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.

The load factor of the average heating plant is such that the total heat required per month will vary according to the following, when measured in percentage of the total heat required for the season:

OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL
7%	12%	17%	20%	18%	16%	10%

All of these points are covered in the chapters which follow outlining the current practice in determining the heat losses from buildings, selecting the proper size radiators, the correct pipe size, an adequate boiler, explaining the principles of design for a steam, hot water or warm air system, heating with oil or gas, temperature control methods and methods of insulation.

In making plans for heating and ventilating systems the following symbols for drawings are recommended: