Chapter Three

Conditioning Processes

Space Air Conditioning-Design Conditions

- Bypass Factor: It is the ration of the air that has passed the coil, cooled and saturated to the ratio of the air that passed unchanged represented by temperature difference between two points and the dew point

$b = t_2 - t_d / t_1 - t_d$ (3-48)

$1-b = t_1 - t_2 / t_1 - t_d$ (3-49)

So the heat transfer rate become: $q = m_a c_p (t_1 - t_d)(1-b)$

- The bypass factor is not used extensively, but sometimes it is found in the manufacturer catalogue, where it is determined from experiments and calculations.

Space Air Conditioning-Design Conditions

- In actual system fans are required to move the air, and some energy may be gained from this.
- All the power input to the fan is justified as sensible heat input to the air.
- When the process is cooling the requirements have to change, so that the capacity of the coil must be greater to offset the fan power input and duct heat gain.

Evaporative Cooling System

- Some climates are hot and dry during the summer so to meet the required comfort humidity wise, so it would be necessary to cool the air and humidifying it.
- This can be don by simple arrangement, where the outdoor air flows through an adiabatic spray and is cooled and humidified.
- The adiabatic cooling and humidification process yields constant enthalpy line before the spray chamber and after it
- The cooling process terminates at the space condition line, where the air is then exhausted. This requires large quantities of air .
- This kind of system is not satisfactory when the outdoor relative humidity is high

- Evaporative cooling can be combined with a conventional system when the outdoor conditions are suitable. There are number of possibilities:

1. If the outdoor air is just mixed with return air without evaporative cooling.
2. The outdoor air could ideally be evaporatively cooled all the way, with least power for sensible cooling, and the air supplied to the space would be 100% outdoor air.

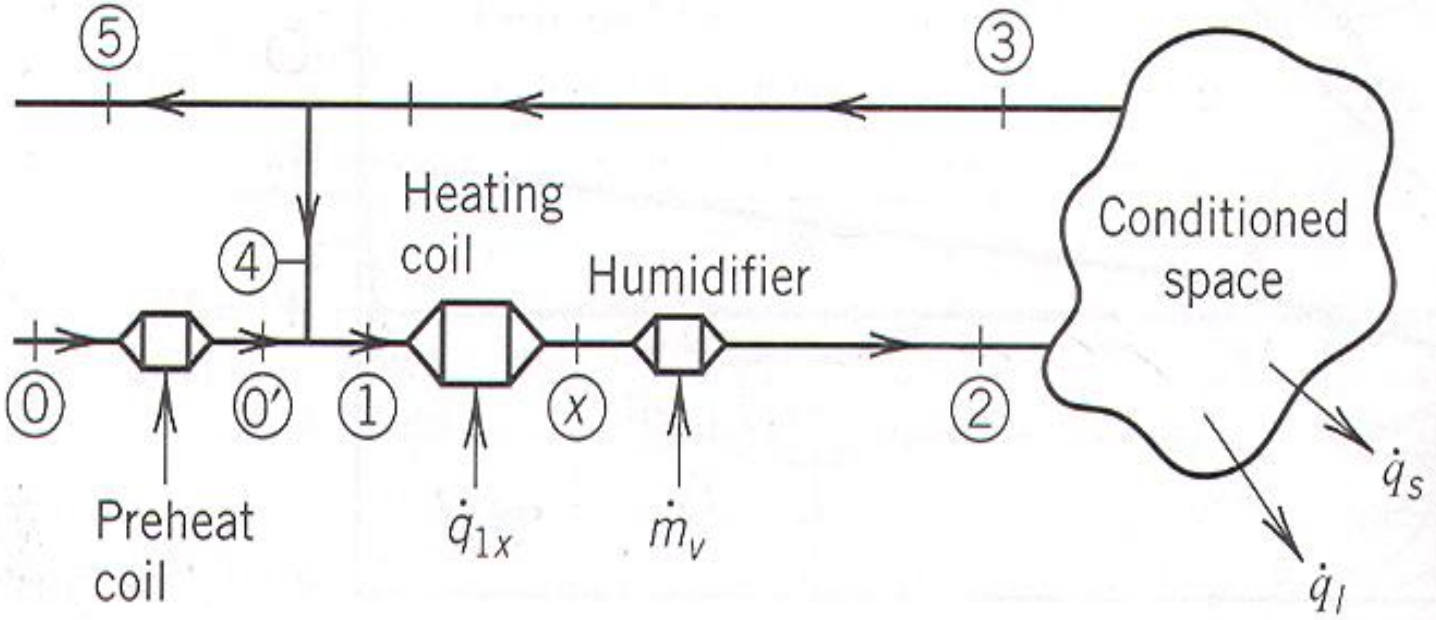

Figure 3-21 Heating system with preheat of outdoor air.

