

2. The use of awnings at all windows in east, south, and west exposures may result in savings of from 20 to 30 per cent in the required cooling load.
3. The cooling load per degree difference in temperature is not constant but increases as the outdoor temperature increases.
4. The heat lag of the building complicates the estimation of the cooling load under any specified conditions and makes such estimates, based on the usual methods of computation, of doubtful value.
5. The seasonal cooling requirements are extremely variable from year to year, and the ratio between the degree-hours of any two seasons occurring within a 10-year period may be as high as 7.5 to 1. Hence an average value of the degree-hours cooling per season is comparatively meaningless.
6. The duct system in a forced-air heating installation can be successfully converted to a system for conveying cool air for the purpose of cooling the structure. No condensation of moisture was observed when the duct temperatures were not less than 65 F.
7. Cooling by means of water at a temperature of 60 F is not satisfactory unless an indoor temperature of less than 80 F is maintained.
8. In the selection of cooling coils, the additional frictional resistance of the coil to flow of air must be given consideration.
9. Cooling the structure by introducing large quantities of air from outdoors at night tended to reduce the amount of cooling required on the following day and was a practical means of providing more comfortable conditions in those homes where cooling systems were not available.

METHOD OF DESIGNING COOLING SYSTEM

The general procedure which may be used for the design of a summer cooling system in a forced-air installation is:

1. Calculate heat gain for each room or space to be conditioned. (See Chapters 4 and 7.) Allowance for addition of outside air must be included in this calculation.
2. Select a temperature of air leaving supply inlets. In Research Residence tests a value of from 65 to 70 F was found satisfactory.
3. Determine indoor conditions to be maintained. In Research Residence 80 F dry-bulb and 45 per cent relative humidity were found satisfactory.
4. Determine the quantity of air to be introduced into each room. (See Chapter 21.)
5. Estimate heat loss in duct system between cooling unit and supply registers.
6. Calculate the heat to be removed by the cooling unit, in the form of sensible heat and latent heat.
7. Determine size of ducts in duct system and size of registers, as explained in this chapter under the heading of Method of Designing Forced-Air Heating Systems.
8. Determine pressure loss in duct system and select fan as also explained in the same section.
9. Select cooling unit from manufacturer's data. Specify temperature and pressure of available cooling water, voltage and characteristics of electrical supply, and method of control of apparatus.
10. Select cooling coils from manufacturer's data to take care of latent heat load and to give required drop in air temperature with the weight of air flowing. (See Chapter 26.)
11. If system is to be used for both winter heating and summer cooling, duct sizes must be checked to insure that velocities and friction losses are reasonable for both conditions of operation. Adjustable dampers will be necessary to make changes in air distribution for the two seasons. Provision must also be made for changing fan speeds for summer and winter operation.

Chapter 21

CENTRAL SYSTEMS FOR COMFORT AIR CONDITIONING

*Types of Systems for Ventilating, Heating, Air Conditioning,
Factors Involved in Use and Design of Systems, Design Procedure*

THE purpose of this chapter is to present a discussion of types of central systems usually encountered, together with a discussion of the factors involved in use and design and an outline of design procedure.

Insofar as this chapter is concerned, a central system is defined as a field assembled apparatus, comprising such elements of equipment as are necessary to fulfill the purpose for which it is designed, and serving one or more conditioned spaces. It may be argued with justification that a factory produced unit, including all the essential items of equipment can be employed as a central system. Unitary equipment is discussed in Chapter 23. Further, this chapter is confined to comfort air conditioning systems as such, and ventilating systems, warm air heating systems, together with central systems of a special nature, are excluded from the discussion.

This chapter assumes a knowledge of all the component parts of a system and the reader is referred specifically to other chapters covering design conditions and physiological principles, cooling and heating load; spray equipment, heat transfer surface coils, cooling dehumidification and dehydration, fans, air cleaning devices, refrigeration, air distribution and air duct design, automatic controls and instruments. In addition, the engineer should refer to the Code of Minimum Requirements for Comfort Air Conditioning¹ prepared by the joint committee of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and the American Society of Refrigerating Engineers, and to national, state or local codes that may apply.

CLASSIFICATION OF SYSTEMS

The generally accepted method of classifying systems is with regard to their function. A given type of system may be changed by the omission of certain of its functions or by the inclusion of others. As an example, a winter air conditioning system, by the omission of humidifying sprays, air cleaning devices, etc., will become a simple warm air heating system,

¹Code of Minimum Requirements for Comfort Air Conditioning (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 27). Reprints of this code are available at \$10 a copy.