

# Advanced Building Science

- Air Processing Equipment
  - Air Handlers & Coils
  - Evaporative cooling
  - Dehumidification/humidification
  - Air Cleaners
  - Heat Recovery
- Readings
  - HF Chapter 10 (review)
  - Handout

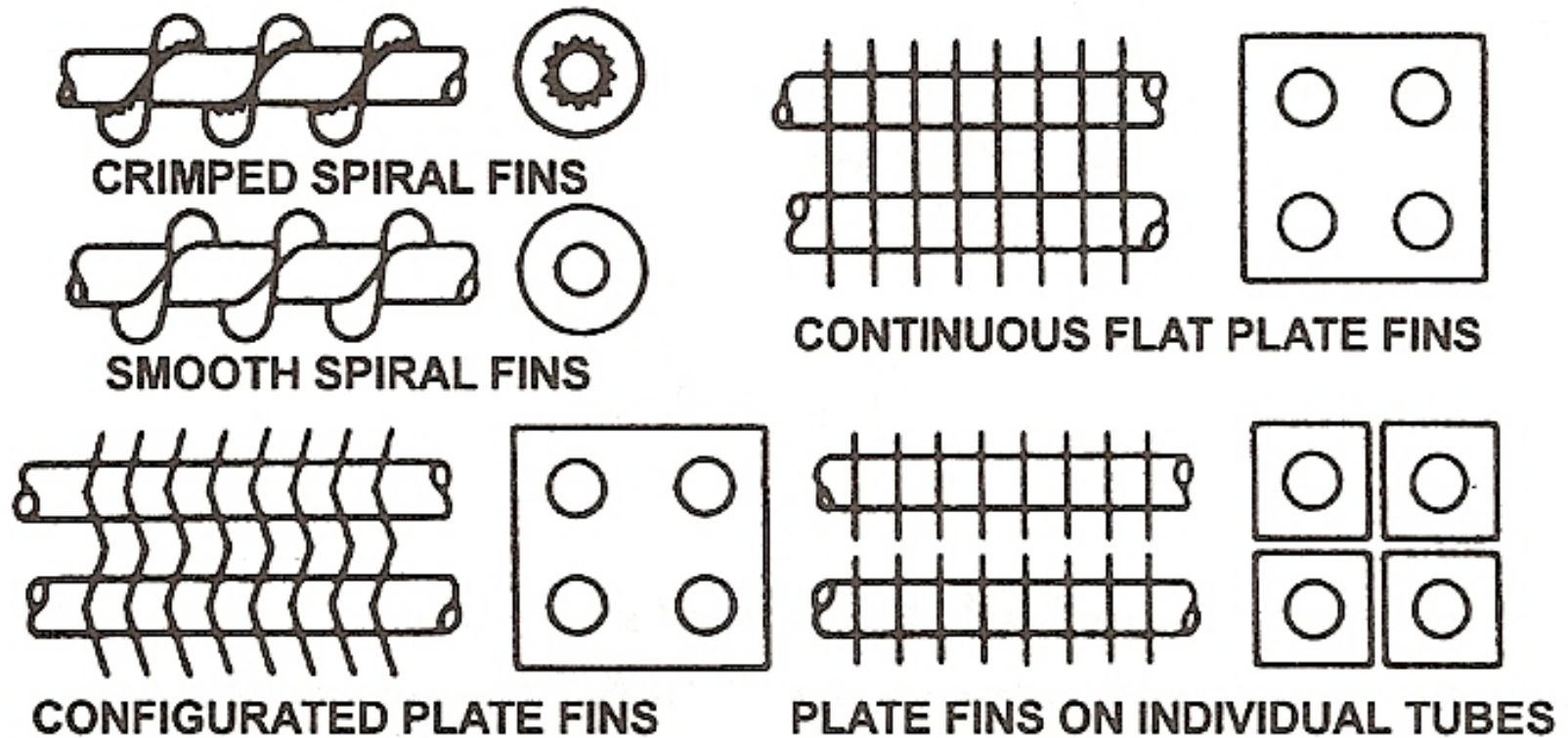
# Air Handlers

- Most residential units will be factory fabricated
- Most times used in multi-zone applications
- Generally will include other elements
  - filters
  - hot water, steam, or electric heating coils
  - chilled water, or evaporator coils
  - mixing boxes and/or dampers

# Cooling Coils

- Primary (tube type); Secondary (fin type)
- Coil types
  - water coils
  - direct expansion (evaporator)
- Coil Selection

# Fin Coils



*Fig. 17-1 Types of Fin-Coil Arrangements*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

