Lessons Learned with New and Proven "Sustainable" Mechanical Systems

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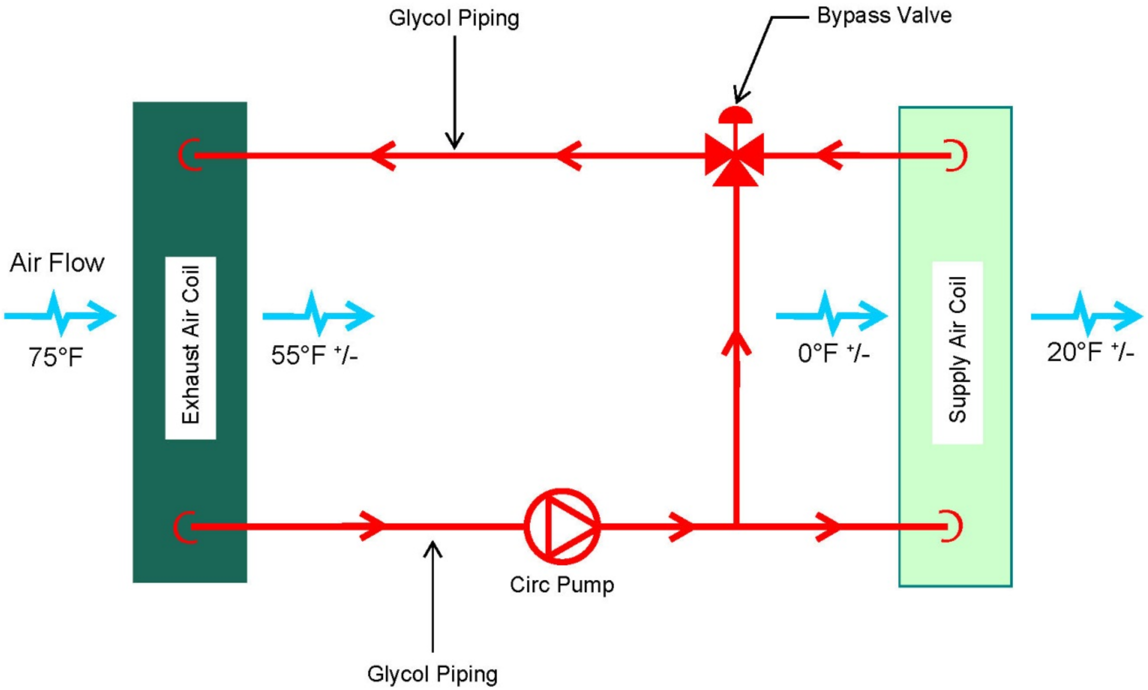
Learning Objectives

- New system applications to achieve higher energy efficiency.
- When to apply new technologies and how the owner should make the decision on the type of system to apply to their building.
- Making a decision on system application: Show Decision Matrix Example to show a variety of options and pros & cons for deciding on the right system for a given building.

