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 قسم الهندسة الحرارية و تقنية تحلية المياه
 نظم التكييف

Air Conditioning Systems

MEP 451

8/10/2008

Air Conditioning Systems

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Outline

- 1-Purpose of AC system
- 2-Some Definitions
- 3-Main Types of AC system
- 4-All -Air systems
- 5-Air-Water systems
- 6-All-Water systems
- 7-Unitary systems
- 8-Constrains on AC system selection

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1- The Purpose of AC system

- *The objective of an AC system is to provide correct:*
 - Temperature
 - R.H.
 - Air Movement
 - Air Cleanliness (Air Quality)
 - Ventilation Requirement
 - Acoustical level

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2- Some Definitions

- Zone
- Air Handler
- Blow through fan system
- Draw through fan system
- Basic ON-OFF Control (see Ch. 1)

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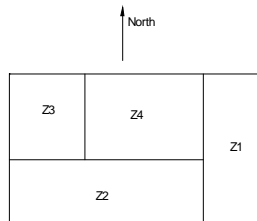
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2- Some Definitions

Zone

Zone: a space where T is to be controlled. It can be more than one room



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2- Some Definitions

Air Handler

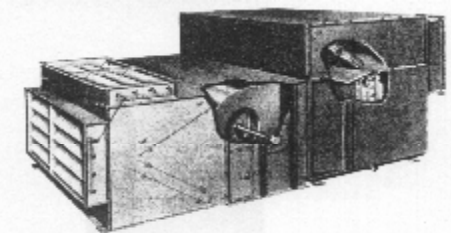


Figure 2-4 A unitized, blow-through air handler showing the coils, fan, filters, and mixing box. (Reproduced by permission of the Trane Company, Milwaukee, WI)

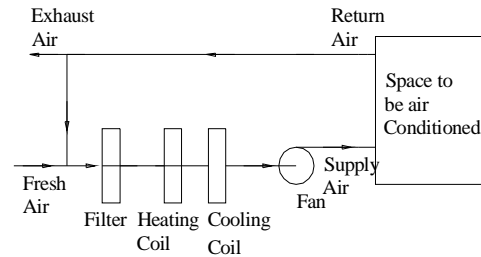
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2- Some Definitions

• Blow through and Draw through



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3- Main types of AC systems:

- 1-All-Air systems
- 2-Air-Water systems
- 3-All-Water systems
- 4-Unitary systems

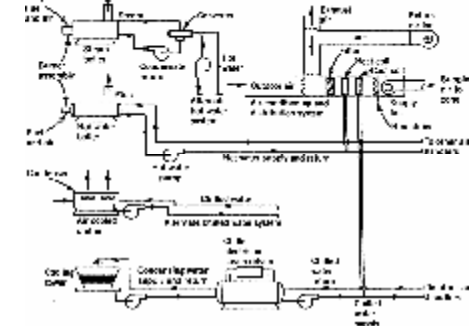
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3- Main Types of AC System

Central Plant



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4- All-Air Systems

• Main types

- Single duct Single zone (CAV)
- Single duct- Reheat
- Dual duct
- Multi-zone
- Variable air volume (VAV)

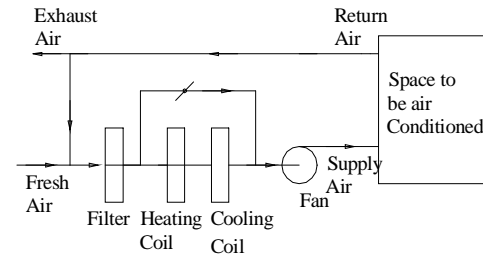
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4-All-Air Systems

• Single duct single zone



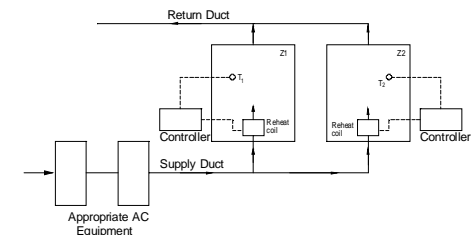
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4-All-Air Systems

