

Fig. 37 .... Typical Psychrometric Process for Recirculated Air System

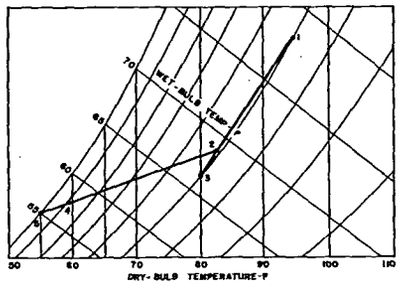

Fig. 38 .... Typical Psychrometric Process for System with Wall Apertures

in pipes, as opposed to air in ducts, considerable space savings can be realized throughout the building.

Maintenance requirements of the central station equipment is generally the same as for any other type of central station perimeter system. Maintenance within the conditioned space is considerably less than where self-contained through-the-wall units are employed.

It may become impossible in future years to replace worn out through-the-wall self-contained units with a duplicate unit which exactly fits an existing through-the-wall sleeve. This, however, is not a problem with the room fan-coil conditioner because of its long life, and because it is installed entirely within the conditioned space. It is not generally necessary to duplicate the unit exactly. It is frequently possible to replace fan-coil conditioners with units of another make if necessary.

In the speculative building the fan-coil conditioner is not so readily adaptable to plans for later addition of air conditioning, as are the through-the-wall self-contained units.

FAN-COIL CONDITIONER TYPES

Room fan-coil conditioners are generally available in nominal sizes of 200, 300, 400, and 600 cfm. Several manufacturers also offer 800 and 1200 cfm models. These air quantities represent the approximate total air per minute delivered at the discharge of the unit, usually at dry-coil conditions.

In the case of *vertical models* which are generally installed along an outside wall, three types which will be designated (a), (b) and (c) for discussion purpose, are available: (a) models having no provisions for introducing ventilation air, (b) models having a damper capable of introducing up to 25 percent outdoor air through a wall aperture, and (c) models having a damper to permit introduction of 100 percent outdoor air through a wall aperture.

Type (a) models can be applied to recirculate 100 percent of the air within the space with no provision within the space for positive ventilation. Applied in this manner these models should be sized to handle the maximum design sensible and latent cooling loads of the space (Fig. 37).

Type (a) models can also be applied where ventilation air is introduced to the space from the duct system serving the interior spaces. Here credit may be taken for the cooling effect of the ventilation air, and, therefore, the Type (a) model may be sized for the *net* sensible and latent cooling loads.

Type (a) models can also be applied in spaces where a separate duct system is used to supply ventilation air. In this instance, the ventilation air is filtered and dehumidified centrally. This dehumidified ventilation air is generally supplied in sufficient quantities to handle the entire latent load of the space. Thus the Type (a) models may be sized to handle the remaining *net sensible* cooling load.

Type (b) models must be sized to handle the total sensible and latent cooling load of the mixture of recirculated air and 25 percent outdoor air at maximum design conditions (Fig. 38).

It is uncommon to apply Type (c) models with the intention of providing 100 percent outdoor air during summer and winter months. The 100 percent outdoor air feature is of most value when free cooling can be obtained without danger of freezing the unit coil by bringing in all outdoor air. In sizing and applying Type (c) models, it is recommended that the designer follow the manufacturer's recommendations concerning sizing and application.

Horizontal models for ceiling applications are constructed similar to the Type (a) vertical models. As with the Type (a) vertical model, they may be applied without provisions for positive ventilation; with ventilation air from the duct system serving the interior spaces; or with a separate ventilation air duct system. Thus the horizontal models should be sized in the same manner described for the Type (a) vertical models for each of these three applications.

Fan-coil conditioners are commonly supplied with three fan speeds (high, medium, and low). It has been the practice to size them for nominal cooling duty at the medium speed setting. Advocates of this practice feel that this conservative method assures them of quiet operation within the space and provides the added safety factor that capacity can be increased by operating the units at high fan speed. As sound level standards and room fan-coil conditioner standards are adopted, the need for this practice should be eliminated.

Since a much greater water temperature difference is possible when the fan-coil conditioners are supplied with hot water for heating than is possible when chilled water is supplied during the cooling season, a unit selected for cooling duty will almost always have more than enough capacity for heating. Thus it is common practice to schedule hot water at the temperature levels capable of heating the space with the unit fans operating at the low speed setting during the heating season.

The exception to this practice might occur when either a heat pump system or waste heat, used as a hot water source, is capable of supplying hot water at only lower temperature levels, thereby requiring the operation of the fan-coil conditioner fan at medium or high speed in mid-winter.

