Use of Non conventional Energy sources effectively to produce Air-conditioning

HOW CAN WE MAKE IN INDIA

IF WE CAN'T BREATHE IN INDIA

Radiant Theory

- Uses both Radiation and Convection
- Radiation (50-60%)
  - Stefan-Boltzmann Equation
  - $q_r = 0.15x10^{-8} \cdot [(t_p+460)^4 - (t_a+460)^4$
- Convection (40-50%)
  - ASHRAE S&E 1996
  - $q_c = 0.31 \cdot |t_p - t_a|^{0.31} \cdot (t_p - t_a)$

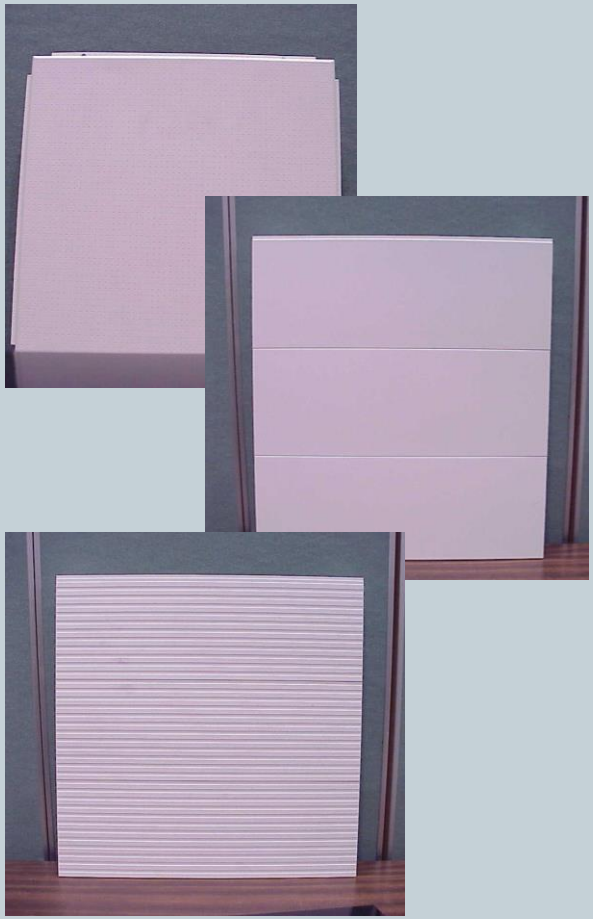
Radiant Paradigm

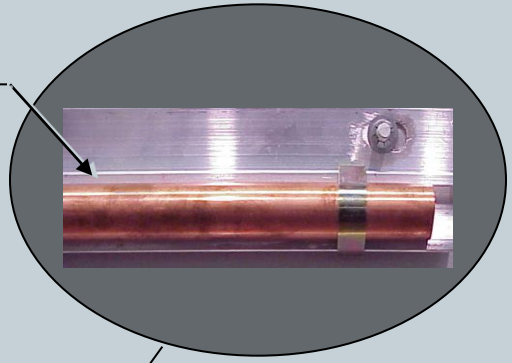
- Expensive
  - High first cost
  - Difficult or improper installation
  - Unavailable

