

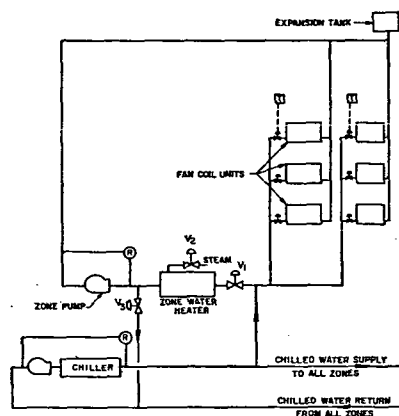


Fig. 40 Single-Supply Multi-Zone System without Separate Ventilation

Central Station Equipment

Depending on system variations, the central station equipment required for a fan-coil system includes some, or all, of the following items: (1) water chillers, (2) primary water pumps, (3) water heaters, (4) zone water pumps, (5) ventilation air dehumidifiers, (6) auxiliary heat exchangers, (7) service valves, (8) control valves and controls, and (9) water and condensate piping.

Water Chillers. The selection of the refrigeration equipment is largely at the discretion of the designer. Reciprocating water chilling systems range in size from 10 to 200 tons per unit while centrifugal equipment is available from approximately 75 tons to almost unlimited sizes. Absorption equipment, using steam as the energy source, is also available for providing chilled water. A fan-coil system is well adapted to use of hot water at the relatively low temperatures available in central heat pump systems.

A very wide range of capacity variation is required by the fan-coil unit system. Thus the refrigeration equipment should be selected to be capable of maintaining the lowest part load capacity possible so that the system can remain in operation under low loads.

Wherever the application is such that the chilled water flow rate required at the fan-coil units will be throttled at light cooling loads, provisions must be made to maintain a constant flow of water through the chiller. Where the water control valves at the fan-coil units are of the bypass type, a constant flow through the chiller is maintained when the flow of water to the fan-coil unit is throttled. Where the water control valves at the fan-coil units are of the throttle type, a relief line must be provided from the outlet of the chiller to the suction of the primary pump. A relief valve in this line is controlled by a pressure differential controller which maintains a constant differential across the chilled water pumps. As the differential tends to increase due to throttling of the unit control valves, the relief valve opens. As the pressure differential tends to drop, the relief valve closes.

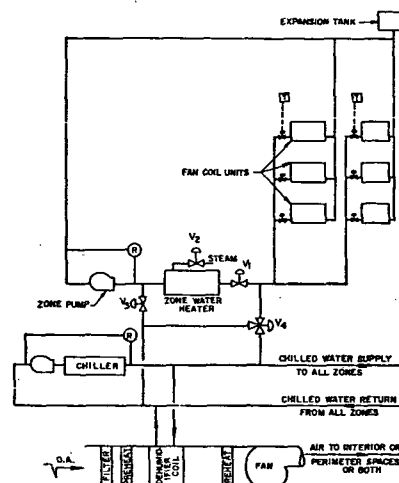


Fig. 41 Single-Supply Multi-Zone System with Separate Ventilation

Primary Water Pumps. The primary chilled water pump recirculates water between the chiller and any or all of the following equipment: ventilation air dehumidifiers (if used), the fan-coil units (single zone system), the zone circuits (multiple zone system), and the primary-to-secondary water heat exchanger (if used). The pumping head is composed of the friction loss through this equipment plus the friction loss in piping, fittings, and control valves.

Since the water chiller requires a constant flow of water under all load conditions, the primary pump is selected to deliver a substantially constant flow against a constant primary water-circuit pumping head. When the system requires less than maximum flow and the pumping head tends to increase, the relief valve opens to bypass the excess water to the pump suction.

Water Heaters. The water heating apparatus may be steam-to-water converters, boilers, or heat pumps. It may be centrally located to serve all spaces with a single zone system, but where multiple zones are used a separate water heater is generally installed in each zone.

In order to secure smooth control of warm water temperatures when using converters, the general practice is to use two steam valves piped in parallel, one sized for approximately $\frac{1}{4}$ and the other $\frac{3}{4}$ of the full steam requirement. By controlling the valves in sequence, closer control is possible than that obtained with one large valve, particularly at light loads.

For buildings having relatively low internal loads, such as hotels, apartments and hospitals, it is desirable to provide dual hot water converters to afford standby protection. Each converter may be selected for 50 to 60 percent of the total heating load. The two converters should be piped for parallel water flow as well as parallel steam flow from a common set of steam control valves.