Energy Recovery Technologies

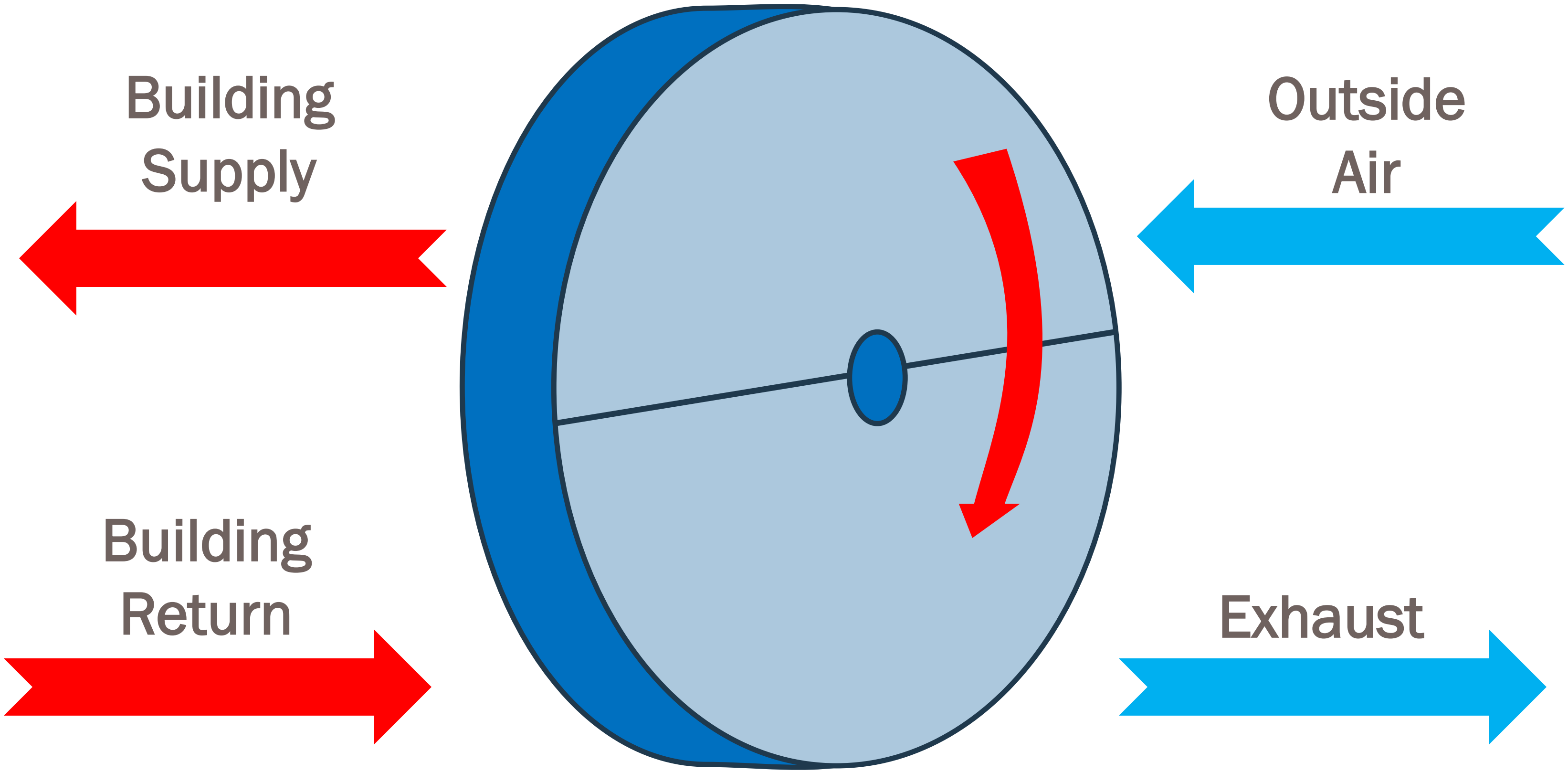
Energy Recovery Technologies

Glycol Run-Around Energy Recovery



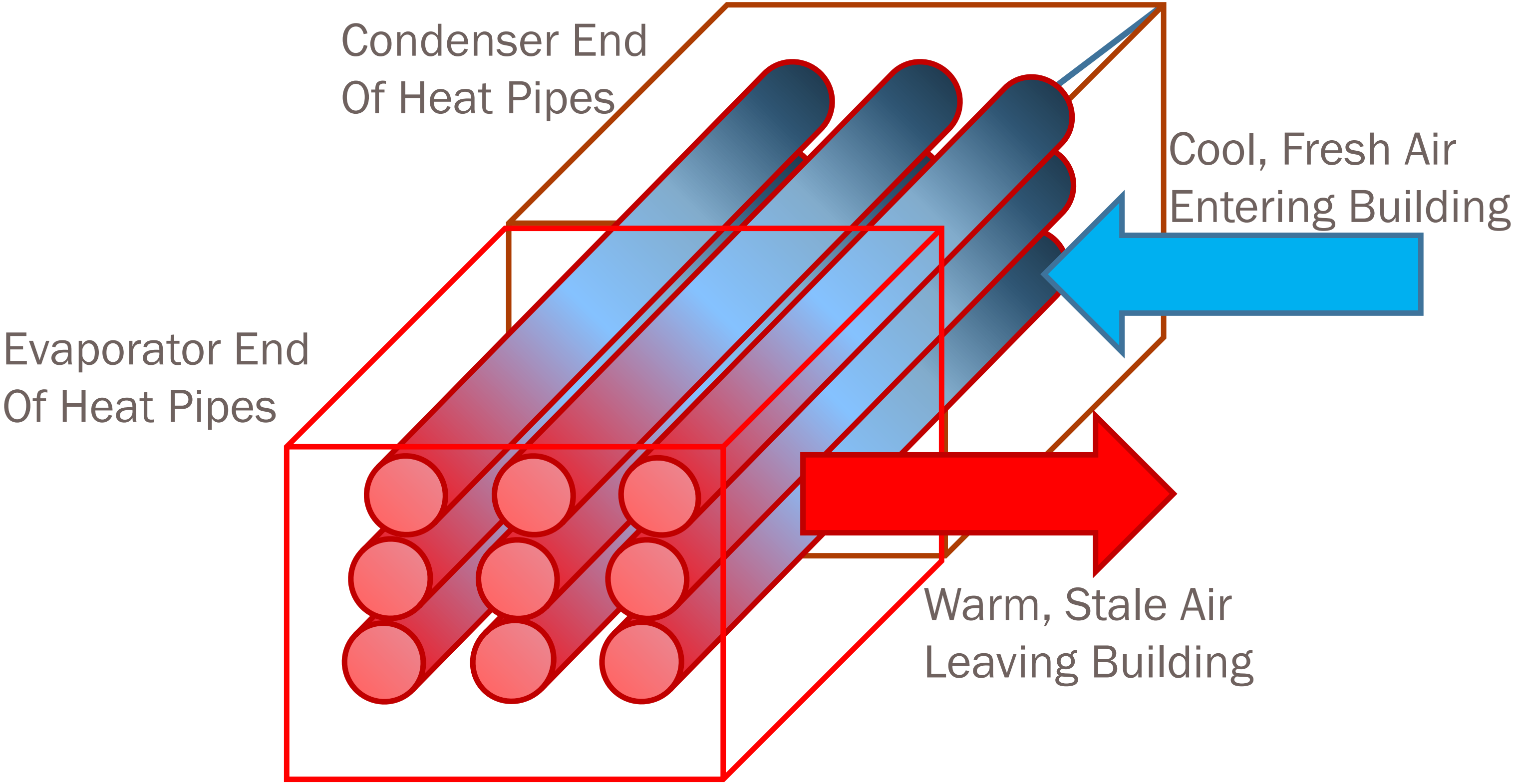
Energy Recovery Technologies

Sensible/Enthalpy Wheels