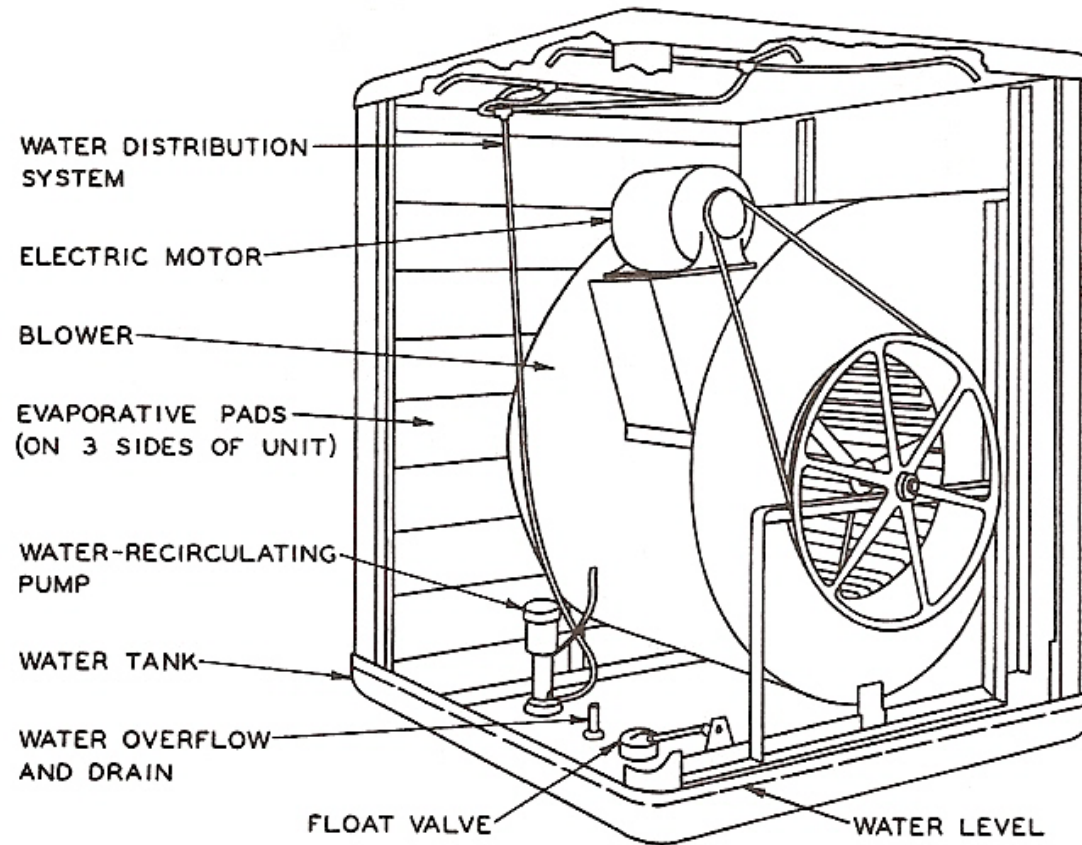
# Heating Coils

- Steam coils => not used much in residential
- Water coils => growing market share in residential
- Electric coils => common as back-up for heat pumps

# Evaporative Cooling

- Exchanging sensible heat for latent heat
- Common in desert Southwest
- Types include
  - wetted pad
  - slinger
  - rotary
  - air washers

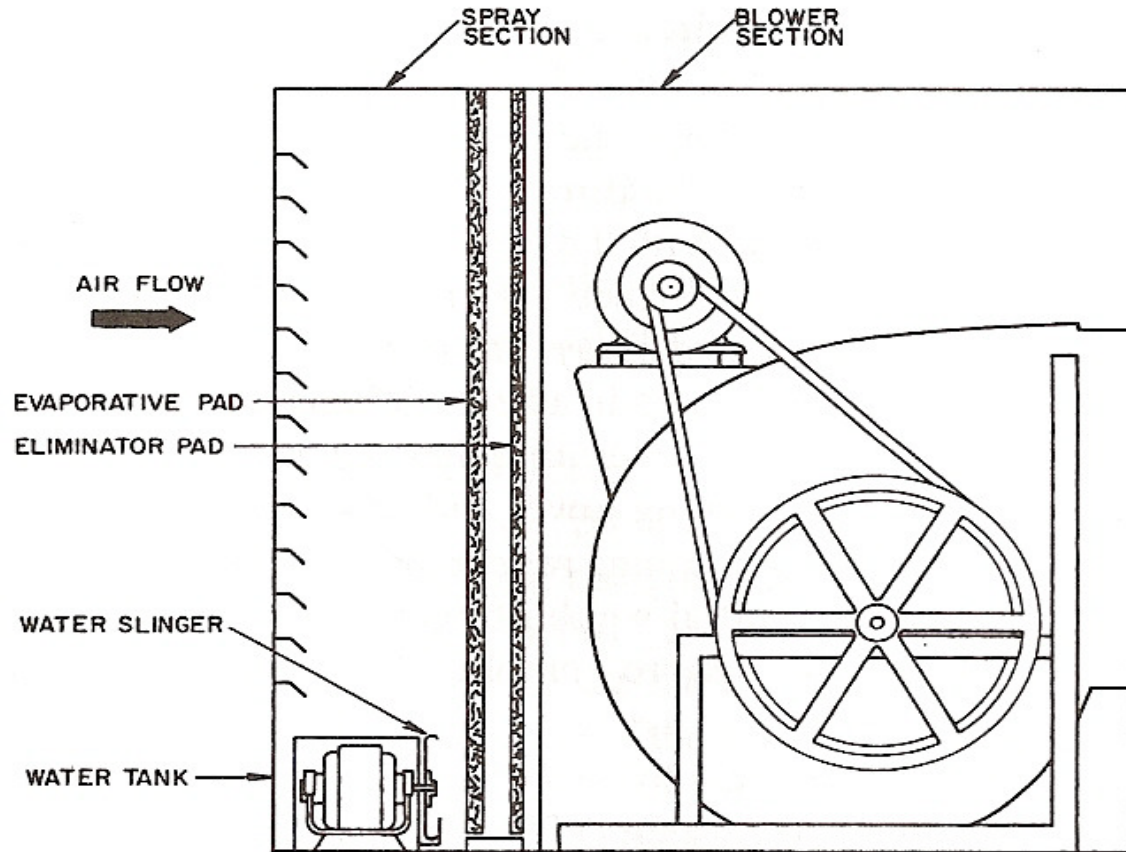
# Evaporative Cooling



*Fig. 17-7 Wetted-Pad Evaporative Cooler*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.3

