

Welcome

AFE Chapter 13 Geo Thermal Systems

Basics of Geo-Thermal Mechanical/HVAC

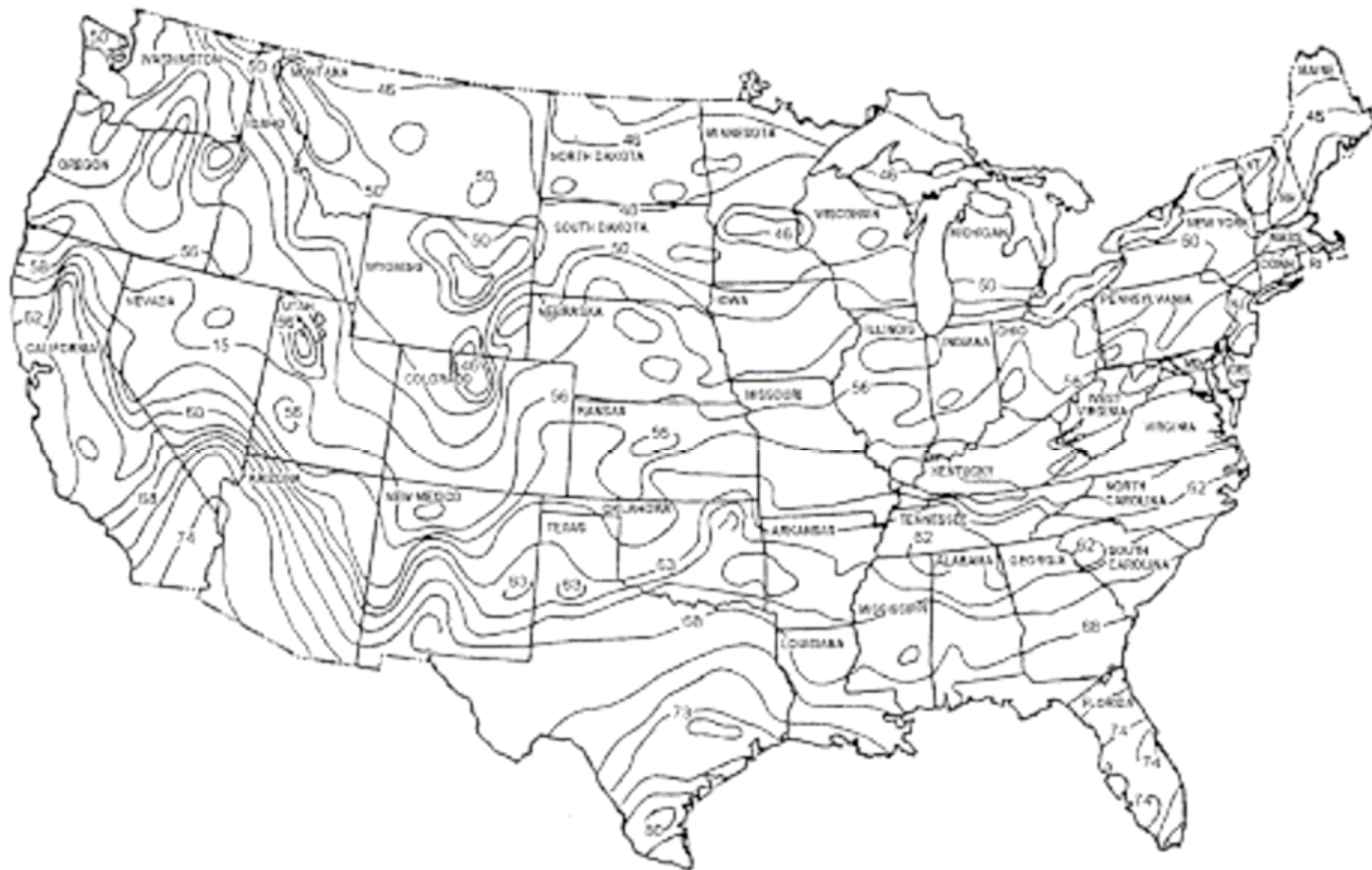
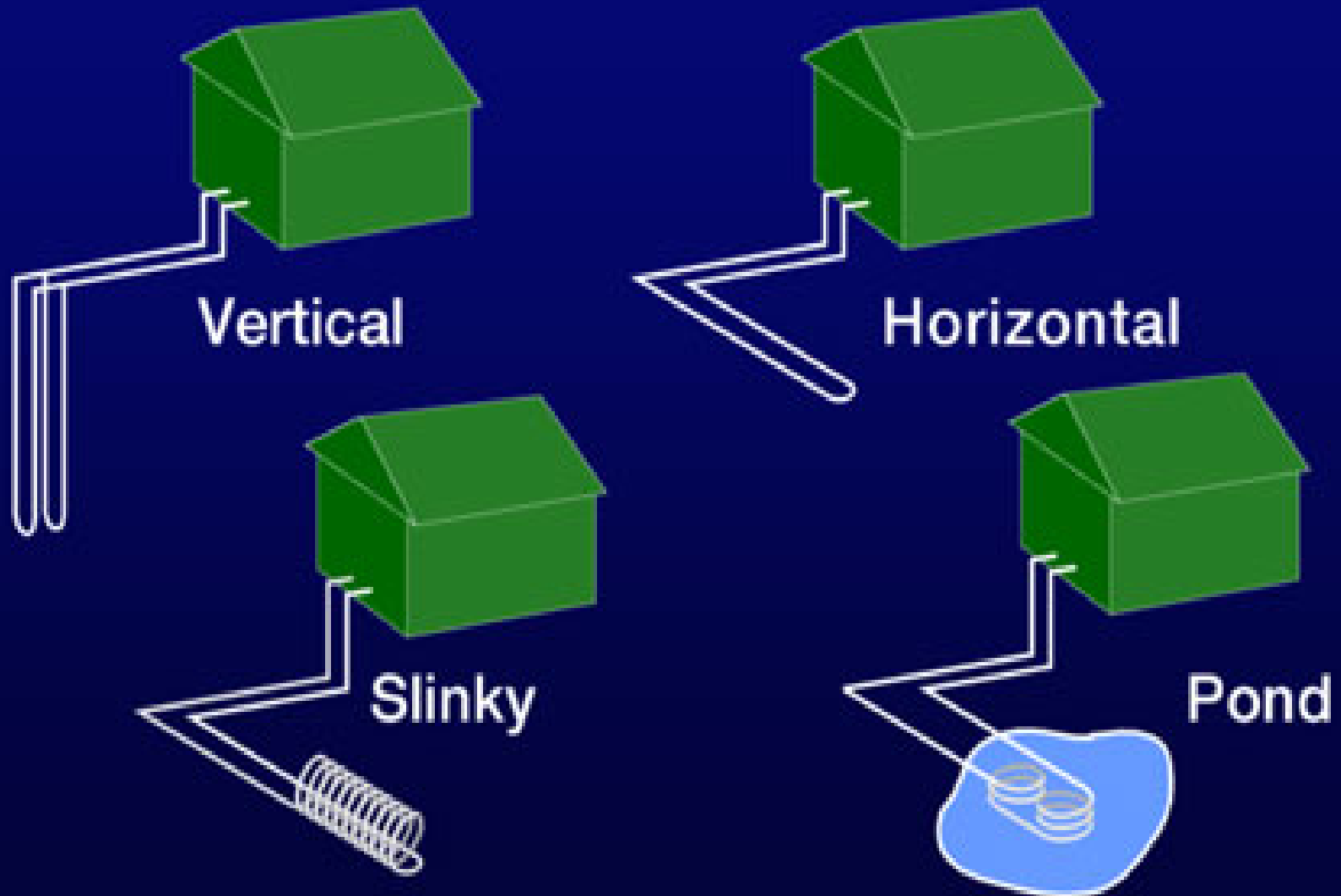