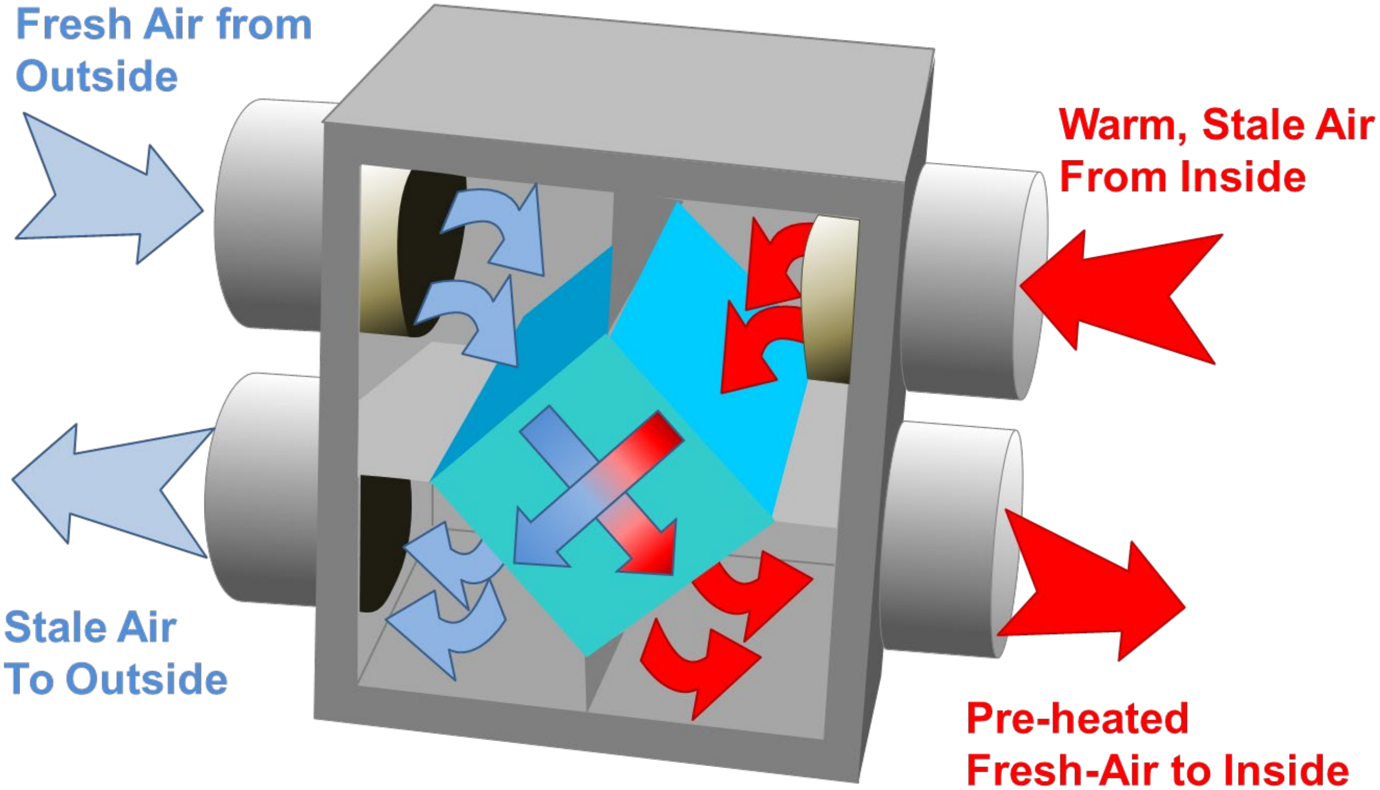
Energy Recovery Technologies

Heat Pipe



Energy Recovery Technologies

Air-Air Plate Heat Exchanger

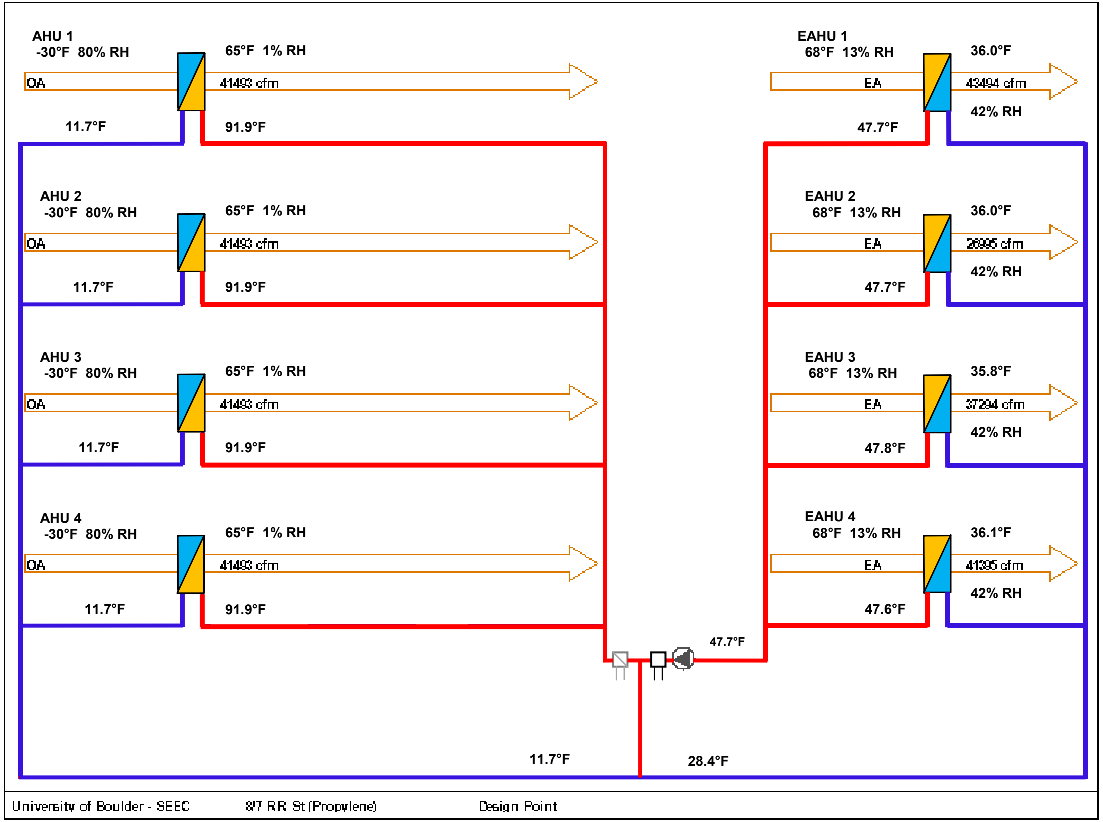


Energy Recovery Technologies

