cleaned regularly before it becomes excessive. Water spray should not touch the steam heating coils as they will quickly become coated with scale. The preferred practice is to install sprays between coils and eliminator plates.

Filters, Fans and Motors

For a discussion of air cleaning devices and for the selection of all types of air filtering equipment refer to Chapter 27. The selection of fans, motors and their control may be based on data available in Chapters 28 and 39.

Sound Control

Problems of sound control should be jointly considered by the acoustical and air conditioning engineer for satisfactory results. Many installations require noise levels which are relatively low and for that reason equipment must be selected having a very low noise rating. In central systems consideration should also be given to the lining of ducts for the reduction of noise levels within an enclosure. Often reduced speeds of equipment and low air velocities are helpful in eliminating undesirable noise conditions. Information is given in Chapter 31 with regard to acceptable noise levels for various types of rooms and methods are outlined for computing length of duct lining materials.

Automatic Control

The control of an air conditioning system is very important. A simple comfort cooling or heating installation requires a minimum of control, whereas a more complex installation justifies a more complete control. In this connection, there are many patents allowed and pending on air conditioning equipment including control, and the designer should consider these factors in selecting equipment. Refer to Chapter 38.

Static Pressure

The static pressure against which the fan must operate is the sum of all pressure losses through all parts of the complete system. Resistances of equipment such as coils, washers, filters, and grilles is obtained from data given in the manufacturers' catalogs. Pressure drop in the duct is calculated as shown in Chapter 30.

SPECIAL CONSIDERATIONS

In designing a central system for air conditioning there are a number of special considerations not referred to previously which must be considered. Certain features of building constructions are important. The building must be suitable in construction so that the desired conditions can be maintained economically.

For instance, excessive sun load on roofs or glass windows may not only cause excessive heat gain to be absorbed by refrigeration, but direct sun radiation heating converts a surface into a panel heater. This radiant heat is not absorbed until it strikes another mass such as a building wall, or a person. It is therefore possible to have comfortable air conditions surrounding a person, and yet have him uncomfortably warm from radiant heat from a hot wall, window, or ceiling near him. As another example, it is much better to provide hoods over steam tables, coffee urns, etc., than to try to remove this heat by mechanical refrigeration.

Another problem is presented with winter conditioning for maintaining satisfactory relative humidity. If 30 to 40 per cent is desired at all times, no matter how cold it is outside, excessive condensation may collect on single glass windows, or on hardware which connects to the outside such as latches and hinges. Condensation on windows can sometimes be prevented by applying a small amount of local heat under the window. In other cases double glass or storm window construction is used. Refer to Chapters 5 and 7 for condensation temperatures.

In many cases, different zones of a building will require entirely different treatment. In some buildings where offices are exposed on all four sides to sun and wind effect, cooling is required on the sunny side and heating is required on the shady side simultaneously, in spring and fall seasons. The central system must be carefully zoned to apply cooling or heating as they may be needed for each zone, independent of other zones.

In many existing buildings, the central system will be added to a radiation system of heating. The designer should take full avantage of this radiation for heating the outside walls and windows. At the same time, it must be controlled to prevent overheating the whole system. A few uncontrolled radiators will often change the heat balance and cause excessive overheating of the whole zone, without occupants near the radiators realizing the source of the trouble. All radiation used locally in connection with the control system should be equipped with automatic control to prevent overheating.

The apparatus should be placed for minimum piping and duct work but it must be accessible for maintenance, repair, and cleaning. The air conditioning unit should be designed to provide access for cleaning coils, drip pans, eliminators and for very easy maintenance on filters. This equipment will be in operation for many years, probably for the life of the building, and a little thought spent in the plan will simplify maintenance and assure successful results.

Example 1. With the assumed values as indicated perform the essential calculations to determine the design loads for heating and cooling and the necessary factors for designing the distribution system.

Solution: Design Conditions from Item 1.

Outside air dry-bulb, winter	0 F
Outside air dry-bulb, summer	95 F
Outside air wet-bulb, summer	75 F
Inside air dry-bulb, winter	72 F
Inside air wet-bulb, winter	56 F
Inside air relative humidity, winter	35 per cent
Inside air dry-bulb, summer	80 F
Inside air wet-bulb, summer	66.7 F
Inside air relative humidity, summer	50 per cent

200 people—4 kw light load.

Design Load for Heating from Item 2.

Sensible heat loss through walls, etc.	200,000 Btu per hour
Outside air—2000 cfm $\times$ 0.075 $\times$ 60 $\times$ 0.24 $\times$ (72 $-$ 0) =	155,500 Btu per hour
Humidification— $\frac{2000 \times 0.075 \times 60 \times (40 - 5) \times 1040}{7000}$ =	46,900 Btu per hour
Heat loss through ducts	33,200 Btu per hour
Heat gain from lights, etc.	Disregard
Total heating load	435,600 Btu per hour