# Evaporative Cooling

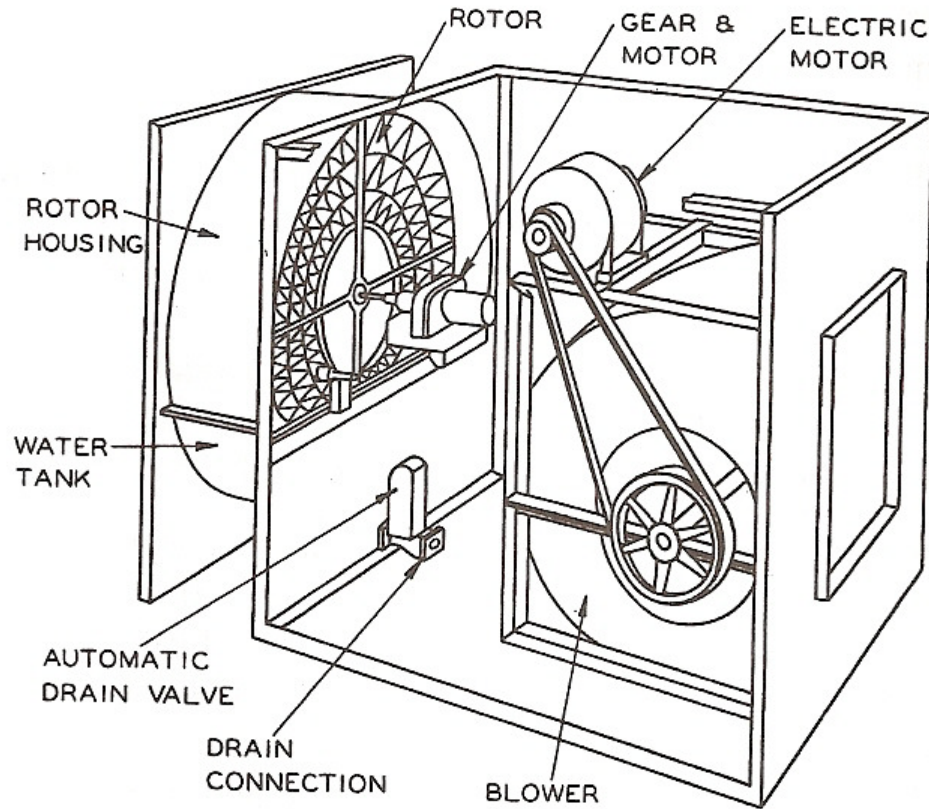


*Fig. 17-8 Slinger Evaporative Cooler*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.3



# Evaporative Cooling



*Fig. 17-9 Rotary Evaporative Cooler*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.3

# Economizers

Introduce unconditioned outside air to provide cooling

- must pay close attention to enthalpy
- capacity is generally inverse to need

# Dehumidification

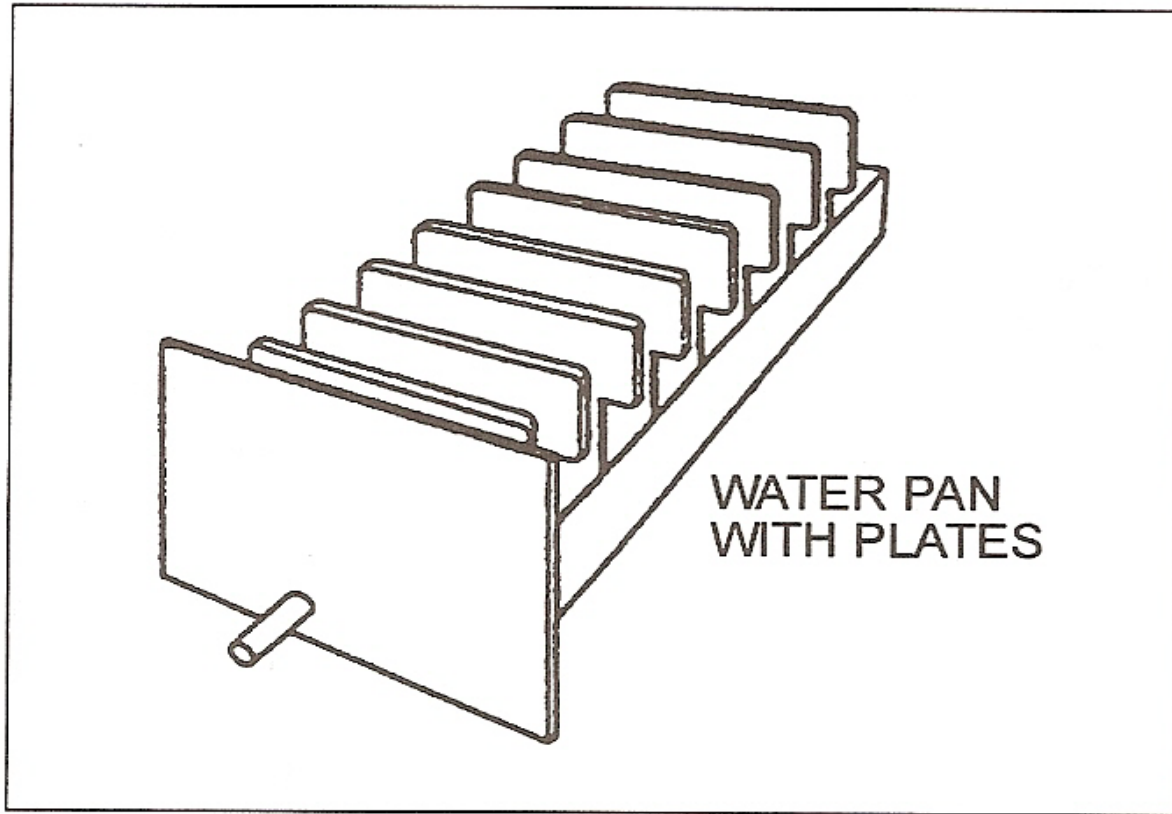
- Compression
- Refrigerant
- Direct sorption
  - liquid => most large commercial
  - solid => desiccant with recharge