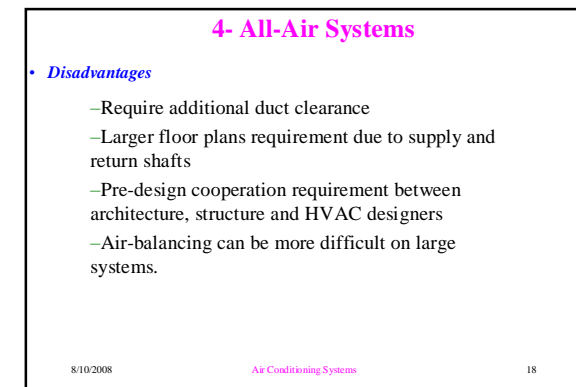
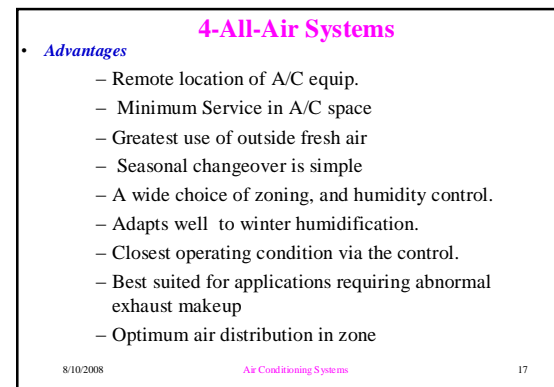
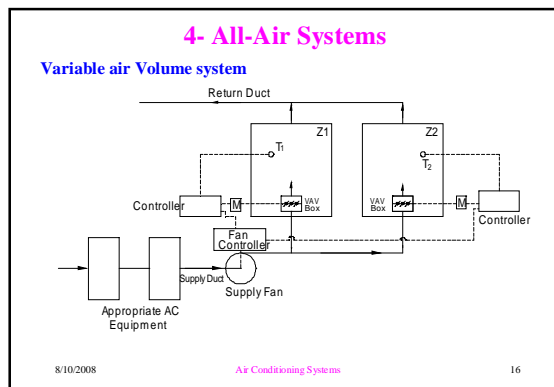
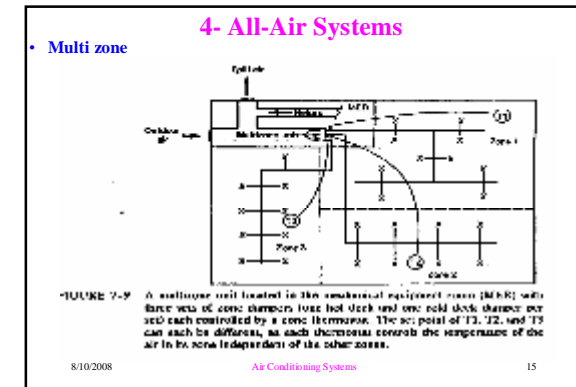
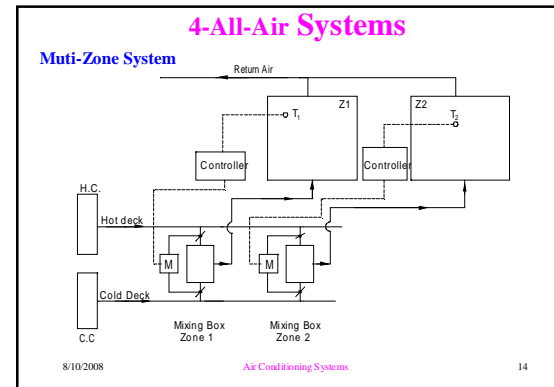
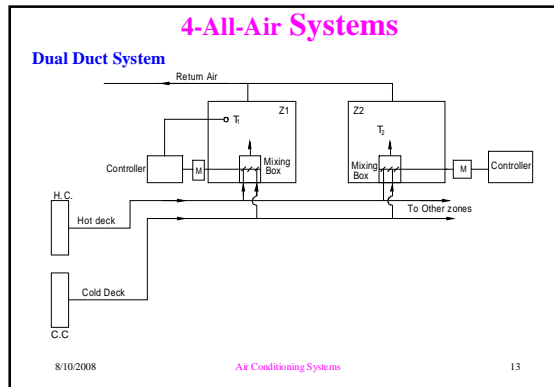
• Single duct reheat



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5- Air-Water Systems

- Air is conditioned in a remote location and provided to zones. Additional conditioning is made using water.
- Both Air and Water are conditioned in a remote area and sent to space

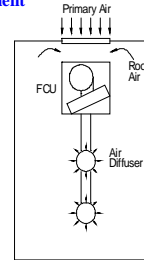
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5- Air-Water Systems