Radiant Cooling

Radiant Tubing in floor

Radiant Panel Construction





Thermally Bonded

Blanketed with Insulation

Aluminum or Copper Fins

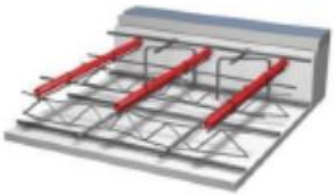
Copper Tubing

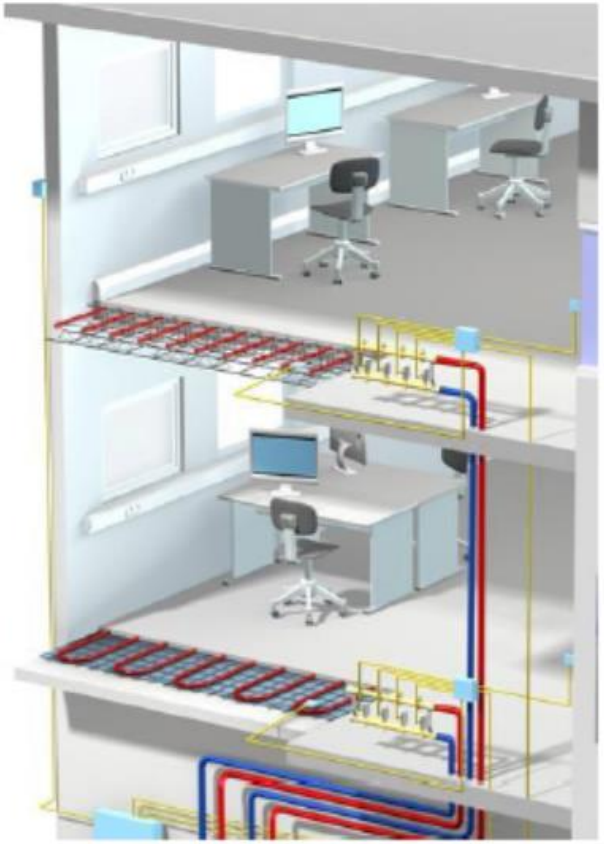
(Serpentine or Parallel Arrangement)

Types of radiant Cooling systems

i. **Thermally Activated Slab (TAS), aka TABS, BKT, or BATISO**

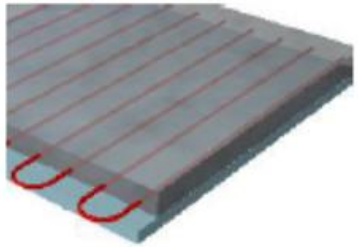
- Without insulation underneath
- Heated/cooled floors and ceilings condition spaces above and below
- Bi-directional





ii. **Radiant Floor Cooling and Floor Heating (FCH)**

- With insulation underneath to condition the space above
- Heated/cooled floor
- Uni-directional



Types

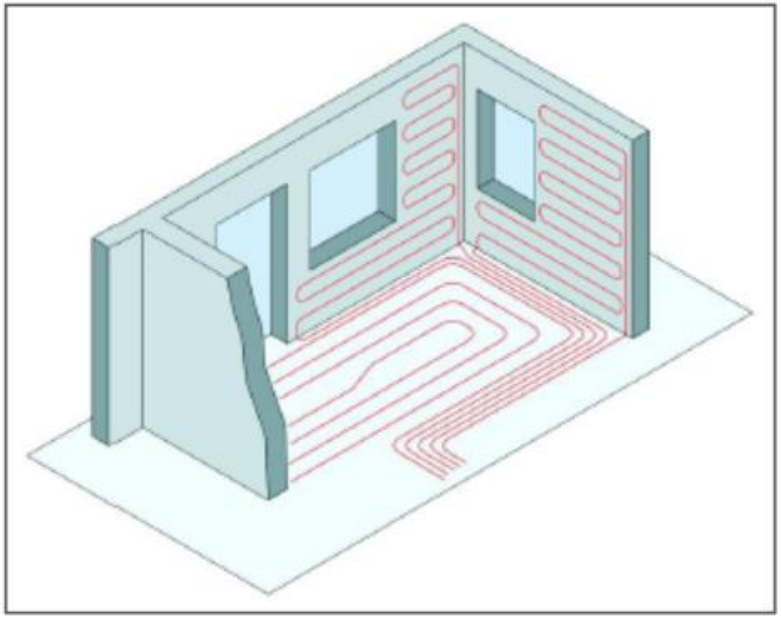
iii. Radiant Ceiling Heating and Cooling (CHC)