Fig. 20 Approximate Groundwater Temperatures (°F) in the United States

Components

- Well Fields (horizontal vs. vertical)
 - *vertical ~ 150' – 200' deep*
 - *horizontal ~ XYZ'*
 - *in-ground vs. lake/water*

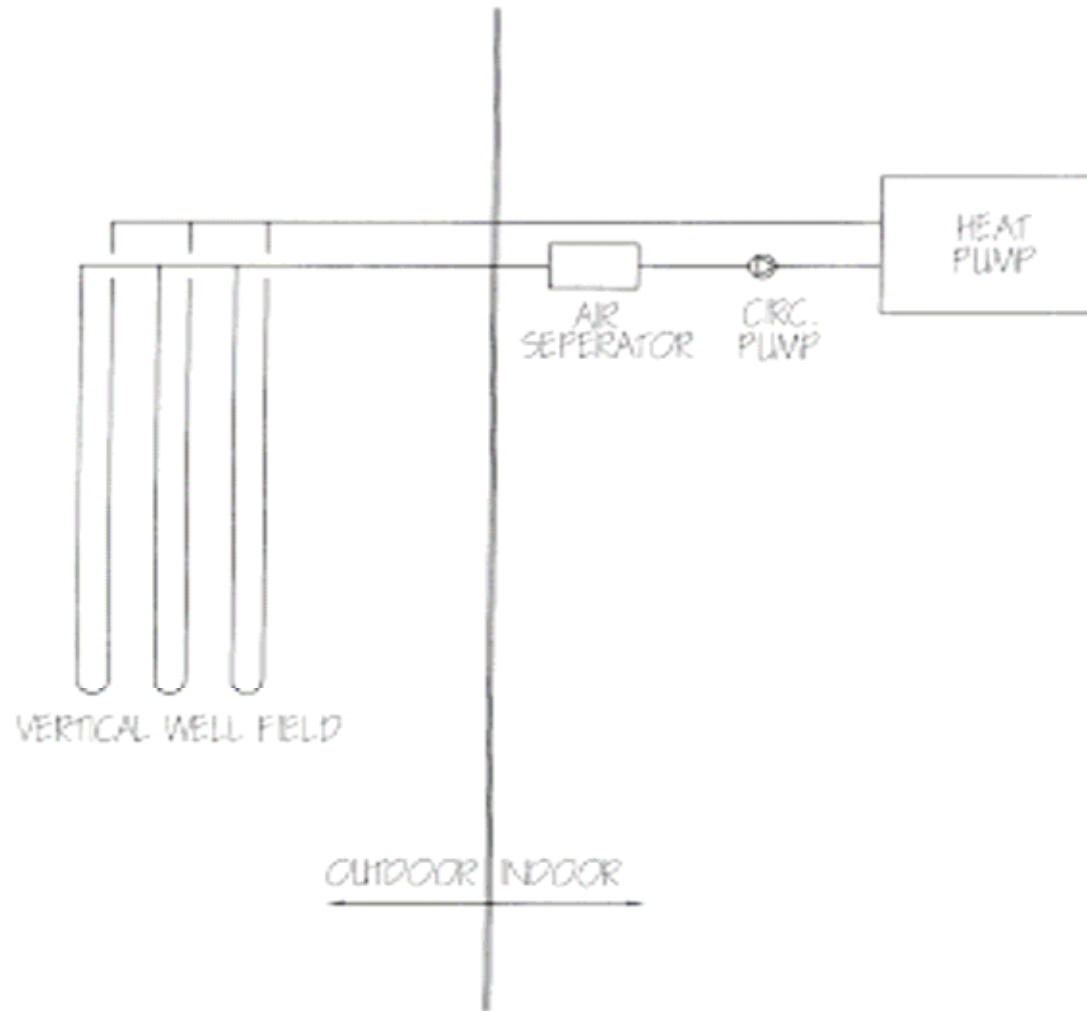
Heat Pump Ground Loops



Components

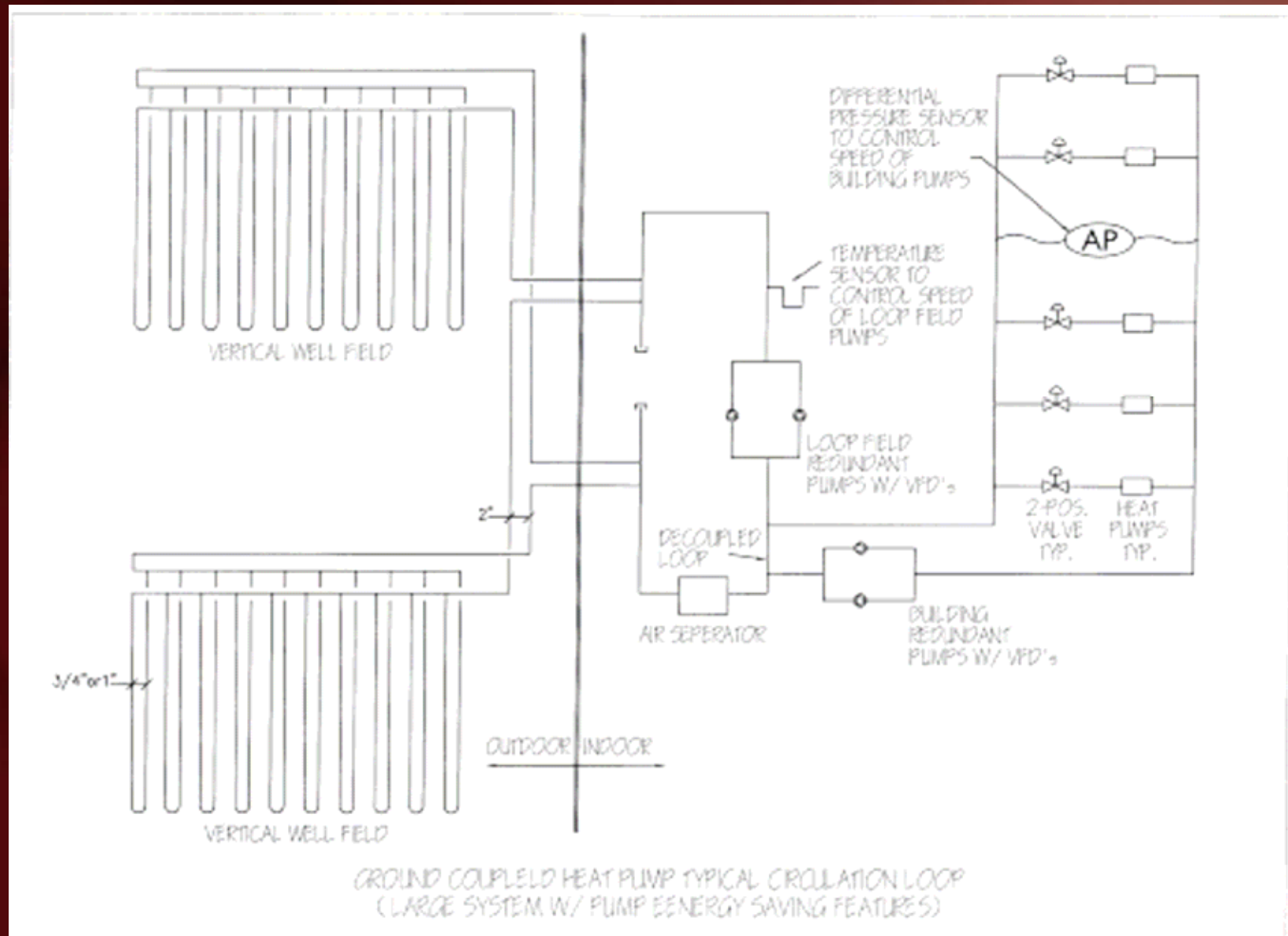
- Circulation Systems
 - *simple direct systems*
 - *coupled/decoupled*
 - *variable speed pump*