Air-Air Plate Heat Exchanger

Energy Recovery Technologies

Intelligent High Efficiency Run Around



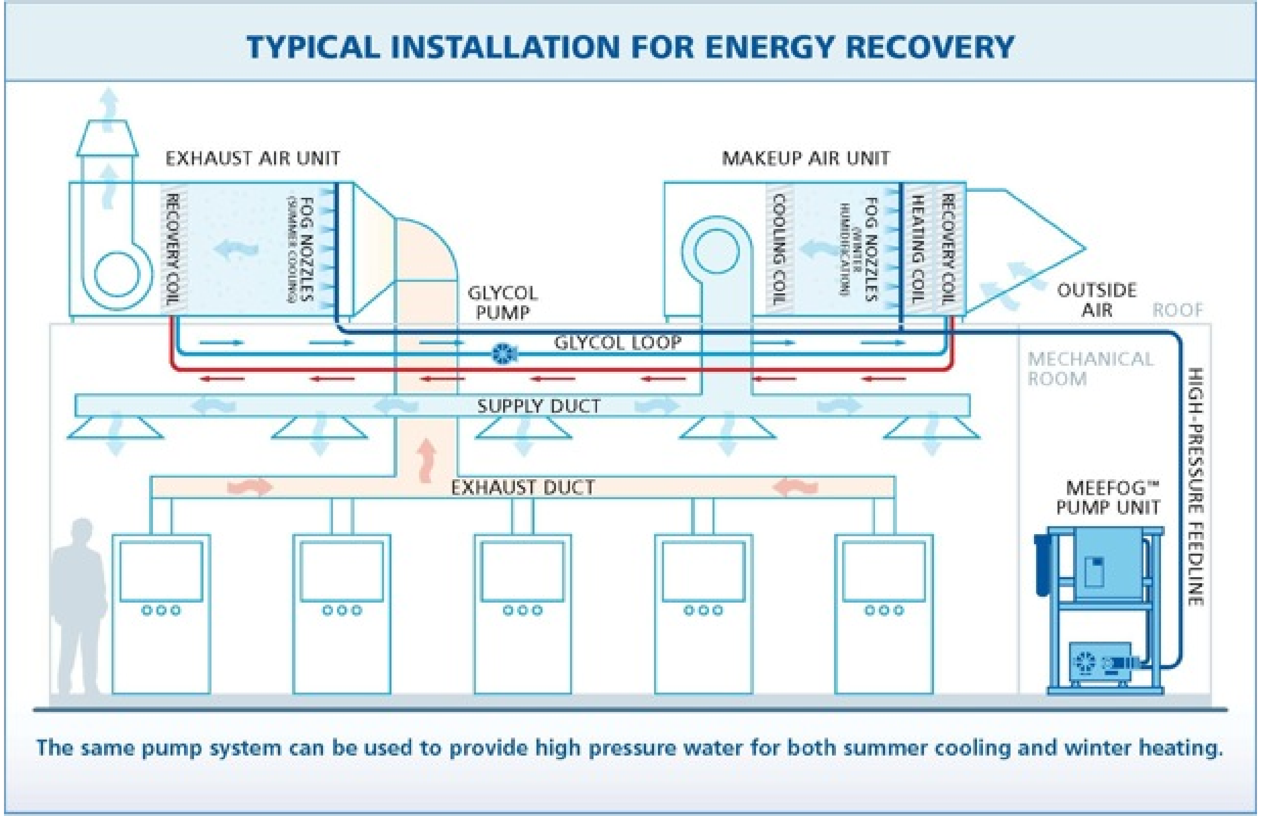
Evaporative Cooling Technologies

Evaporative Cooling Technologies

Glass/Cell Deck Media (Swamp Cooler)