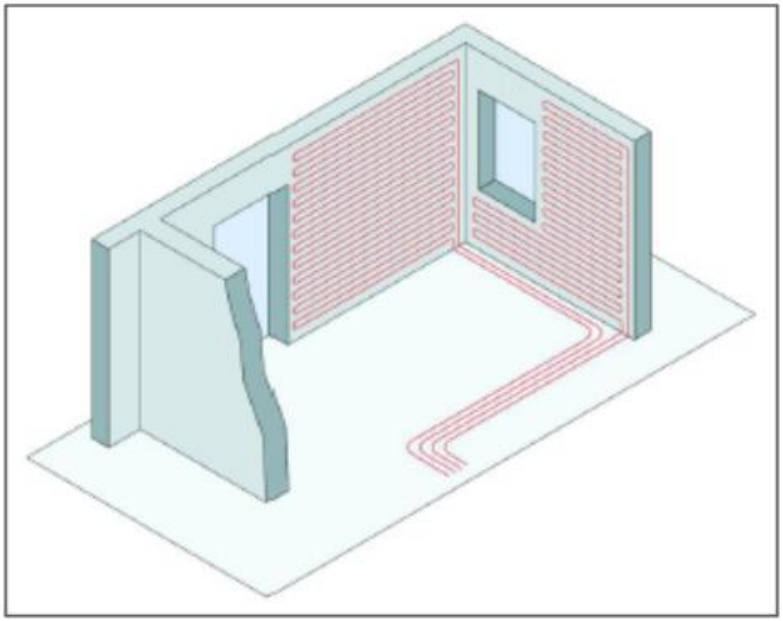
- Installed directly below structural ceilings, either as panels with embedded pipes, or as pipes attached to ceiling, then "plastered" over

Types

iv. Radiant Wall Heating and Cooling (WHC)

- Small diameter pipes are attached to walls then "plastered" over
- Pipes may be run from the floor as the same circuit, same fluid (left)
- Pipes may be run as a separate circuit (right)





Actual Thermal and Moisture control

- Divide and rule
- Separate control for sensible and latent
- DOAS
- Higher CHW temp
- Lower energy cost
- Fan energy plus higher chilled water temperature

Cost Advantages

- Long Term Savings
  - Smaller, More Efficient Chillers
  - Reduced Fan Energy
  - Reduced Maintenance Cost
  - Not paying for Over Ventilating
- Other Cost Savings
  - Piping is not insulated
  - Reduced Sprinkler Piping
  - Testing and Balancing Made Simpler

ADVANTAGES OF COMBINED RADIANT HEATING AND COOLING SYSTEMS

MULTIPLYING THE ADVANTAGES BY COMBINING THE SYSTEMS

SUMMARY

Six primary benefits of combined RH and RC systems:

a) Adaptability
b) Architectural freedom
c) Thermal comfort
d) Control
e) Efficiency
f) Safety

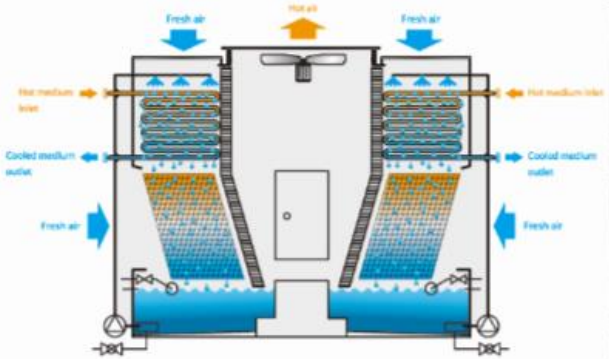
Block B – Radiant Cooling with DOAS, and closed circuit cooling tower.

- We have selected radiant cooling system where the sensible load is taken care by underfloor radiant system and latent load by TFA. The chilled water temperature is raised to 18/23 Deg C instead of 7/12 Deg C. This reduces the power consumption substantially and also closed circuit reduces the running cost by lowering the fouling on the condenser side.

