

ature rises above the normal level, cool air is discharged into the room. The room thermostat accomplishes this by throttling the heat supply, finally shutting it off, and then opening the outdoor air damper to prevent overheating of the room. The air-stream thermostat frequently takes control during this stage, to prevent the discharge temperature from falling below a set level.

The three basic cycles of control commonly used are as follows:

Cycle I. 100 percent of outdoor air is admitted at all times, except during the warm-up stage.

Cycle II. A minimum amount of outdoor air (normally 25 to 50 percent) is admitted during the heating and ventilating stage. This percentage is gradually increased to 100 percent, if needed, during the cooling and ventilating stage.

Cycle III. Except during the warm-up stage, a variable amount of outdoor air is admitted as needed, to maintain a fixed temperature of the air entering the heating element. This is controlled by the air-stream thermostat, which is set low enough (often at 55 F) to provide cooling when needed.

Night Control

For maximum economy, it is general practice to maintain the building at reduced temperature at night and over weekends and vacations. Several control arrangements to accomplish this are in common use. One turns the fans on and off, as in the case of a unit heater, whenever the unit convective capacity is insufficient. Another arrangement uses the convective capacity of the unit, supplemented by the convective capacity of auxiliary heating equipment installed within the room. More elaborate arrangements are available, permitting operation at daytime temperatures in some spaces and at lowered temperatures in others, for maximum economy during night occupancy of part of the building. For general information on controls, see Chapter 13.

Location of Unit Ventilators

The location of the unit is important. Wherever possible, it should be placed against the outside wall and near the centerline of the room. It is more difficult to obtain proper air distribution if the unit is installed either on an inside wall or in the corner of the room. Standard unit models are set against the wall, or may be recessed into the wall, and discharge the air stream upward. Ceiling models discharge the air horizontally. Best results are obtained if the unit can discharge against or across a flat ceiling, with the air flow pattern uninterrupted by ceiling beams or surface-mounted lighting fixtures.

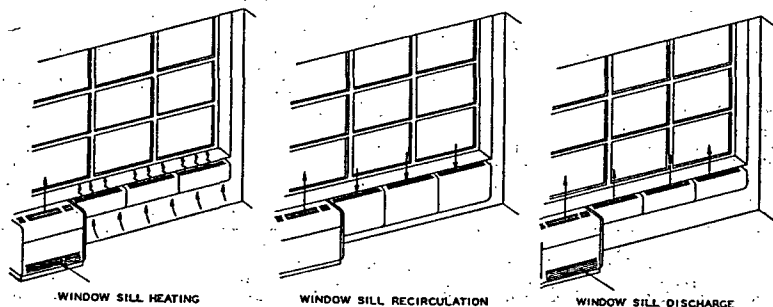


Fig. 5 Three Methods of Preventing Window Draft

Air Exhaust Vents

The location and size of exhaust vents¹ are not of particular importance on systems employing unit ventilators. However, many states have regulations which require vents in public buildings. When vents are used, it is important that they be sized and located properly. Vents should be fitted with manual dampers so that the exhaust can be regulated for proper air distribution. Back-draft dampers should be installed in the vent opening to prevent cold air from entering through the vent.

It has become common practice, where regulations permit, to exhaust into the corridor through louvers in the classroom door, and to use powered or gravity exhaust from the corridor to the outdoors. Thus, the slight pressurizing of the building by the unit ventilators provides the force to exhaust the entire building. It is also common practice to use the exhaust from the classroom as secondary ventilation, by passing the exhaust air through wardrobes and lockers. Many state and local codes make this arrangement mandatory.

Cabinet exhausters can be used in localities where codes dictate a positive mechanical supply and a positive mechanical exhaust. They are located along the outside wall and match the unit ventilator exterior.

Window Downdraft Prevention

The increased use of large window areas has presented a window downdraft problem, caused by chilled air flowing down the windows and into the occupied areas of the room. Three basic means of combating these downdrafts have been developed for use with unit ventilators. These are shown in Fig. 5 and operate as follows:

Window sill heating employs finned radiation of moderate capacity, installed along the wall under the window area. Heated air rises upward by convection and counteracts the downdraft by tempering it and diverting it upward to eliminate the cold draft.

Window sill recirculation is obtained by placing the return air intake along the window sill. Room or return air to the unit includes the cold downdrafts, takes them out of the occupied area of the room, and thus eliminates the problem.

Window sill discharge directs a portion of the unit ventilator discharge air into a delivery duct along the sill of the window. The unit discharge air, delivered vertically at the window sill, provides room-wide air distribution and uses upwardly-directed streams of air to combat downdraft.