Evaporative Cooling Technologies

Fog System

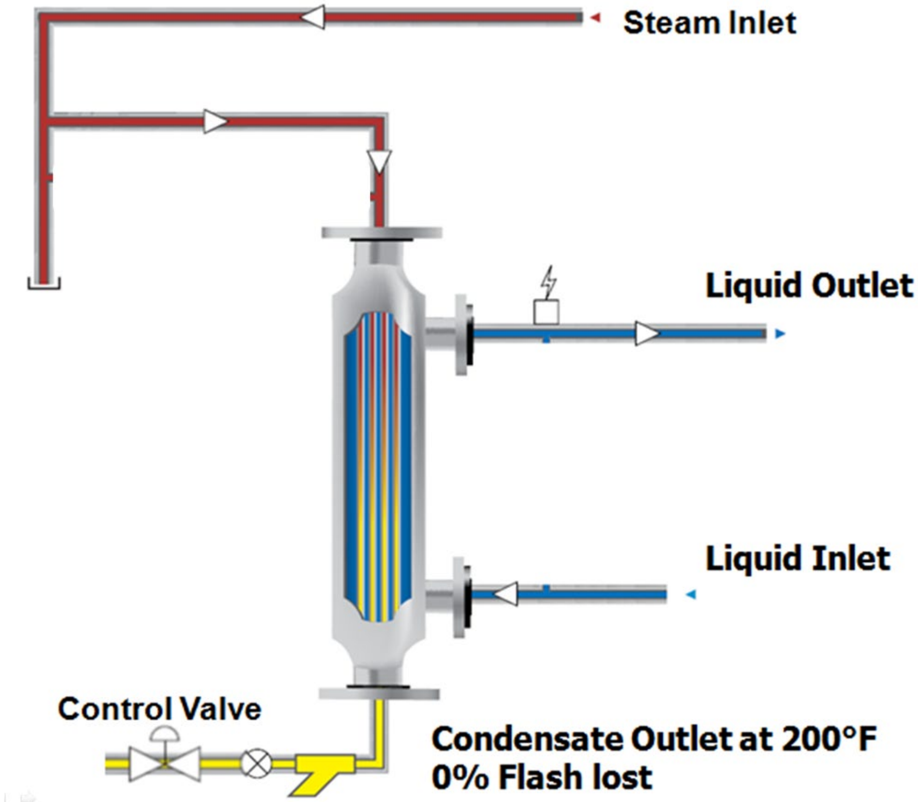


Evaporative Cooling Technologies

Ultrasonic Humidifier

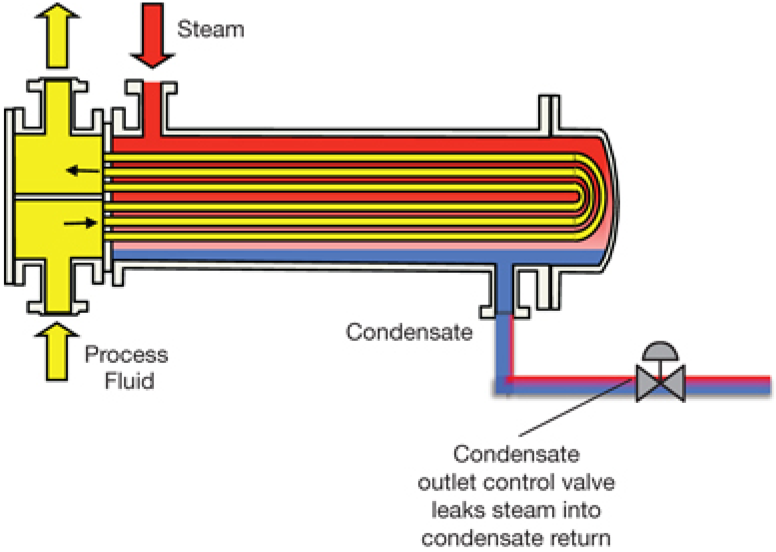
Heat Exchangers

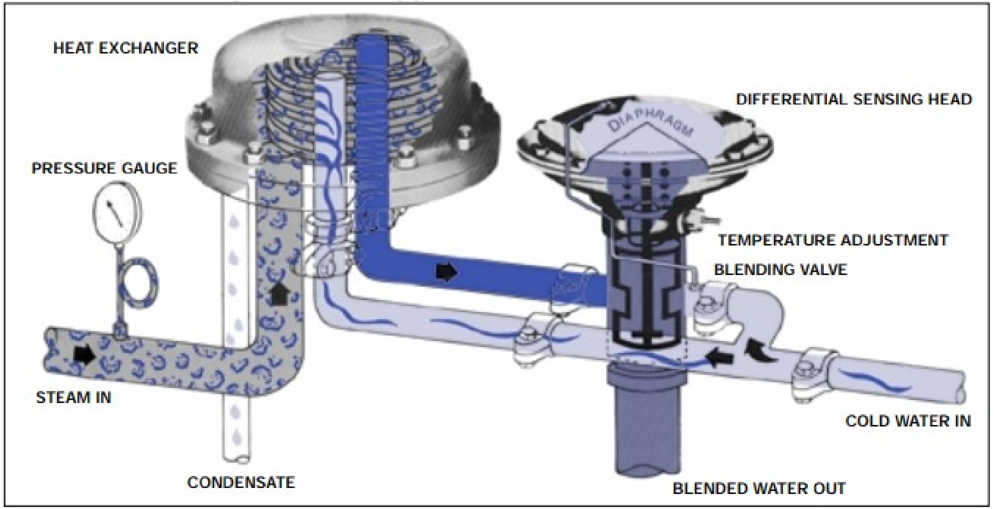
Flooded Heat Exchangers



Flooded Heat Exchangers

Non-flooded Heat Exchangers





Boilers

Heating Boilers

Variable Refrigerant Flow Systems (VRF)

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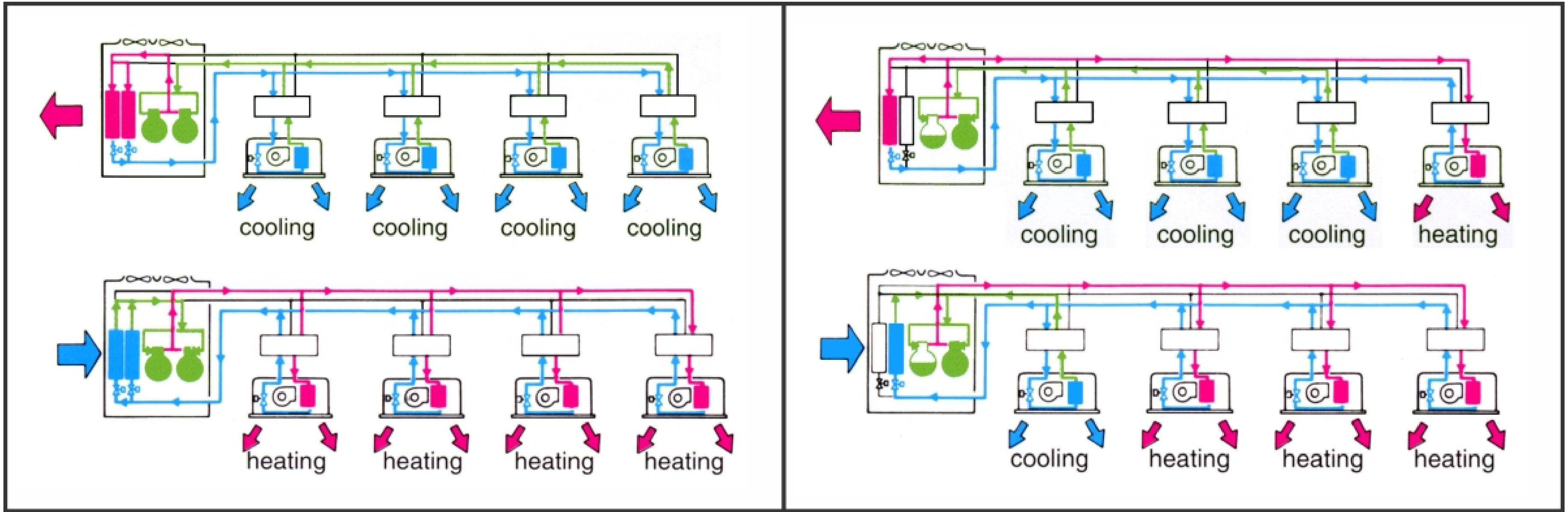