# Humidification

Common residential units include

- pan type
- wetted elements
- steam
- atomizing

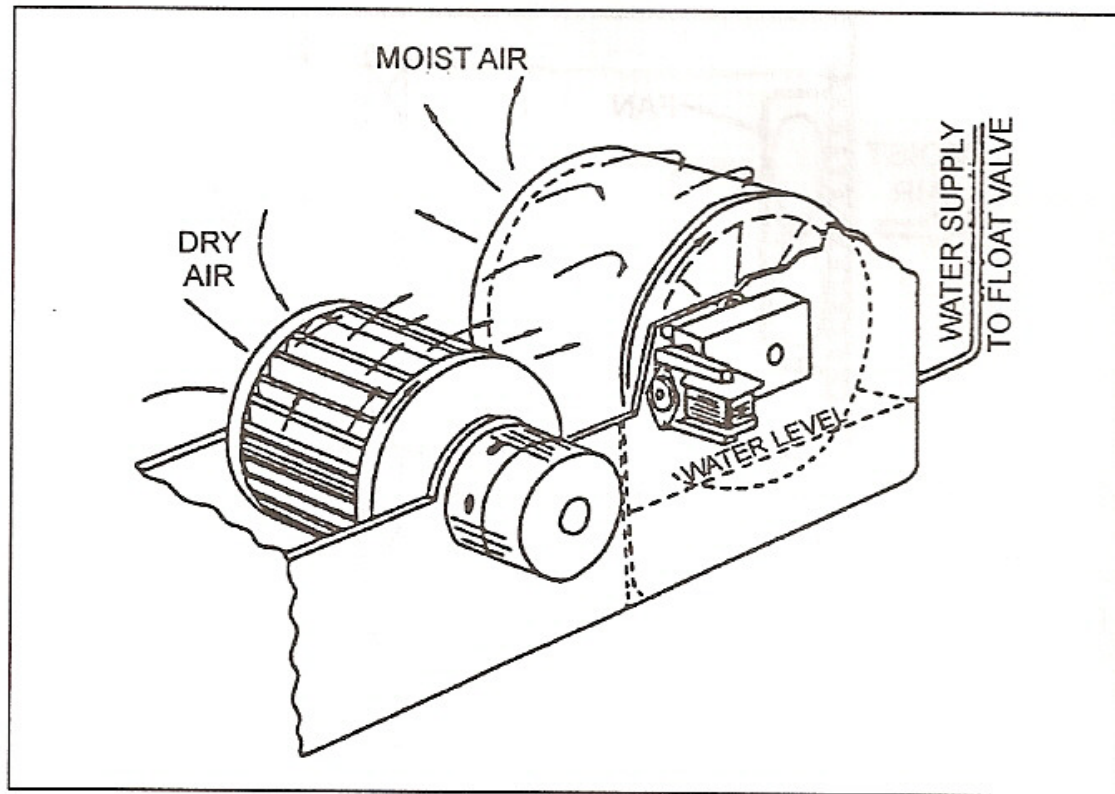
# Humidification



*Fig. 17-15 Pan-Type Humidifier*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.11

