect simultaneously, considerable care must be used in determining their phase relationship.

The conditions to be maintained in an enclosure depend upon several factors, especially the outside design conditions, duration of occupancy, and relationship between air motion, dry-bulb and wet-bulb temperatures. Information concerning the proper indoor effective temperature to be maintained is given in Chapter 12, for different geographical locations and for various age groups of individuals. Typical commercial design room conditions for the summer average peak load are shown in Table 1.

Summer dry-bulb and wet-bulb temperatures of various cities are given in Table 2. The temperatures are not the maximums but the design temperatures which should be used in air conditioning calculations. The maximum outside wet-bulb temperatures as given in Weather Bureau reports usually occur only from 1 to 4 per cent of the time, and because they are of such short duration it is not practicable to design a cooling system for them. The temperatures shown in Table 2 are based on available design conditions known to be applied successfully.

COMPONENTS OF HEAT GAIN

A cooling load determination is composed of five components which are classified in the following manner:

1. Normal heat transfer through windows, walls, partitions, doors, floors, ceilings, etc.
2. Transfer of solar radiation through windows, walls, doors, skylights, and roof.
3. Heat emission of occupants within enclosures.
4. Heat introduced by infiltration of outside air and controlled ventilation.
5. Heat emission of mechanical, chemical, gas, steam, hot water, and electrical appliances located within enclosures.

The components of heat gain, classified by source, are further classified as sensible and latent heat gain.

The first two components fall into the classification of sensible heat gain, that is, they tend to raise the temperature of the air within the structure. The last three components not only produce sensible heat gain but they may also tend to increase the moisture content of the air within the structure.

Normal Heat Transmission

By normal heat transmission, as distinguished from solar heat transmission, is meant the transmission of heat through windows, walls, partitions, etc. from without to interior of enclosure by virtue of difference between outside and inside air temperatures. Since the daily range of