FAN-COIL CONDITIONER APPLICATION

Room fan-coil conditioners also are classified into three model types (Fig. 39).

1. Vertical models—floor supported
2. Vertical models—off-the-floor (or wall supported)
3. Horizontal models—ceiling mounted

All three types are generally available for both decorative enclosure and furred-in applications.

The *horizontal models* may be desirable because they do not occupy any floor space. For this reason, marine systems generally require horizontal models. Unfortunately, it will be seen, other factors of the building often preclude their use.

For new *construction buildings* any of the three model types are suitable. In northern climates where heat is needed along the exterior wall, the vertical models are generally applied under (or adjacent to) a window. It is desirable to blanket the window area with the warm air discharge from the fan-coil conditioner. To accomplish this, manufacturers offer several different types of fixed vane and adjustable vane discharge grilles. In southern climates where heat is not needed along the exterior wall, the *horizontal models* are frequently used.

Existing buildings undergoing modernization with the addition of air conditioning frequently utilize the horizontal models both in the southern climates and in the northern climates where existing under-the-window radiation will continue to supply heating with the fan-coil conditioners used only when cooling is required. This approach results in a relatively low first cost since the horizontal models can be ceiling mounted within the space along the interior wall, or they can even be ceiling mounted in the corridor to discharge through the interior wall into the conditioned space. In either case, the supply and return water pipes, as well as the condensate lines serving the units, can be furred above a false corridor ceiling.

In northern climates where the existing heating system in a building is to be replaced and the fan-coil conditioners are to be used for both heating and cooling duty, vertical models can be installed where the radiators are removed. The off-the-floor vertical model is frequently used in these instances since its use eliminates the expense of cutting carpets and baseboard and rerouting electrical and telephone wiring. Existing water or steam lines are frequently utilized as part of the condensate system if their condition is judged satisfactory.

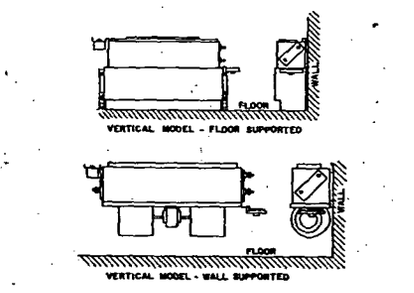

Fig. 39 .... Typical Fan-Coil Conditioners

The layout of the building often influences the type of ventilation air system that will be used. Thus it indirectly influences the choice of model. Where a building consists entirely of perimeter spaces, ventilation air is most readily obtained with a through-the-wall aperture. Thus vertical models are frequently used. Where it is possible to secure ventilation air from the duct system serving interior spaces, either vertical or horizontal models are applicable. If vertical models are used, the ventilation air enters the space through a side wall or ceiling outlet. If horizontal models are used, the ventilation air is generally ducted to the fan plenum of the horizontal model.

While economics has a considerable bearing on the overall system variations, it does not have a direct bearing on the model of fan-coil conditioner, since first cost and operating cost of the three models are about equal. Generally, the horizontal models with corridor supply lend themselves to a lower first cost system. Because they are installed above a false ceiling, maintenance costs will generally be higher than for vertical models.

Geographic location of the building has a strong bearing on whether or not vertical models must be installed along an exterior wall. It should be realized, at the same time, that the installation of vertical models is not restricted to exterior walls, particularly in southern climates. In many installations the vertical model is placed along sidewalls and even interior walls.

LOAD CALCULATIONS

Total cooling load determines the installed refrigeration capacity that will be required. It is generally less than the sum of the individual module loads since peak design loads do not occur in all modules simultaneously. The maximum solar heat gain values used to select the fan-coil units occur on each exposure at different times of day; sometimes at different time of year. In northern latitudes, for instance, the maximum design solar load on the south exposure occurs during the fall and winter months when the sun is lower on the horizon. Intermittent shading of sunlit exposures due to adjacent buildings and setbacks in high rise building also influences zone loads.

The total heating load determines the installed heating capacity. Since maximum heating capacity calculations are based on the absence of solar load, the total heating load will generally equal the summation of the individual module heating loads.

While total load calculations must be made properly to be the basis for selection of the central station heating and cooling equipment, it is also necessary to determine how these loads will vary over the full range of outdoor ambient temperature because these data will be required to check the equipment performance at part load conditions. This load information is also valuable in determining supply water temperature schedules to the room fan-coil conditioners, as well as for determining where *free cooling or the use of waste heat* principles can be applied.

While this section is primarily concerned with calculating total heating and cooling loads of perimeter spaces served by the room fan-coil conditioners, it is important that for those buildings which have interior spaces, the cooling requirement of the interior spaces be added to the total perimeter load.