Circulation System Schematic



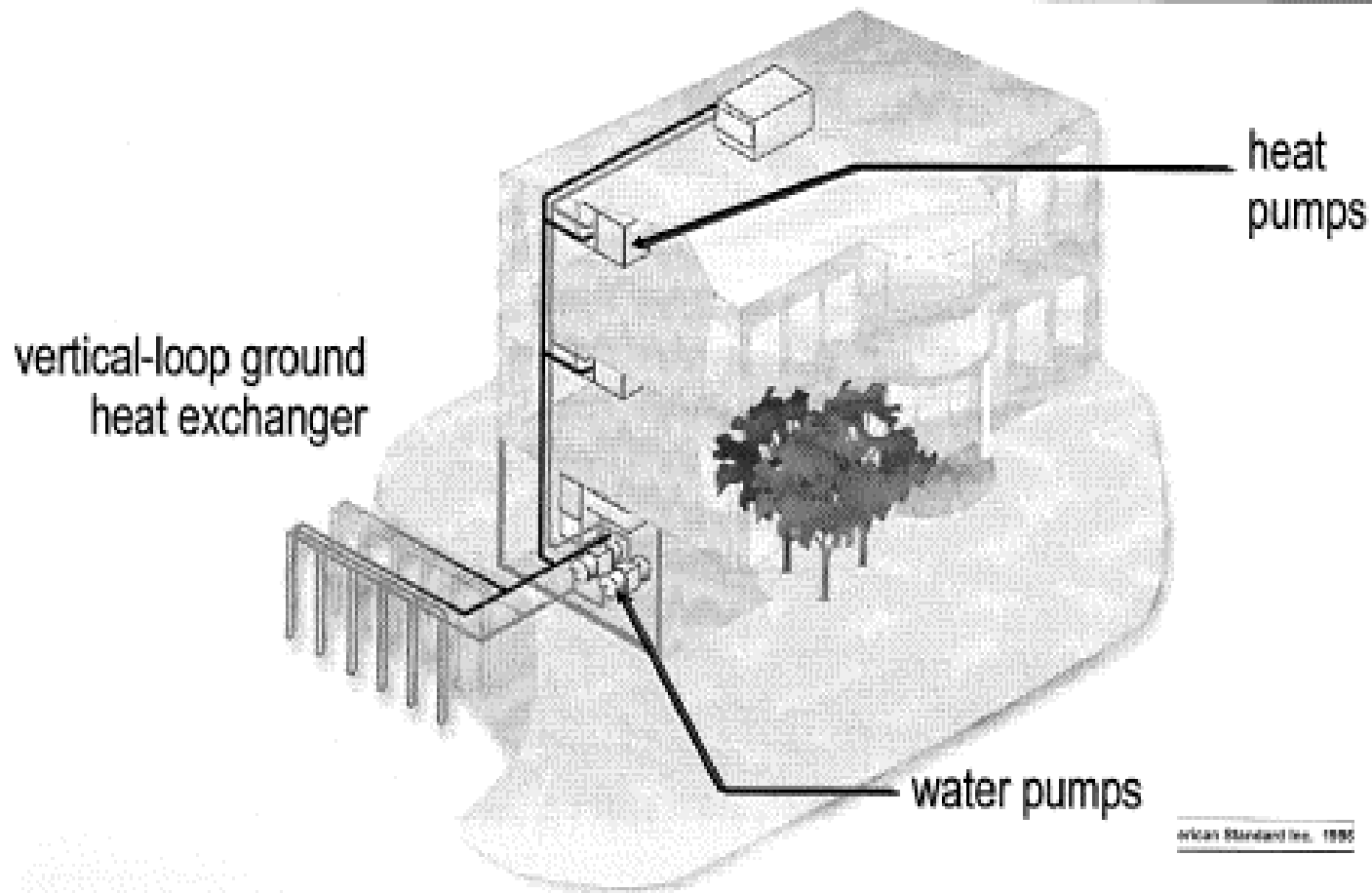
GROUND COUPLED HEAT PUMP CIRCUIT
(SMALL SYSTEM)