Zone Water Pumps. When two-pipe fan-coil systems are

applied with multiple zones so that units on one zone can receive hot water while units on another zone receive chilled water, each zone requires its own pumps as shown in Figs. 40 and 41. With 3-pipe and 4-pipe fan-coil systems, zone water pumps are not required, as explained later.

These pumps should be selected to pump the required zone chilled water flow rate at the calculated zone pumping head. This water flow rate will generally equal the summation of the individual fan-coil unit water flow rates.

Ventilation Air Dehumidifiers. Where a separate ventilation air system is employed to serve the perimeter space, dehumidifier stations must be provided. The designer should determine whether one station should serve the entire building or whether smaller multiple stations each serving several floors are more practical. These stations will generally contain the outdoor air dampers, preheat coil, filters, dehumidifier coils, reheat coils and fan.

Auxiliary Heat Exchangers. Where it is practicable to obtain free cooling from the cooling tower, water-to-water heat exchangers may be employed to supply chilled water. If waste or condenser heat are to be used to supply all or part of the hot water requirement, water-to-steam or water-to-water heat exchangers may also be used.

Service Valves. It is common practice to locate service valves so that major system components may be isolated from the water system for service, thereby eliminating the need for draining the entire system. Control valves, controls, and water piping will be discussed in a later section.

VENTILATION-AIR SYSTEMS

The choice of ventilation-air systems is influenced both by codes and all building factors previously discussed and listed in Table 9. How the designer treats ventilation air has a direct effect on:

1. Owning cost of system.
2. Maintenance cost of system.
3. The building space required by the air-conditioning system.
4. The acceptability of the system to the tenants and owner.
5. The architectural appearance of the building's exterior.

There are four ventilation-air systems frequently employed with fan-coil unit systems. Table 10 evaluates the four systems with respect to the preceding 5 factors.

Generally, it is desirable to pressurize the building slightly by introducing slightly more ventilation air than is exhausted through toilet exhausts, central exhaust systems, etc. This assures that any air leakage will be from the inside of the building to the outdoors instead of the reverse. If the perimeter spaces are maintained at a slightly higher pressure than the corridors, there is less likelihood that odors and airborne bacteria will be transmitted from one occupied space to another. This consideration is especially important in the case of patient rooms in hospitals.

Systems 1 and 2 of Table 10 provide partial ventilation without pressurization of the building. Systems 3 and 4 provide ventilation with pressurization, but are higher in cost.

Ventilation by Infiltration and Exhaust

Here, the fan-coil conditioner is used to recirculate only room air (Fig. 42). Bathroom or toilet exhaust promotes some ventilation by drawing outdoor air into the space through cracks such as those around windows and doors. As would be expected, the results would not be good during periods of high occupancy or heavy smoking.

Infiltration and exhaust as a source of ventilation air might be considered where existing buildings are being air conditioned and codes permit. If positive ventilation was not re-

Table 10 Relative Evaluation of Fan-Coil Ventilation Air Systems

Ventilation Air System	Lowest Installed Cost	Lowest Maintenance Cost	Least Required Space	Best Ventilation	Best Exterior Appearance
1. Infiltration and Exhaust	1	1	1	4	1
2. Wall Apertures	2	2	1	3	3
3. Interior Space System	3	3	2	2	1
4. Separate Perimeter Duct System	4	4	3	1	2

quired before the building was air conditioned and only heating was available, then it may not be essential or economical to also provide a ventilation system that assures positive ventilation when mechanical cooling is added. This approach might be considered in the case of motels where the rooms are occupied for relatively short periods and are easily aired out by the maids when they are making up the rooms.

The use of wall apertures would provide only slightly better results at an increase in first cost and would incur an architectural problem of installing them so that they would not clash with a building facade of an earlier period.

Ventilation with Wall Apertures

The use of wall apertures (Fig. 43) may be considered wherever vertical models are to be installed along the exterior wall. The fans of the fan-coil conditioner draw ventilation air through the building wall from the outdoors. The through-the-wall assembly (Fig. 44) should be constructed to incorporate the following features:

1. A decorative grille face to blend architecturally with the exterior of the building.

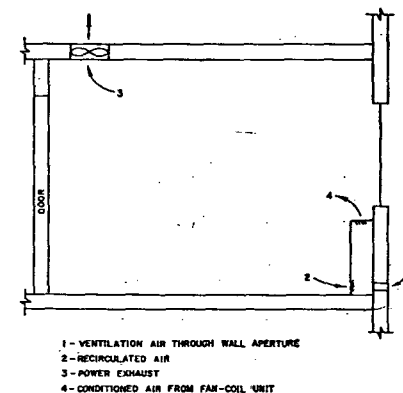


Fig. 42 Ventilation by Infiltration and Exhaust