Unit Ventilators and Unit Heaters

Year-round Unit Ventilators

Due to increased use of school buildings during the summer months, some building plans now include mechanical cooling or have provisions for including it in the future. Year-round unit ventilators, which are equipped for cooling and dehumidifying during the summer season as well as for heating, ventilating, and cooling with outdoor air during the winter season, are being installed in increasing numbers to meet such application requirements.

These units provide the same functions during winter operation as the unit ventilators previously discussed, and, in addition, are arranged to provide a fixed outdoor air quantity during occupied periods in the summer season. These units differ from conventional unit air conditioners in being able to provide up to 100 percent of their rated air capacity from outdoors, for natural cooling during winter operation, and in being normally bypass-controlled for maximum dehumidification.

Year-round unit ventilators are usually furnished with combination heating-cooling elements, employing hot water as the heating medium and chilled water as the cooling medium. In addition to the components furnished for winter operation, these units are provided with condensate drain pans and suitable insulation for chilled water operation. The classification, air capacity, heating capacity, application, and control of unit ventilators previously discussed in this chapter are also generally applicable to year-round unit ventilators. The same types of unit and arrangement of elements are available. The same air capacity ratings are employed, and heating capacity requirements and ratings for winter operation are similar. Data on application, control, location, venting, and window downdraft prevention are also generally applicable.

The added condition of summer operation for year-round unit ventilators requires consideration of several factors in addition to those previously discussed. The sensible and latent cooling capacity required for air conditioning must be provided, in addition to the capacity to meet room ventilation requirements. The calculations are comparable to those shown for winter operation. The air capacity will usually be dictated by the summer load, but may occasionally be fixed by the cooling capacity requirement during mild weather outdoor in southerly exposed rooms with large windows. The outdoor air quantity for summer ventilation will usually be the same

as the winter minimum, but may be different in some cases, and will be less likely to be dictated by a local code. The summer cooling capacity will usually establish the required water quantity. Comparatively low hot water temperatures will be necessary during winter operation, to prevent excessive heating capacities and consequent control problems.

Winter control sequences are the same as those described for conventional unit ventilators, with summer sequences consisting of a cool-down stage and a cooling and ventilating stage. The same control components and sequences are used during both winter and summer operation, with the addition both of relays for automatic changeover and of devices to limit to the desired quantity the amount of outdoor air introduced during summer operation. Since bypass control is used for winter operation as well as for summer, outdoor reset of system water temperature down to a temperature suitable for introduction into the chiller (usually 80 F or lower) at the changeover temperature, reduces the time required for changeover. Because year-round unit ventilators can introduce up to 100 percent outdoor air for cooling during winter season operation, changeover temperatures as high as 55 F and 60 F may be used, with consequent minimum chiller operation.

Year-round unit ventilators may be installed as part of a complete air conditioning system in the initial installation, or may operate as winter-season unit ventilators, in anticipation of the future installation of mechanical cooling equipment. When such provision for future mechanical cooling is made, the supply and return piping, piping insulation, year-round unit ventilators, and controls are usually included in the original installation. Water chillers, cooling towers or evaporative condensers, and associated accessories are installed later, when the mechanical cooling is required. (See Fig. 6.)

The cost of adding provisions for future cooling to a unit ventilator system generally adds 15 percent to the heating and air conditioning contract. Full mechanical cooling adds 35 to 50 percent to the contract.

UNIT HEATERS

The term *unit heater* denotes an assembly of elements, the principal function of which is heating. The essential elements of a unit heater are a fan and motor, a heating element, an enclosure, and a directional outlet. Filters, dampers, duct collars, combustion chambers, and flues may also be included. Some types are shown in Figs. 7 to 14.

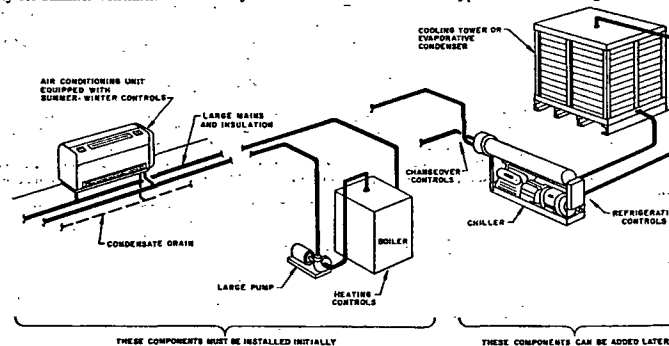


Fig. 6 Components Required for a Summer-Winter Air Conditioning System