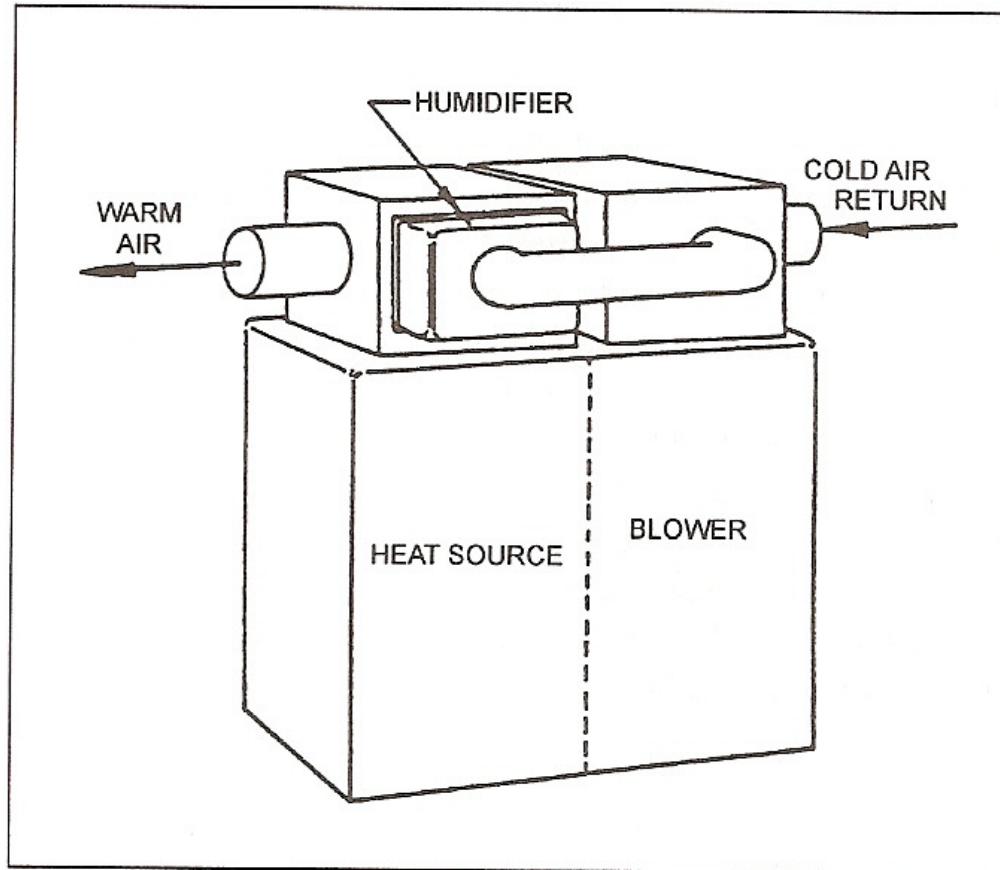
# Humidification



*Fig. 17-16 Wetted-Drum Humidifier*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.11

# Humidification



*Fig. 17-17 Bypass Wetted-Element Humidifier*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.11

# Heat (Energy) Recovery Units

- Performance ratings
  - transfer effectiveness (sensible, latent, or total)
- Basic types
  - fixed plate (many sensible only with some both)
  - rotary (some sensible only but most with both)
  - coil loops (mostly commercial and generally sensible only)
  - heat pipe (sensible only)
- Economics
  - but don't forget tempering advantages
    - comfort, condensation, freeze control