Large Circulation System



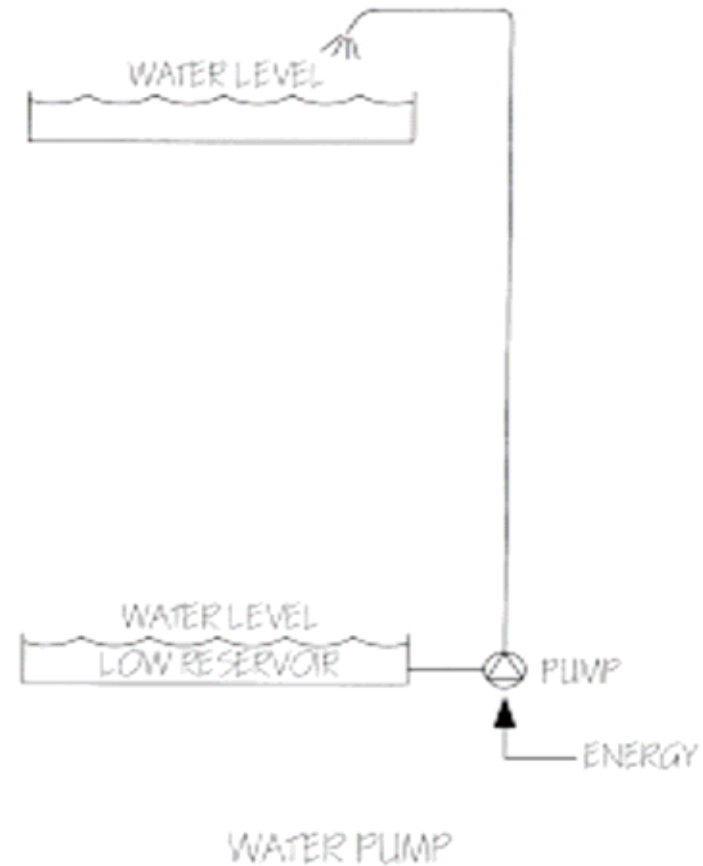
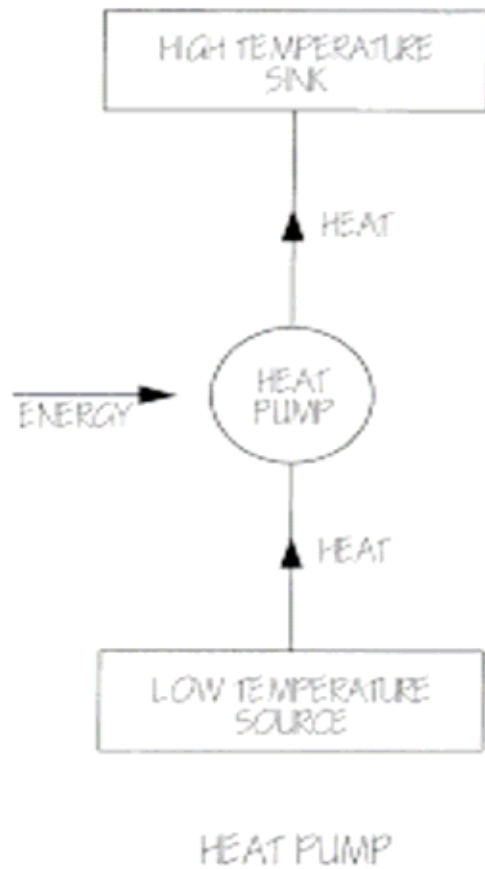
Large Circulation System

