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<sup>8</sup> Room Air Distribution Research for Year-Round Air Conditioning, Part II—Supply Outlets at Three Floor Locations, by H. E. Straub and S. F. Gilman (ASHVE TRANSACTIONS, Vol. 60, 1954, p. 249).

<sup>9</sup> Investigation of Summer Cooling in the Warm Air Heating Research Residence, by A. P. Kratz, M. K. Fahnestock and S. Konzo (*University of Illinois, Engineering Experiment Station Bulletin* 290, 1930).

<sup>10</sup> Annual Utility Cost Operating Residential Cooling System, by T. N. Willcox (*Fuel Oil News*, June 1954).

<sup>11</sup> The Operating Cost of Residential Cooling Equipment, by S. F. Gilman, L. A. Hall and E. P. Palmatier (ASHVE TRANSACTIONS, Vol. 60, 1954, p. 525).

<sup>12</sup> Relative Cooling Requirements for American Homes, by S. S. Visser (*The Scientific Monthly*, November 1945, p. 211).

<sup>13</sup> *Heat Pump Applications*, by E. N. Kemler and S. Oglesby (McGraw-Hill Book Co., First Edition, 1950, p. 246).

<sup>14</sup> *Summer Weather Data* (published by The Marley Co., Kansas City, Kansas, 1939, Chapter VI).

## CHAPTER 51

## SCHOOLHOUSE HEATING AND VENTILATING

General Considerations; Factors Affecting Design: Classrooms, Other Spaces, Government and Fire Safety Regulations, Economic Considerations; Systems in Use: Open Window, Gravity and Mechanical Exhaust, Forced Air, Unit Ventilators, Panel Heating; Maintenance and Operation

SCHOOL buildings present certain special problems due to diversity of use of various spaces, differing times of occupancy, recent trends in building construction, and additional sources of odors. A school is generally a composite building, containing classrooms, large public meetings rooms which also serve as teaching spaces, offices and administrative areas, health departments, locker rooms, toilet rooms, laboratories, shops, cafeterias, and miscellaneous other spaces such as corridors, stairways and service areas. The heating and ventilating requirements are different for each type of space.

## GENERAL CONSIDERATIONS

The uses of spaces in schools vary widely in normal operation. The usual classrooms, assembly rooms, lecture halls, auditoriums, and other similar areas have occupants of relative inactivity. Consideration must also be given to areas such as music rooms, laboratories, shops, basketball courts and gymnasiums where various degrees of activity are found. All of these areas have different temperature and ventilation requirements. Most state laws require relatively large glass areas in classrooms, thereby imposing a real heating problem upon the designer. The lower mean radiant temperatures make these rooms particularly susceptible to objectionable drafts which the heating and ventilating system should be designed to combat or overcome.

The areas having higher levels of activity will require lower temperatures and, due to the increase in body odor, should have relatively more ventilation.

A major aspect of time of use of the various spaces is the dual use of the building by the school and by the community, not only of the auditorium and gymnasium, which may be planned for physical segregation during the evening, but also of any of the classrooms or the cafeteria. The room used by the board of education may be in use at any hour or time, and may require air conditioning.

The type of construction and its effect on comfort and condensation must be considered. The tendency, particularly in the Southern States, to encourage the use of one-story schools with outside corridors and concrete slabs on the ground has introduced many new heating problems. This construction greatly enhances the use of natural or window ventilation because the rooms are equipped with high windows on one side, usually the north or northeast, and low windows on the opposite side. The amount of ventilation air is thus regulated by the adjustment of the windows.

In the extreme South there is some tendency to design schools with very light wall construction and to omit any wall insulation, thus producing a