FACTORS INFLUENCING APPLICATIONS

The conditions and limitations outlined under the heading Application of Comfort Chart should be noted in applying the temperatures and relative humidities specified in Tables *A* and *B* of the preceding A.S.H.V.E. Ventilation Standards.

Air Quality

In occupied spaces in which the vitiation is entirely of human origin, the chemical composition of the air, the dust, and bacteria content may be dismissed from consideration so that the problem consists in maintaining a suitable temperature with a moderate humidity, and in keeping the atmosphere free from objectionable odors. Such unpleasant odors, human or otherwise, can be easily detected by persons entering the room from clean, odorless air. A further discussion of air quality will be found in Chapters 15 and 16.

Air Motion

As a result of studies by Baetjer[34] and work carried on by the A.S.H.V.E. Research Laboratory, it is now recognized that the importance of air motion in air conditioning ranks only second to temperature. Air in an occupied space having all the other essential qualities but lacking in air motion feels stagnant, stuffy, and depressing, because the vitiated air next to the body is not replaced by the surrounding air possessing the satisfactory qualities. Hence, air motion is absolutely essential that an occupant may realize the other desired qualities of the atmosphere. Possible limits in variation in air motion may range from 5 fpm to 50 fpm, as measured by the Kata thermometer. (See Chapter 43.) However, satisfactory results are more likely to be insured by air velocities ranging from 15 to 30 fpm. The limit of 5 fpm may be taken as the minimum during the heating season, and 50 fpm as the maximum for the cooling season.

Air Distribution

Variation in concentration of carbon dioxide in different parts of an occupied room has been used as a measure of satisfactory distribution of the outside or conditioned air supply. For satisfactory air distribution, the carbon dioxide concentration at the 36-in. level should not vary by more than one part in 10,000 parts of air. Recent work[2] by the A.S.H.V.E. Research Laboratory demonstrates that variations in dry-bulb temperature, wet-bulb temperature, or moisture content of the air are equally good indices of air distribution. This work also indicates that the presence of satisfactory air motion within the room (15 to 30 fpm as measured by the Kata thermometer) insures satisfactory distribution. Because of the laborious and exacting technique involved in making carbon dioxide determinations, it is recommended that satisfactory distribution can be amply insured by the presence of such air velocities in all parts of the room together with dry-bulb temperature variations of not to exceed 3 deg at the 36-in. level.

[34] Threshold Air Currents in Ventilation (*American Journal of Hygiene*, Vol. IV, No. 6, p. 650, 1924).

Air Quantity

The quantity of air to be circulated through an occupied space, whether by natural or mechanical means, or whether the air is conditioned or not, must in all cases be sufficient to maintain the required standards of air temperature, quality, motion and distribution. The factors which determine air quantity include the type and nature of the building, locality, climate, height of rooms, floor area, window area, extent of occupancy, and last but not least, the method of distribution.

The quantity of air supplied to a room by an air conditioning or ventilating system serves two purposes: *First*, the supply of sufficient outside air for the needs of the occupants; and *second*, the setting up of circulation or air motion within the room. Until recently it was considered that 30 cfm were necessary in any occupied space, particularly in a classroom. It has since been demonstrated that 10 cfm of outside air per person is frequently sufficient to remove body heat, insure against body odors, and provide the chemical needs of respiration. However, it is found that a greater volume should be circulated in the average room in order to provide the required air motion. It is now customary to supply the minimum amount of outside or conditioned air required for removing heat and odors, and to recirculate the additional volume.

In offices and small rooms where the occupants smoke, from 6 to 7 cfm of outside air per occupant will be necessary to eliminate the nuisance effects of the smoke; this quantity of air, however, may be a part of that necessary for other ventilation requirements. Restaurants which permit smoking, because of the exposed food and the necessity that restaurant air seem very clean, need from 10 to 12 cfm of outside air per occupant to care for the smoke condition. This air, likewise, need not be in addition to that required for other ventilation purposes.

Temperature Rise

The total quantity of air introduced is governed largely by the needs for controlling temperature and humidity when either heating or cooling is required. As a rule, the introduction and distribution of warm air into an occupied space does not present as many difficulties as does the introduction of cold air. The former is determined from the amount of heat to be given up to the space, and the latter is determined from the amount of heat to be removed from the space, using a temperature rise that will produce uniform distribution without the production of disagreeable drafts.

Fig. 6 shows the changes in carbon dioxide concentration and moisture content resulting from occupation, in the atmosphere of a room supplied with various volumes of outside air. Data are given for an adult, 5 ft 8 in. in height weighing 150 pounds and having a body surface area of 19.5 sq ft, and for a child, 12 years of age, 4 ft 7 in. in height, weighing 76.6 pounds and having a body surface area of 12.6 sq ft. It is a recognized fact that the dissipation of heat and moisture to the atmosphere, the addition of carbon dioxide, and all metabolic changes take place in proportion to the surface area of the individual. Hence, data for persons of other sizes may be obtained by interpolating among the curves given. The rate of sensible heat production is given in Fig. 9. Fig. 6 also gives