Academic Block – Radiant Cooling

Radiant Tubing in floor

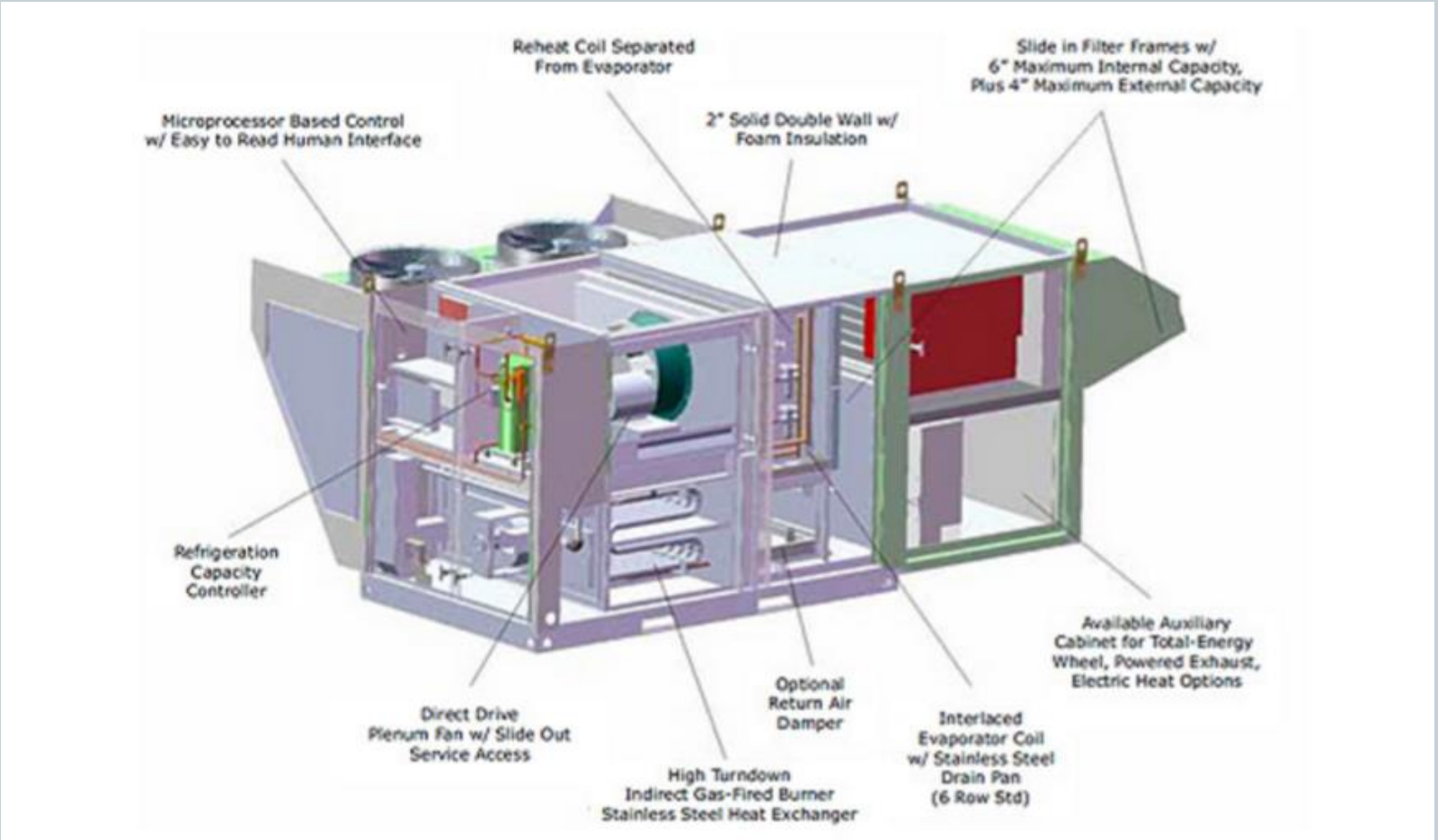
Closed circuit Cooling Tower



Process principle

Mixed flow is to use both condensing coil and PVC fill for heat transfer in an evaporative condenser. Water is pumped from evaporative condenser bottom sump and distributed over the fill. Air is induced through the fill, causing a small portion of the water to evaporate. This evaporation removes heat from the remaining water which will be cooled, and the "cooled water" cascading downward and "encapsulating" over the tubes of the coil. The high temperature gaseous refrigerant is circulated through the coil. Heat from the refrigerant is dissipated through the coil tubes. The remaining water falls to the sump at the bottom of the condenser where it is recirculated by the pump up through the upper water spray distribution system and back down over the fills and coils. The heat exchange on the coil surface is mainly sensible heat exchange which reduces evaporation load in the coil section and minimizes the potential for scaling and fouling.