Ground-Coupled System



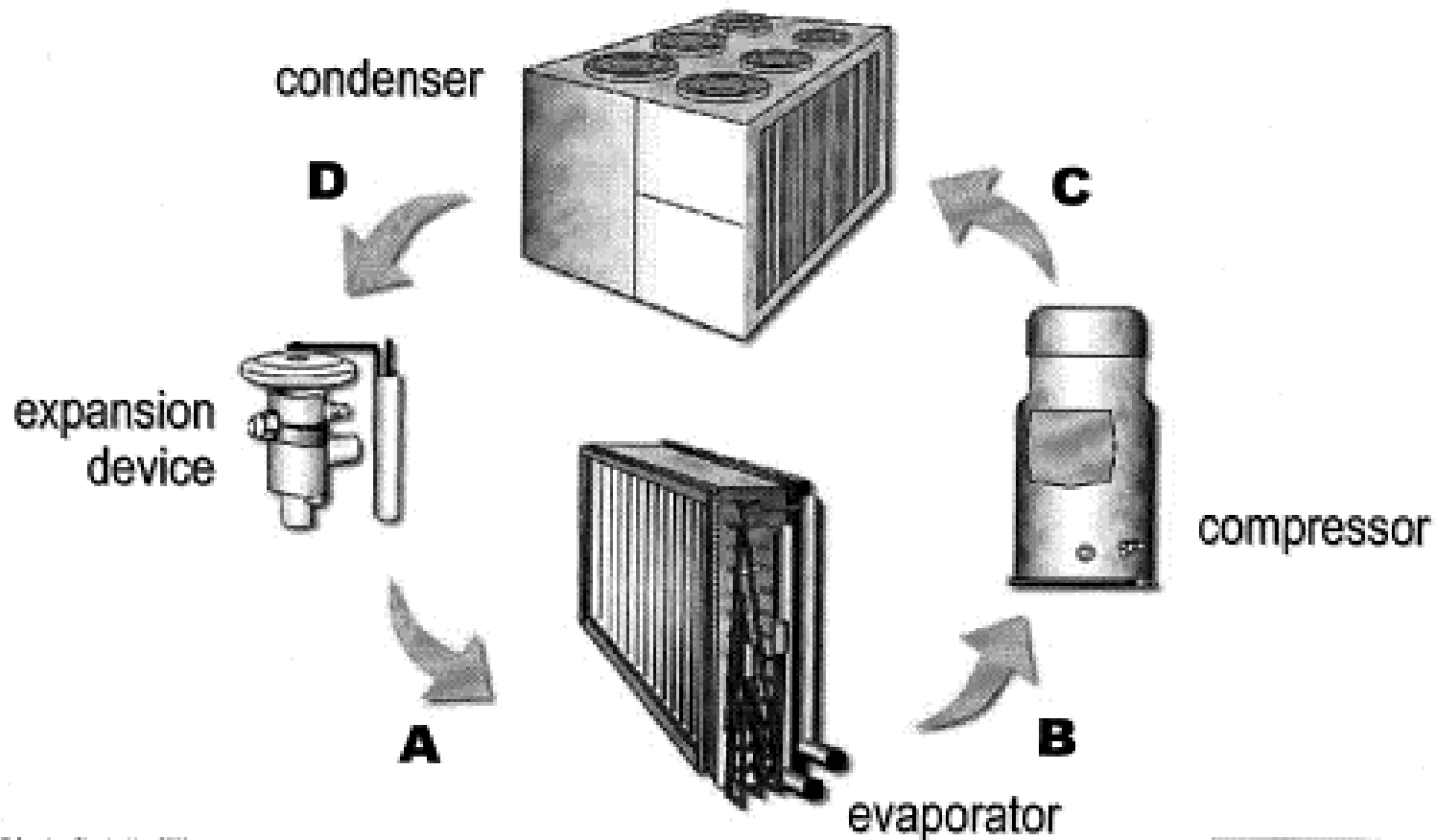
Components

Basic theory of Heat Pumps

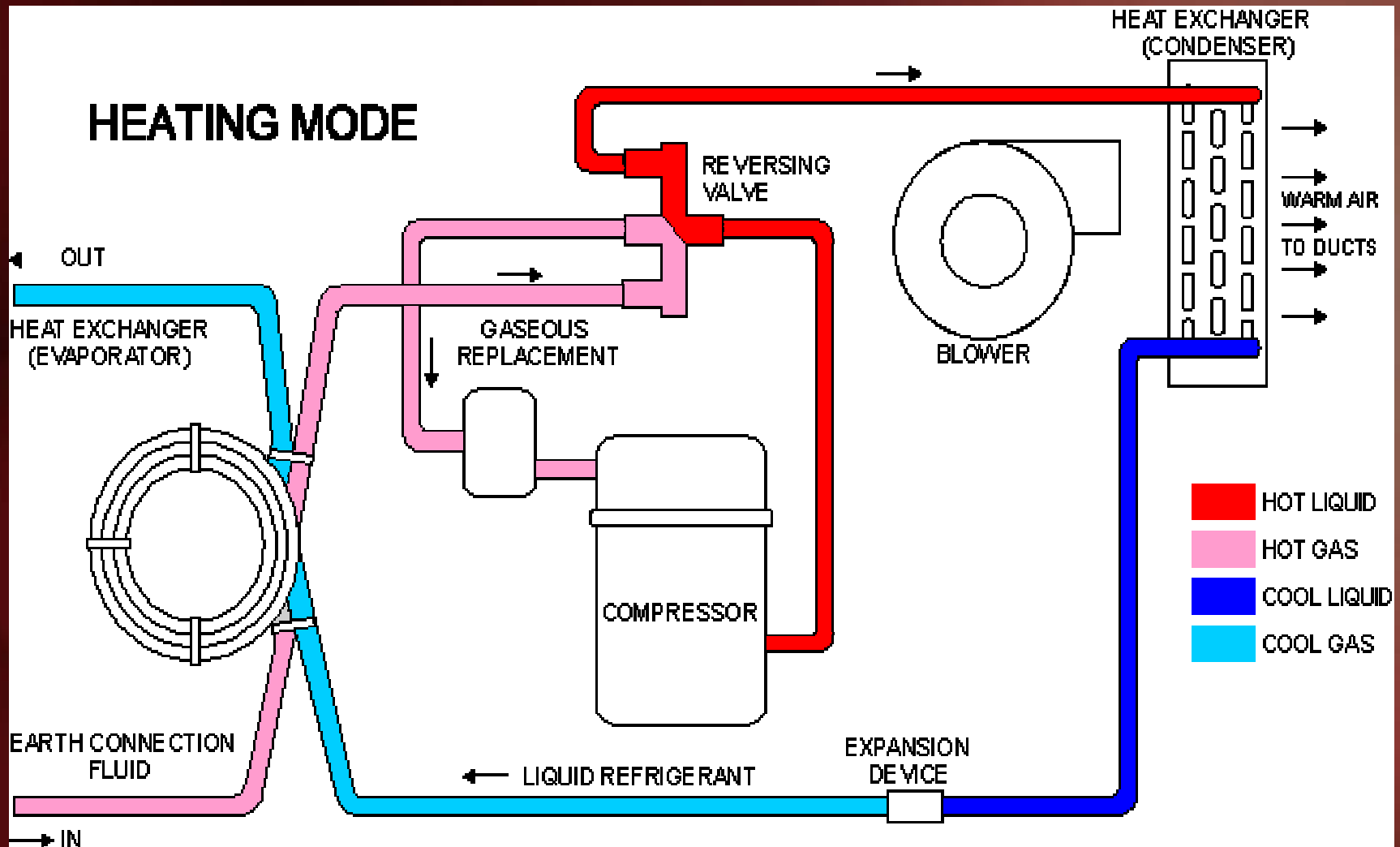


Four components of air conditioning system

Vapor-Compression Refrigeration



Water to Air Heat Pump



Operation

- Water to Air Systems

Pro's: Less expensive

Typically more suitable to schools

Higher efficiency COP ~ 3.6,
kW/ton ~ 0.75

Con's: Tough to obtain adequate O/A
Conditioning

Low external static pressure
Capabilities (filtration)

Low discharge air temperatures
the heating mode-Drafty;
typically in lows 90s°F

Operation

- Water to Water System

Pro's

Can be used with conventional air handling unit systems (That is chilled and hot water circulating systems to perform a wide variety of functions including conditioning fresh air)

Con's

More expensive

Lower efficiency COP ~ 2.7,
kW/ton ~ 0.85 (Because of
additional heat transfer step)

Functional Limitations

(Water to Air type Heat Pumps)

- Comfort/Drafts
 - Heating side – low discharge temps
 - Cooling side – similar performance to residential cooling equipment
 - Zoning accomplished through multiple units (not capable of additional zoning with for instance with VAV Boxes)
 - Heat pump placement (noise and service above ceilings etc.)
- Fresh O/A air limitations
 - Air to Air requires dedicated outside air conditioning system (can be excellent application for air to air heat recovery)

Functional Limitations

(Water to Water type Heat Pumps)

- Heating
 - Supply Temperatures around 110 to 115°F
 - Can design heating and reheat to operate at these temperatures.
 - Radiant Ceiling panels are out.
 - Good application for in-floor heat (maybe patient Rms)
- Cooling
 - System operate similar to conventional chilled water systems.

Costs

- Installation (inside vs. outside)
 - Internal mechanical equipment typically similar to normal HVAC equipment
 - External mechanical is additional
 - ~ \$1300 to \$1800/ton
- Operation & Maintenance
 - heat pump replacement (ASHRAE says ~ 20yrs?)

Issues

- Water to water payback
- Water to air payback
- Generator Capacity
- Conditioning fresh air
- Large office setting (saturated loop temps)

Open Forum

Thank You For Your Time