and the connections simple. In this instance, when the by-pass damper is at maximum opening it may be much easier for outside air to pass through the return damper, into the return duct connection and through the by-pass than for return air to pass through the by-pass connection into the fan. Air always takes the easiest path and if the dehumidifier resistance is high, and the return duct resistances low, this situation is apt to occur unless precautions are taken. A return fan instead of a back-draft damper may be required for this case if the failure of return air to reach the dehumidifier or conditioner is a serious matter under reduced load conditions.

The location and arrangement of the dehumidifier, humidifier, or conditioner with reference to each apparatus assembly are more or less standardized. In general, the outside air intake, preheaters, and return air connections precede the conditioner while the by-pass, reheaters and fan follow the dehumidifier. In the cases of the *blow through* system, where the fan is located ahead of the conditioner, the leakage of air at the conditioner is outward instead of inward and may be accompanied by water leakage unless the proper precautions are taken.

The location of the complete apparatus assembly including the dehumidifier will be dependent on the type of building, spaces available, structural characteristics, etc. The type of conditioner used may limit the location under certain conditions. Where cooling coils employing chilled water or brine as the cooling agent are used there are few restrictions with regard to location other than those of pumping power, working pressures, line costs, etc. Where open spray dehumidifiers are used very definite limitations present themselves, and these may require certain extraneous equipment to make the system workable. If several spray type dehumidifiers are located on different levels, a surge or storage tank to which the return water from each dehumidifier can be taken is required Should the water level in the pan of the dehumidifiers be low in relation to that of the surge tank, return water pumps will be required, and these pumps will have to be operated until the water supply lines are drained in order to prevent flooding of the lower dehumidifiers. Where spray dehumidifiers are on the same level, equalizing lines between the pans may be required if a storage tank is not provided.

All of the various pieces of equipment from the outdoor air intake through the fan usually are connected together by sheet metal casings. Frequently the building structure or specially constructed walls or partitions may be used to form all or a portion of the casing. In any case the casing or connection must be sufficiently sturdy for the required duty. Sheet metal work must be well braced not only to prevent bellying or vibration under pulsations in air flow but to withstand the abuse of normal usage. Casings should be adequately braced wherever access doors are installed and all large panels should be adequately reinforced by angle iron.

Each apparatus layout is to be made with accessibility in mind. Where cooling coils are used space for removing and repairing or replacing the coils should be provided. Adequate space is to be provided for the servicing and replacement of eliminators. Filters must be so located that the proper cleaning, replacement or routine servicing can be accomplished without difficulty. Free access to the bearings of all moving machinery is a necessity. Provisions should be made for the complete removal and replacement of any part of the system that is subject to wear, deterioration or damage, whether it may be filter, fan wheel, motor, rotor, pump impeller or heat transfer surface.

DESIGN PROCEDURE

The customary design procedure is outlined herewith. For simplification the procedure is set up on the basis of a year 'round system. For summer only or winter only systems, the unrelated parts are to be omitted.

1. Selection of design conditions (inside and outside).
   - *a.* Summer.
   - *b.* Winter.
2. Determination of outside air requirements.
3. Determination of cooling load.
   - *a.* Room sensible heat gain.
   - *b.* Room latent heat gain.
   - *c.* Room total heat gain.
   - *d.* Grand total heat gain.
4. Determination of heating load.
   - *a.* Room sensible heat loss.
   - *b.* Room moisture loss.
   - *c.* Humidification requirement.
   - *d.* Total heating requirement.
5. Determination of apparatus dew-point and dehumidified or humidified air quantity.
   - *a.* Summer (full load and part load).
   - *b.* Winter.
6. Supply air temperature difference and quantity.
   - *a.* Summer.
   - *b.* Winter.
7. Equipment selection.
8. Equipment layout.

The foregoing steps are merely typical. Many applications will require at least a preliminary investigation of some of the latter steps before proceeding with the earlier steps.