DOAS – Separating Sensible and Latent load (Divide and Rule)



Block Energy Calculations

- Tonnage : 66 TR
- Power consumption (Standard system) :
  - Chillers Air Cooled : 95 kw
  - CHW pumps : 10 kw
  - AHU's : 20 kw
- Running Cost per yr : 20 L/yr
  - With 12 hrs per day, 250 days, Rs 8 per unit with load profile
- Radiant Cooling with TFA and Closed circuit cooling towers : 66 TR
- Power consumption (Radiant/closed circuit):
  - Chillers (with radiant & closed circuit) : 33 kw
  - CHW pumps : 12 kw
  - CDW pumps : 12 kw
  - TFA : 10 kw
- Running Cost per yr : 10 L /yr
  - With 12 hrs per day, 250 days, Rs 8 per unit with load profile

Block B

- Tonnage : 66 TR
- Cost of standard system : 0.50 Cr
  - With AHU / AC Chillers
- Running Cost per yr : 20 L/yr
  - With 12 hrs per day, 250 days, Rs 8 per unit
- Cost of Radiant Cooling with DOAS and Closed circuit cooling towers : 0.73 Cr
- Running Cost per yr : 10 L /yr
  - With 12 hrs per day, 250 days, Rs 8 per unit
- Payback period : 2. 3yrs
- Savings in 20 yrs : 1.80 Cr