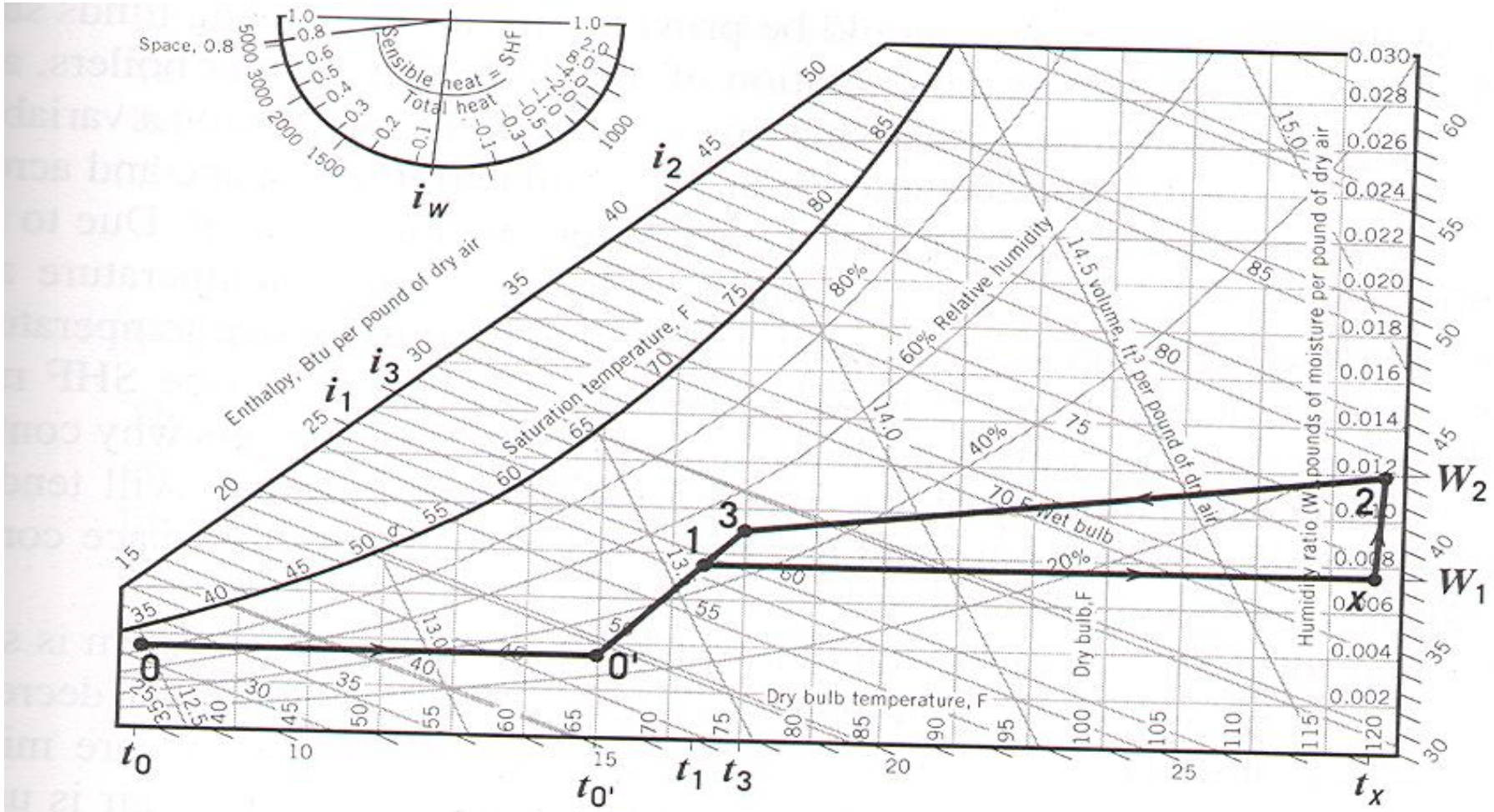

Figure 3-22 Psychrometric diagram for Fig. 3-21.

Space Air Conditioning-Off-Design Conditions

- Most of the space requires only part of the designed capacity of the conditioning equipment most of the time. This needs a control system to match the required heating and cooling loads.
- These systems should accommodate off-design partial load conditions, as well as nonstandard conditions such as very high latent loads (low SHF).
- The control system mainly depends at controlling the flow of air and the heating and cooling fluids through the coils.
- The fluid flow rates and entering fluid temperatures are the key factors in the control process.
- The entering air temperature is a function of the load conditions and can not be changed, also the other fluid temperature cannot be varied quick enough to match the rapid change in the system.
- Changing either or both of the fluid flow rates changes the mean temperature difference between the fluids, which is the most practical way of to control the coil.
- For example decreasing the chilled water flow rate in a coil will tend to increase its leaving temperature, as well as reducing the flow rate of the air will tend to lower its leaving temperature.
- Two way throttling valve s are used to maintain a fixed leaving temperature

- Flow of air over the coil may be varied by terminal units in the space or by coil bypass based on air temperature in the space.
- Controlling the coolant flow rate is necessary for the chillers, boilers and associated piping systems. It is also important not to reach high humidity and SHF.
- The behaviour of the coil in a constant-air-volume face and bypass system is similar to the variable air volume system (VAV) because the coil leaving air temperature and humidity decrease with decreased air flow.
- As the space load decrease and more bypass air is used, the space humidity will get higher even the design temperature in the space is maintained, this means that the SHF of the space may increase or decrease, which is a disadvantage of a multi-zone face and bypass system, which is corrected by controlling the coolant flow rate.
- Water control is mainly used in conjunction with the VAV system in commercial applications