# Heat (Energy) Recovery Units

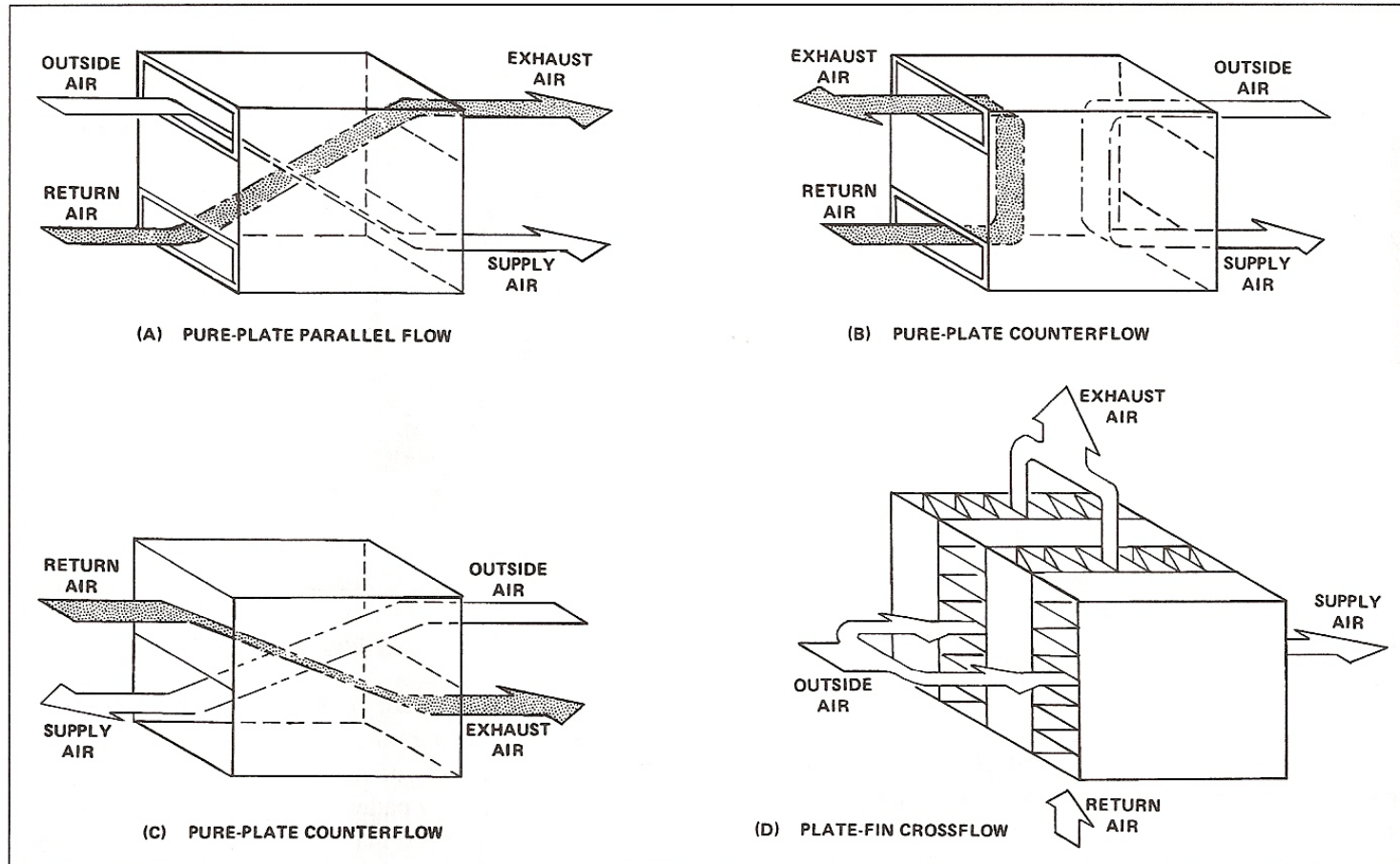
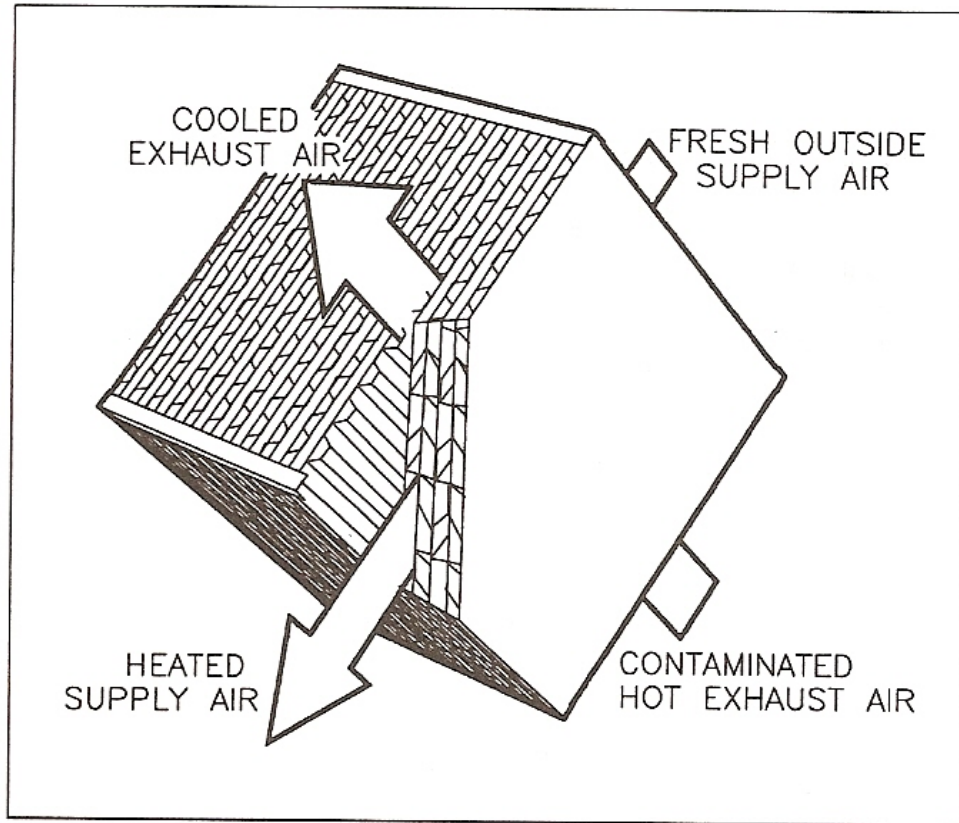