Energy Saving System Guide

1 **Ground Source Heat Pump System**

2、Ground Water Source Heat Pump System

3、S**urface** Water Source Heat Pump System

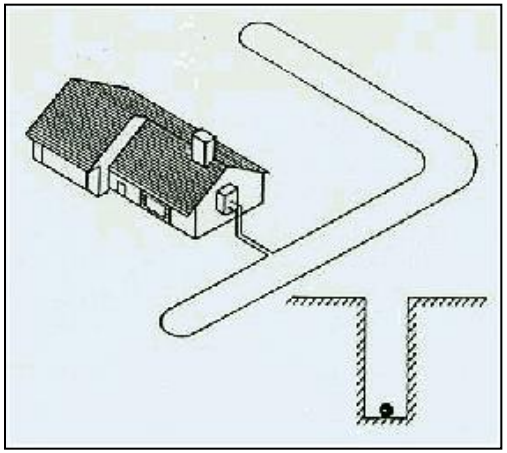
4、Sea Water Source Heat Pump System

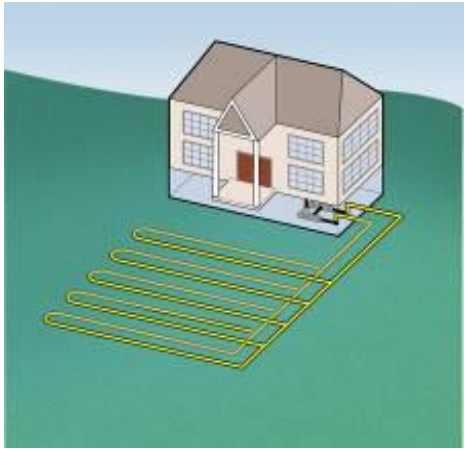
5、Sewage Water Source Heat Pump

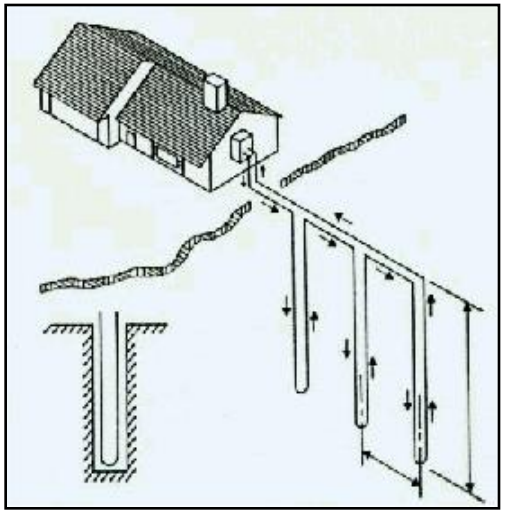
6、Water Loop heat Pump System

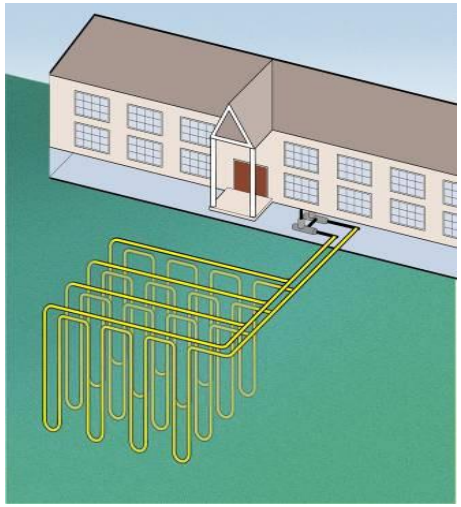
7、Hybrid System

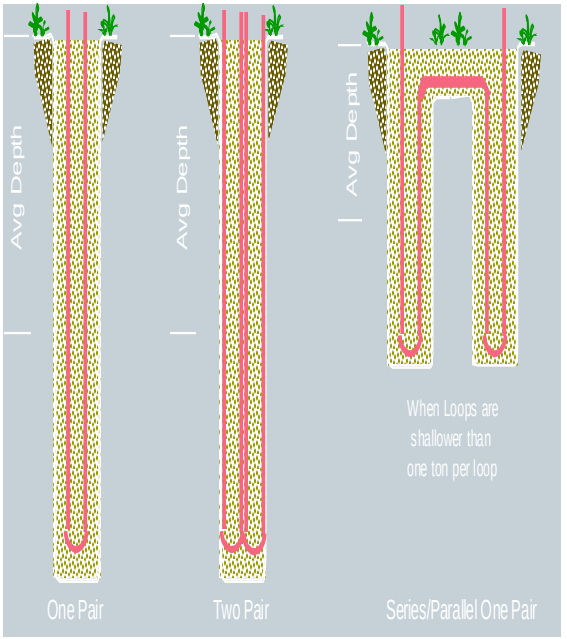
GSHP



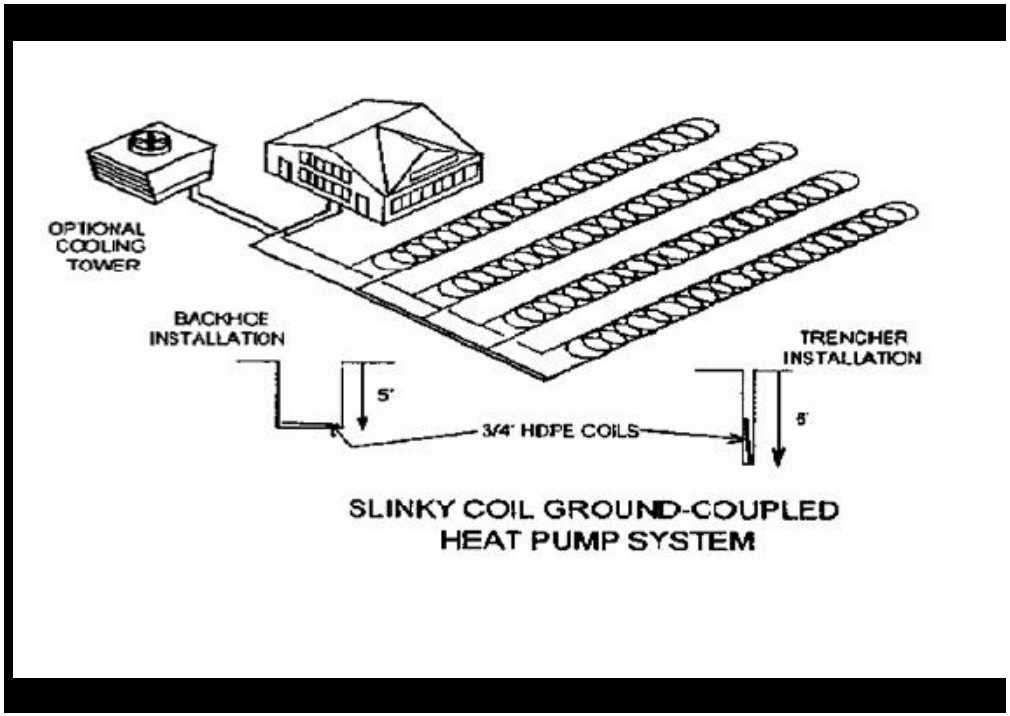




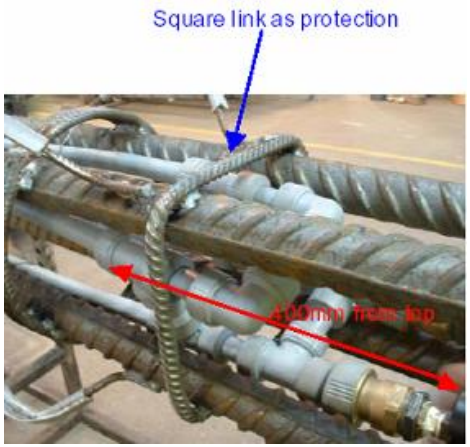



Avg Depth
Avg Depth
Avg Depth
When Loops are shallower than one ton per loop
One Pair
Two Pair
Series/Parallel One Pair