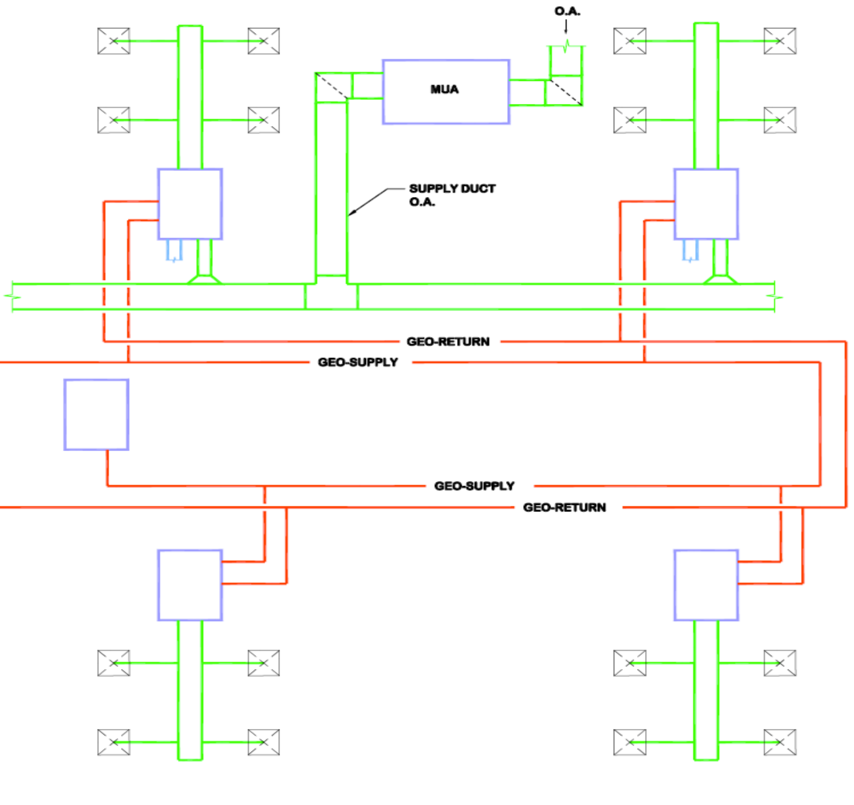
HEATING OR COOLING

HEATING AND COOLING

Geothermal/Ground Source Technologies

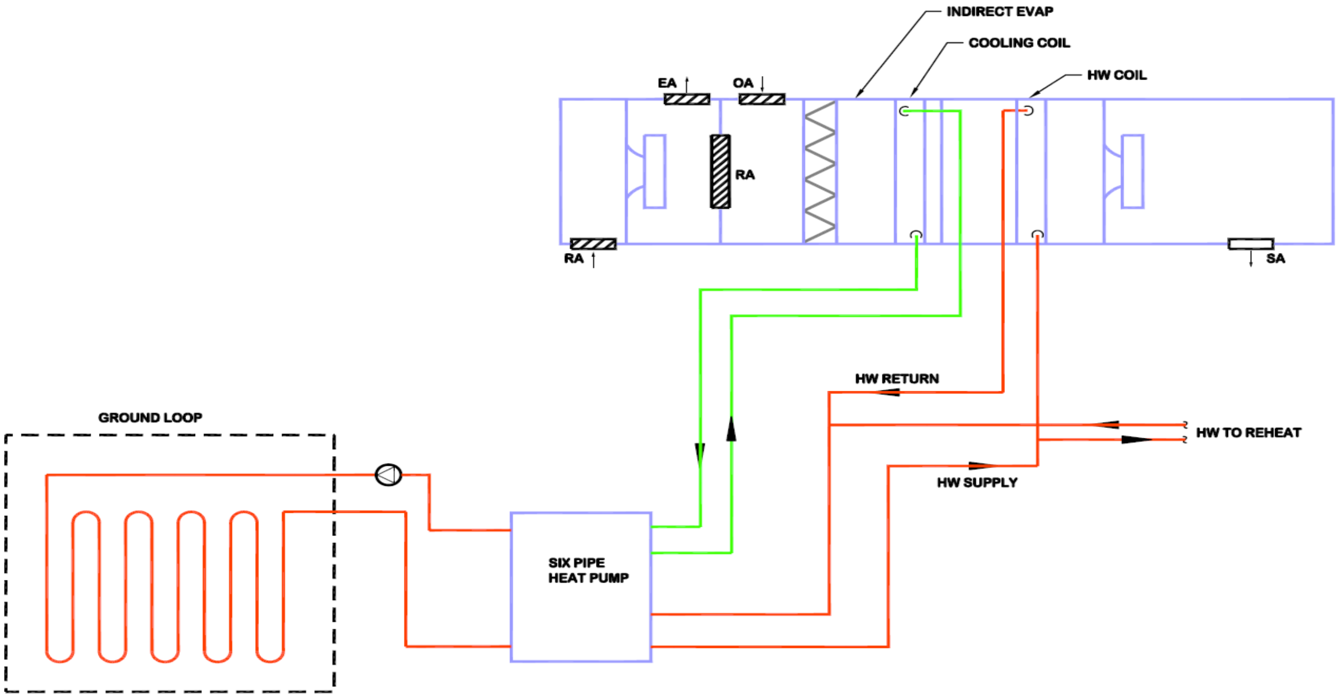
Geothermal/Ground Source Technologies

Distributed Heat Pump System



Geothermal/Ground Source Technologies

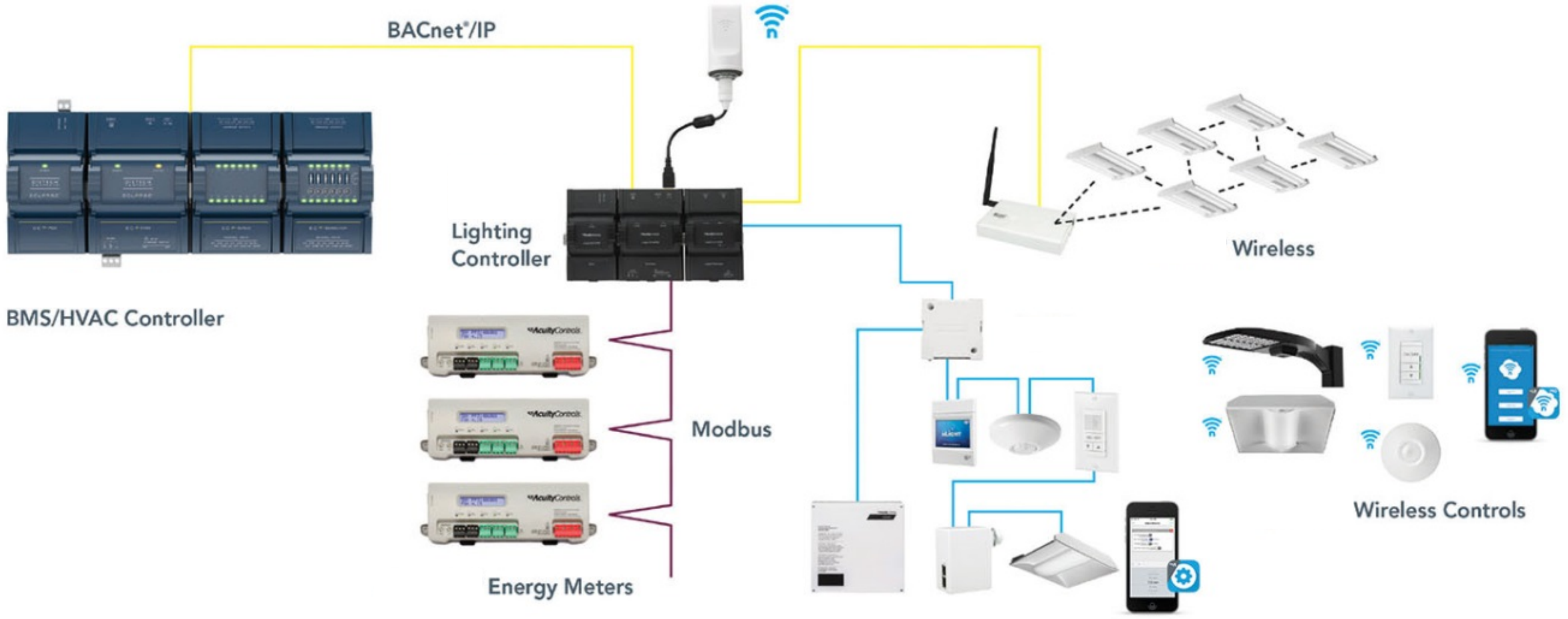
Six Pipe Heat Pump System



Lighting Controls

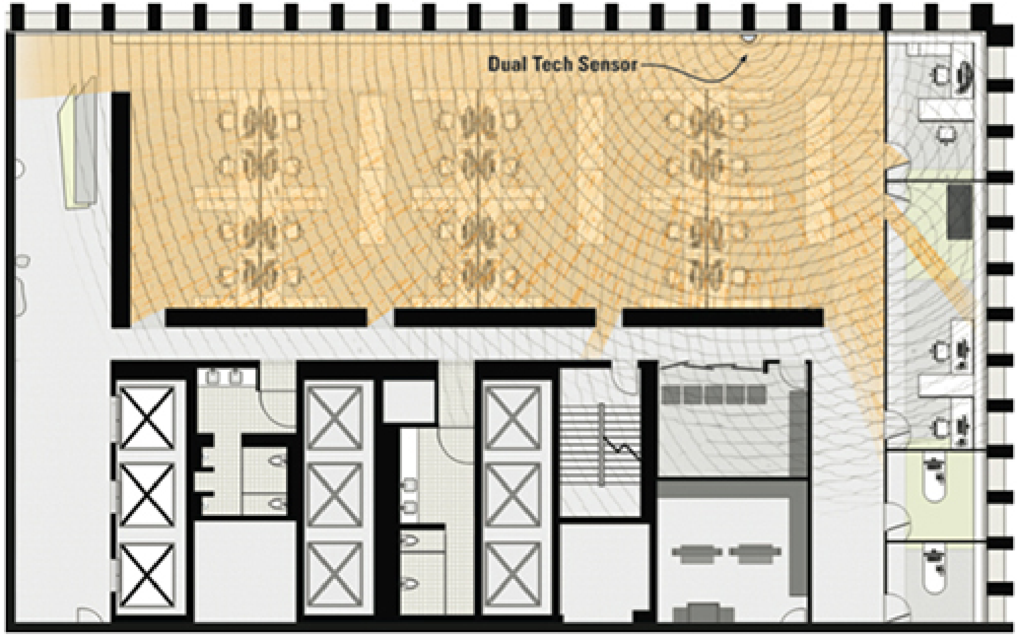
Lighting Controls

Overview



Lighting Controls

Occupancy Sensors



Dual Technology