Typical air-water system arrangement



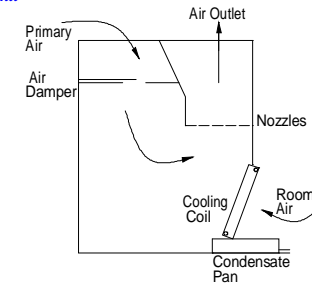
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5- Air-Water Systems

• Induction Unit



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5-Air-Water Systems

• Advantages

- Individual room temperature control
- Separate heat and cool sources in the primary air and secondary water provide more flexibility and control.
- Less space is required for distribution system.
- Smaller size of the central air-handling apparatus.
- Humidity adjustment is performed outside the conditioned space.
- Ventilation air supply is positive and may accommodate recommended quantities
- Space can be heated w/o using the air system.

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5-Air-Water Systems

• Disadvantages

- Changeover complexities with two-pipe system.
- Controls are more numerous than that associated with all-air system.
- The primary air supply is usually ON with constant flow especially in residential buildings.
- The system is not recommended for spaces with high exhaust requirements (Spray shops, Toilets).
- Condensation problems on coil surface.
- Higher initial cost than that of all-air system.

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6- All Water Systems

• Main Types

- Two-pipe
- Three-pipe
- Four-pipe

• Terminal Unit Types

- Fan coil Unit
- Unit Ventilator
- Radiant panel

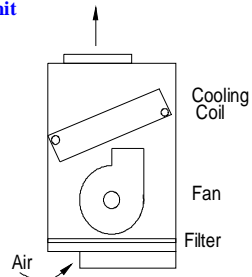
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6- All Water Systems

Fan coil Unit



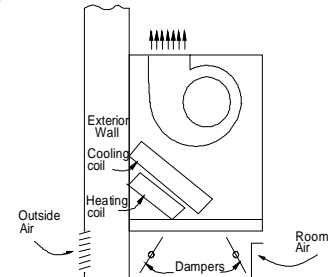
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6- All Water Systems

Unit Ventilator



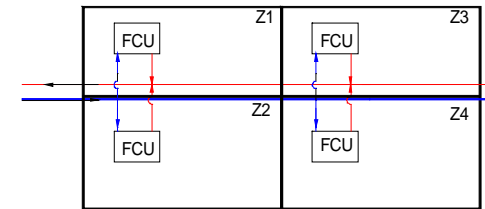
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6- All Water Systems

Two pipe system



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6- All Water Systems

Two Pipe System

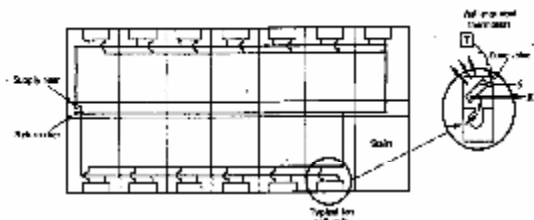


FIGURE 7.12 The two-pipe fan coil system in this plan view of a model is the most economical in operation but is limited in its ability to cope with varying outside temperature. Although in theory the temperature of the water can be changed during the course of the day to provide heating in the morning and possibly cooling in the afternoon, in practice this is rarely not done due to the thermal inertia of the system.

6- All-Water Systems

Three & Four Pipe Systems

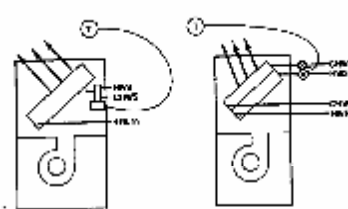
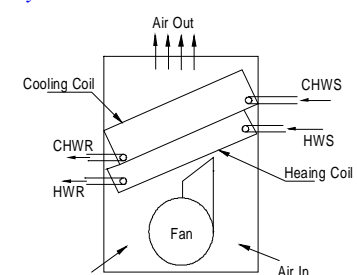


FIGURE 7.17 In the three-pipe fan coil unit shown at the left, either hot or chilled water flows through the coil upon demand of the thermostat. As the right a split coil is used for the four-pipe configuration. The thermostat again determines whether heating or cooling is required. In some designs a single coil is used for both heating and cooling. In such cases two three-way valves are used, one on the supply and one on the return to direct the water in the appropriate manner.

