operating under a comparatively low load factor for the greater part of the time and may be correspondingly inefficient and uneconomical, unless properly designed to meet these conditions.

In the smaller plants this is hard to overcome without either having a plant too large for economy or too small to heat up in a reasonable time. This is sometimes attempted by having the normal capacity of steam boilers about 60 per cent of that required for *maximum conditions* which provides for their average operation at about normal capacity and at corresponding overloads for the maximum conditions. In order to make this successful the boiler plant must be adapted to operate successfully on at least 50 per cent overload for short periods. In larger plants the boilers may be divided into *two or three units, so that one unit may be operated during mild weather*, one or two units during average weather and the entire plant during extreme weather which arrangement is ideal for flexibility and economy.

Another important design problem is to bring the building up to its working temperature. This is a general requirement for buildings that are not heated over night, or which are used periodically and not heated during the time that they are not used. Recent tests have indicated that from 10 to 20 per cent more fuel is required for maintaining normal working temperatures in office buildings throughout the 24 hours than is ordinarily required for maintaining working temperatures throughout the day and allowing the heat to be shut off during the time that the building is not in use. It may be assumed that other classes of buildings would show similar results.

In office buildings, factories and other work places, it is not generally considered so necessary to have the temperature up to normal at the beginning of the working period as it is in schools, churches, theatres and other places of assemblage where the occupants are sitting still, and for this reason the relative capacity of the heating system may be less.

In school buildings and other buildings where the heating of the air for ventilation is a large part of the load, this factor may be greatly reduced by recirculating the air during the heating up period, so that while the entire normal average load on the building may be from two to three times as much for heating the air as for supplying the direct radiation *the heating-up load for the air may be reduced to from one-half to* one-third of its normal value, so that the total load may not be more than twice the direct radiation load.

By continuous recirculation for the ventilation, arranged to vary the amount of air taken in from the outside from 100 per cent at an outside temperature of 55 deg. to 25 per cent at an outside temperature of 0 deg. the boiler capacity required for heating the air may be held practically constant at about 25 per cent of that required for 100 per cent of 0 deg. air from the outside.

Recognizing the fact that uniform practice in the design of heating systems and some standards in the installation of the necessary piping and equipment are desirable, the Society has undertaken the compilation of the most practical information available on these subjects for the use of architects, engineers, contractors, students, etc., and for these data have drawn upon the experience of members, the results of Research Laboratory investigations, reports of technical committees, the TRANSACTIONS and other reliable sources.

CHAPTER I

CALCULATING THE HEAT LOSSES FROM BUILDINGS

INTRODUCTION

IN the revision of Chapter I for the 1928 Edition of THE GUIDE, the latest available data on the internal conductivities of building materials and insulations have been included in Table 4, greatly extending its scope and usefulness. With these values available, it has been possible to compute an entirely new set of tables of heat transmission coefficients for modern wall, roof and floor constructions, such as are in use today for insulated as well as uninsulated buildings, replacing and greatly extending the old Tables 6 to 12 inclusive.

The procedure to be followed in determining the heat loss from any building can be divided into seven consecutive steps, as follows:

1. Determine on the inside air temperature, at the breathing line, which is to be maintained in the building during the coldest weather.

2. *Determine on an outside air temperature for design purposes,* based on the minimum temperatures recorded in the locality in question, which will provide for all but the most *severe conditions.* Such conditions as may exist for only a few consecutive hours are readily taken care of by the heat capacity of the building itself.

3. Select or compute the heat transmission coefficients for outside wall and glass, also for floor, or top-floor ceiling, if these are next to unheated space. Include roof if next to heated space.

4. Measure up net outside wall, glass and roof next to heated spaces, as well as any cold floor or ceiling next to unheated space. Such measurements are made from building plans.

5. 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 paragraphs 1 and 2 above.)

6. 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 kind or width of crack and wind velocity, and when multiplied by the length of crack and

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The work of compiling and computing Tables 6-12, in accordance with the methods set forth in the text, has been done by P. D. Close, a graduate of the University of Illinois.