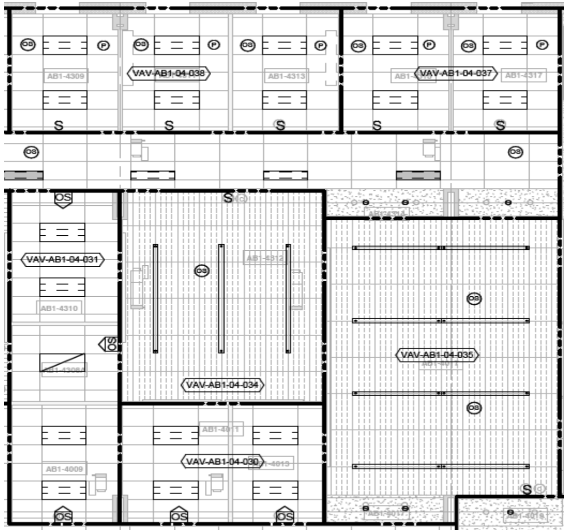
Uses a combination of both PIR and ultrasonic to detect both major and minor motion in a space.

Lighting Controls

Planning/Coordination

- Coordinate the location of the components on the shop drawings using the reflected ceiling plans.
- Do not use excessive amount of switch types, keep switches the same type from lab to office.
- Mechanical and electrical engineers working together to produce a coordination drawing.

This:

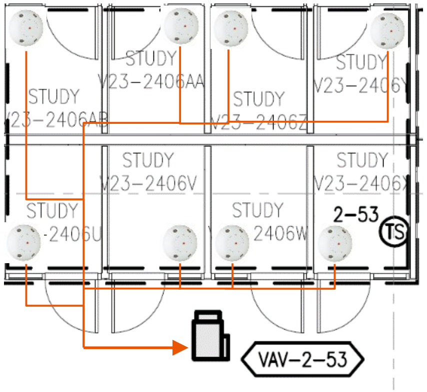


Not this:

Lighting Controls

Interface with HVAC Equipment

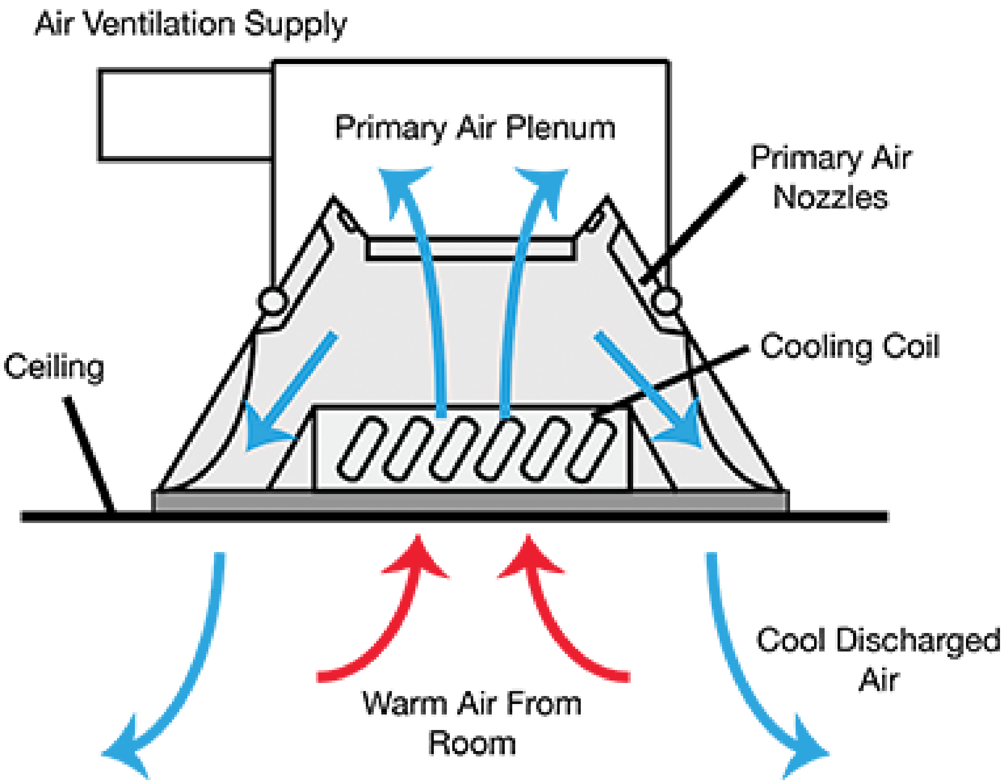
- Lighting sequence – manual on with auto off.
- HVAC sequence – Occupancy sensors are interfaced for HVAC equipment operation.
  - Occupied range - 70° to 75°
  - Unoccupied range - 65° to 80° with damper and valve closed, reset open as needed.



- All of the sensors are summed as one input to the VAV.
  - Input can be hardwired or through communication, such as BACnet.
- Use corner offices as always occupied areas.
- Use in labs to setback air change rates during unoccupied times.
  - May require a flush mode or spill buttons in labs
- Provide the maintenance staff with the ability to override occupancy in the event of a loss of communication or problem.

Chilled Beams

Chilled Beams



Sun Shading Technologies

Sun Shading Technologies

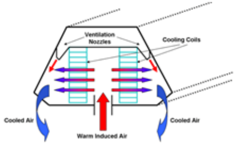
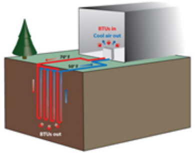
Motorized External Solar Shades

Sun Shading Technologies

Electrochromic Glass

How do you decide?

Systems Decision Matrix

RECOMMENDED SYSTEMS										
Order	**Option**	**Description**	**1st Cost ($)**	**1st Cost incl. controls, no plumbing & acoustics**	**Maintenance Comments**	**Energy Savings**	**Usability of Space**	**Comfort**	**Other Comments**	**Image**
1st	**VAV air system with direct evap cooling and DX cooling and condensing (95% eff) boiler**	Similar to baseline, but adding evap cooling to keep DX compressors off line longer throughout the year, and improving efficiency on heating water system.	$57/GSF = $1,995,500	$51/GSF = $1,785,000	Evap cooling can be in conflict with wood finishes	15%-20%	- Approx. 3,000 of site square footage would be needed for mechanical		- $ Based on 3 closed offices per HVAC zone - see additive prices below for 2 or 1 closed office per zone - $ Does not include interlocked operable windows	
2nd	**VAV air system with direct and indirect evap cooling and displacement ventilation and condensing (95% eff) boiler**	NO Mech Refrigeration. More efficient than item 2. Improving efficiency on heating water system.	$59/GSF = $2,065,000	$53/GSF = $1,855,000	Evap cooling can be in conflict with wood finishes	30%	Larger ductwork needed since supply air temperature will be higher (65 deg) than system with refrigeration cooling.	10 days a year could have higher temp and humidity	- $ Based on 3 closed offices per HVAC zone - see additive prices below for 2 or 1 closed office per zone - $ Does not include interlocked operable windows - Vertical Shafts (Gypsum board) required	 
3rd	**Chilled Beam System**	minimize the amount of building air. This would require some form of chilled water. But for 35,000 sq.ft., not sure how the building could afford a chilled water plant and chilled beam system. Chilled beams utilized for cooling allows supply air quantity to be reduced. Requires additional chilled water loop with higher temp. chilled water.	$65/GSF= $2,100,000	$59/GSF= $2,065,000	"wet" utility going through the space is typically a concern. Complex controls	Approx. 20-25%	Lower floor to floor height possible due to ductwork decrease in ceiling plenum	Good option for offices. AHU recommended for conference rooms	- Not recommend with direct evap. The direct evap systems requires more sophisticated controls (humidity sensors etc..). - $ Based on 3 closed offices per HVAC zone - - $ Does not include interlocked operable windows	
4th	**Ground Source Heat Pump (assumed 2nd Recommended System base mechanical system modified for geoexchange)**	Vertical bore holes with pipes & thermal grout to conduct energy into the ground. Closed loop glycol from bore holes circulate to heat pumps inside the building. Heat pumps can be distributed like fan coils, or system can be developed with larger heat pumps as part of air handlers and as a hot water boiler for VAV with Reheat system.	$62/GSF = $2,170,000	$56/GSF = $1,960,000	If Distributed Fan Coils, much more maintenance intensive with compressors throughout the building.	30%	If distributed fan coil units, need more ceiling space than VAV system	Could be noisier than a VAV system if distributed fan coil units.	- $ Based on 3 closed offices per HVAC zone - - $ Does not include interlocked op. windows - Conductivity test ROM = $10,000 - Approx. 25,000 SF of Geofield needed - Approx. +$175,000 and temp. parking relocation if parking lot is used as geofield	 

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Questions?