6- All-Water Systems

Four Pipe System



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6- All Water Systems

• Advantages

- Less building space requirement
- Ability to shut off local terminals in unused areas
- Easier to install in existing building retrofit than an All-Air system
- Odor difficult to diffuse into other zones

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6- All Water Systems

• Disadvantages

- Maintenance is required in occupied spaces.
- Drain system requirement in conditioned spaces
- Not a good control on ventilation air.
- Frequent air filter change

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7-Unitary Systems

Assembly of factory matched refrigerant cycle

- **Arrangement:** single or split
- **Heat rejection:** Air cooled, water cooled
- **Placement:** Floor standing, wall mount, etc
- **Location:** Indoor, outdoor
- **Heat:** electric, hot water

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7- Unitary Systems

• Examples

- Packaged Units
- Through the wall air conditioners.
- Roof top system.
- Window & Split unit air conditioner.

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7- Unitary Systems

• Packaged unit

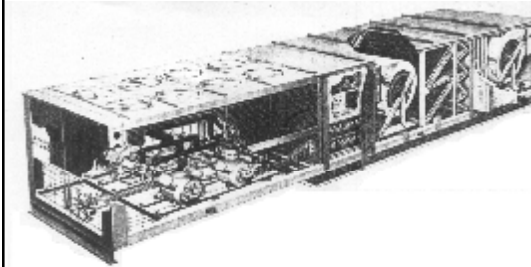


Figure 2-26 A packaged unit air conditioning system. (Courtesy of Carrier Thermaclima Systems, 1999)

7- Unitary Systems

• Roof top unit

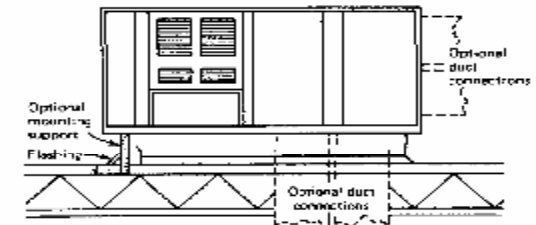


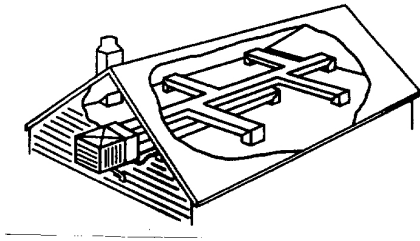
Figure 2-27 Rooftop installation of air-cooled single-package or single-package year-round unit.

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7- Unitary System



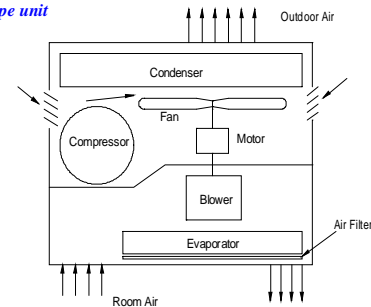
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7- Unitary Systems

• Window type unit



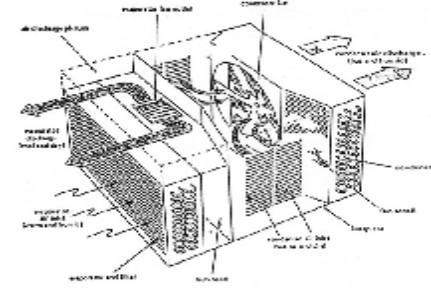
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7- Unitary Systems

• Window type unit



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7- Unitary Systems

• Advantages

- Simple and inexpensive individual room control
- Individual air distribution for each zone
- Heating and cooling capability at all times independent of other spaces
- Individual ventilation air
- Consistent performance assured by manufacturer matched components
- Usually save space
- Usually quick available and installation
- Usually low initial cost
- Equipment serving unoccupied spaces can be turned off

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7-Unitary systems

• Disadvantages

- Limited performance options (fixed size)
- Not generally suited for close humidity control
- Energy use may be greater than for central system
- Low cost outdoor air cooling is not always available
- Air distribution control may be limited
- Operating sound levels can be high
- Ventilation capabilities are limited
- Overall appearance can be unappealing
- Air filtration options are limited

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8- Constrains on AC- System Selection

- Available space
- Zoning requirement
- Degree of control of T&RH
- Ventilation capabilities
- Architectural constrains (size & appearance)
- Space available for duct
- Noise level
- Accessibility of components for maintenance
- Economics (first cost, operation cost, maintenance cost)

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