Fig. 17-31 Pure-Plate and Plate-Fin Models

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.22

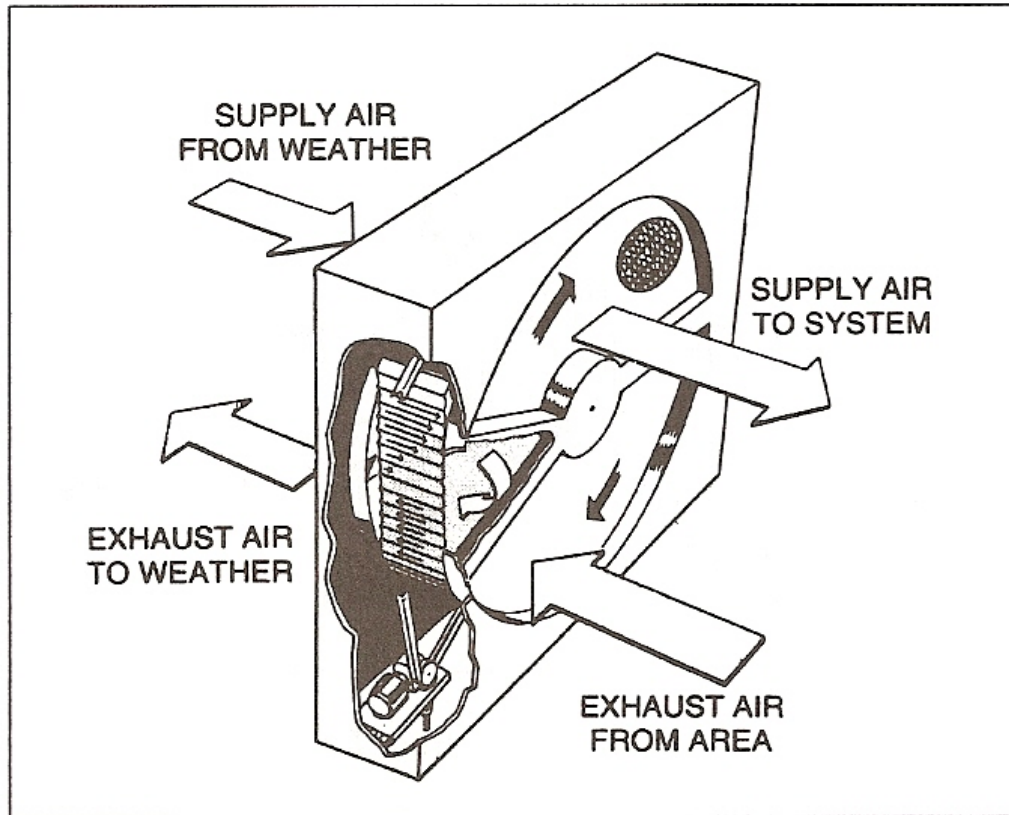
# Heat (Energy) Recovery Units



*Fig. 17-30 Fixed Plate Heat Exchanger*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.21

# Heat (Energy) Recovery Units



*Fig. 17-24 Rotary Energy Exchanger*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.19

# Heat (Energy) Recovery Units

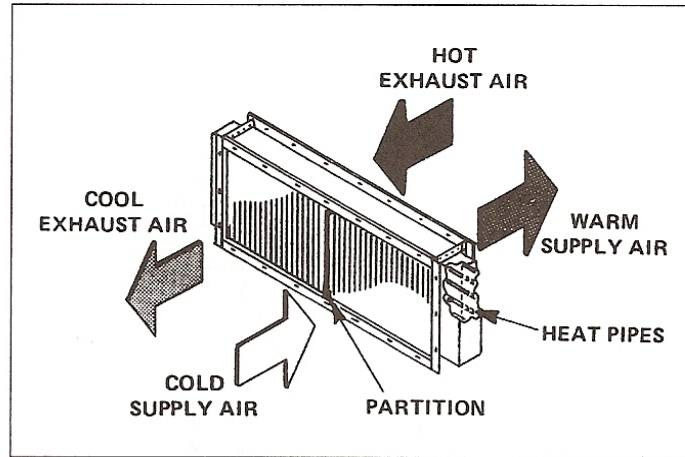


Fig. 17-27 Heat Pipe Heat Exchanger

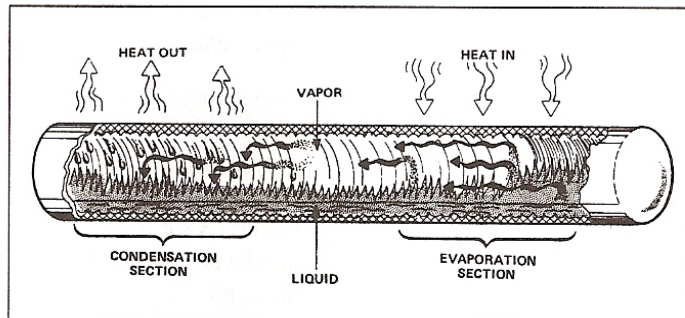


Fig. 17-28 Heat Pipe

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.20

# Heat (Energy) Recovery Units

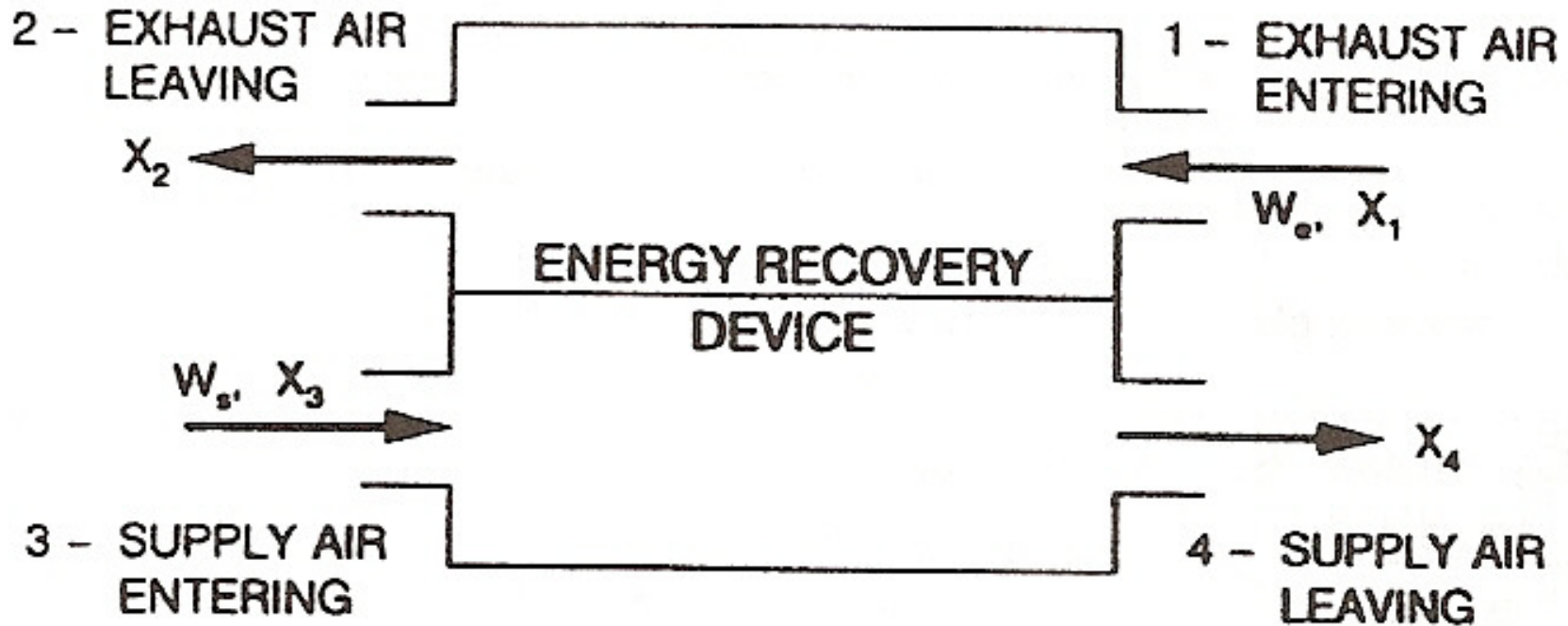
Table 17-2 Comparison of Air-to-Air Energy Recovery Devices

	Fixed Plate	Rotary Wheel	Heat Pipe	Runaround Coil Loop	Thermosiphon	Twin Towers
Airflow arrangements	Counterflow Crossflow Parallel flow	Counterflow Parallel flow	Counterflow Parallel flow	Counterflow Parallel flow	Counterflow Parallel flow	
Equipment size range, cfm	50 and up	50 to 70,000	100 and up	100 and up	100 and up	
Type of heat transfer (typical effectiveness)	Sensible (50 to 80%)	Sensible (50 to 80%) Total (55 to 85%)	Sensible (45 to 65%)	Sensible (55 to 65%)	Sensible (40 to 60%)	Sensible (40 to 60%)
Face velocity, fpm (most common design velocity)	100 to 1000 (200 to 1000)	500 to 1000	400 to 800 (450 to 550)	300 to 600	400 to 800 (450 to 550)	300 to 450
Pressure drop, in. of water (most likely pressure)	0.02 to 1.8 (0.1 to 1.5)	(0.4 to 0.7)	(0.4 to 2.0)	(0.4 to 2.0)	(0.4 to 2.0)	0.7 to 1.2
Temperature range	-70 to 1500°F	-70 to 1500°F	-40 to 95°F	-50 to 900°F	-40 to 104°F	-40 to 115°F
Typical mode of purchase	Exchanger only Exchanger in case Exchanger and blowers Complete system	Exchanger only Exchanger in case Exchanger and blowers Complete system	Exchanger only Exchanger in case	Coil only Complete system	Exchanger only Exchanger in case	Complete system
Unique advantages	No moving parts Low pressure drop Easily cleaned	Latent transfer Compact large sizes Low pressure drop	No moving parts except tilt Fan location not critical Allowable pressure differential up to 60 in. of water	Exhaust airstream can be separated from supply air Fan location not critical	No moving parts Exhaust airstream can be separated from supply air Fan location not critical	Latent transfer from remote airstreams Multiple units in a single system Efficient microbiological cleaning of both supply and exhaust airstreams
Limitations	Latent available in hygroscopic units only	Cold climates may increase service Cross-air contamination possible	Effectiveness limited by pressure drop and cost Few suppliers	High effectiveness requires accurate simulation model	Effectiveness may be limited by pressure drop and cost Few suppliers	Few suppliers
Cross-leakage	0 to 5%	1 to 10%	0%	0%	0%	0.025%
Heat rate control (HRC) schemes	Bypass dampers and ducting	Wheel speed control over full range	Tilt angle down to 10% of maximum heat rate	Bypass valve or pump speed control over full range	Control valve over full range	Control valve or pump speed control over full range

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.18



# Heat (Energy) Recovery Units



*Fig. 17-23 Nomenclature for Effectiveness Evaluation*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 17.17

# In Summary

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## Questions and Discussion

# Next Class

- Air Contaminants
  - Classes of contaminants
  - Indoor
  - Outdoor pollutants
  - Soil gases
- Air Cleaners
  - Equipment types
- Readings
  - HF: Chapter 11 & 12