GSHP

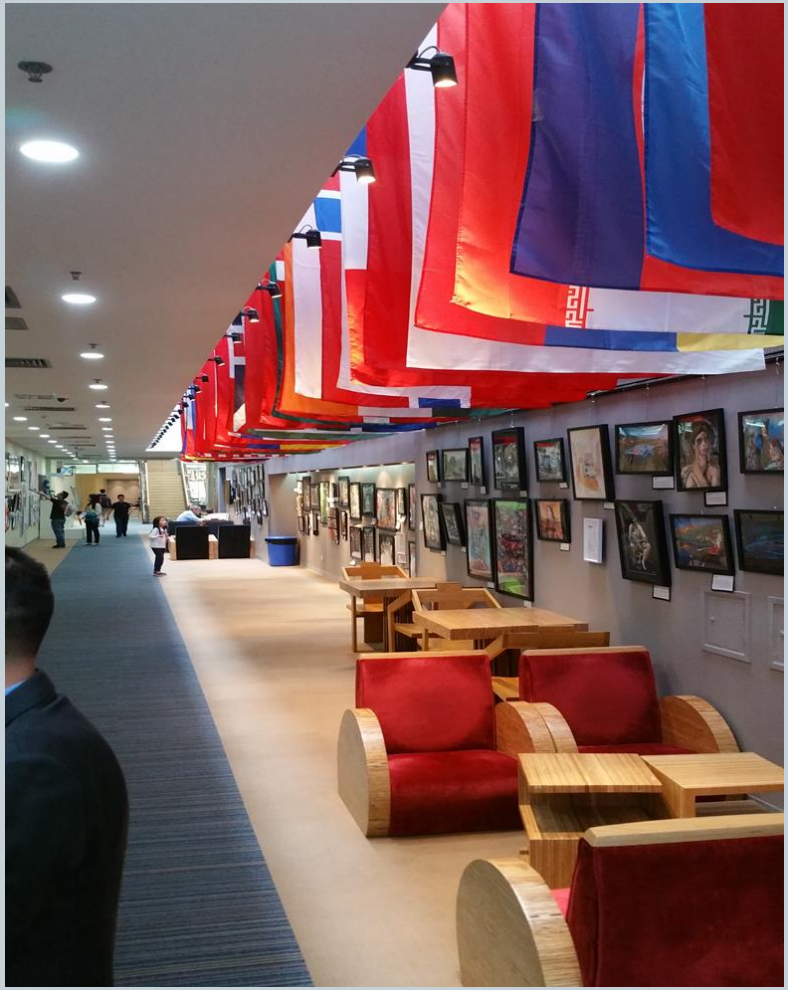

OPTIONAL
COOLING
TOWER
BACKHOE
INSTALLATION
TRENCHER
INSTALLATION
5'
3/4" HDPE COILS
5'
SLINKY COIL GROUND-COUPLED
HEAT PUMP SYSTEM

GSHP

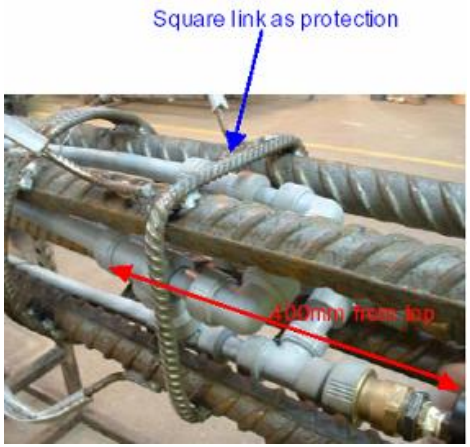


Energy Piles

Shanghai International School

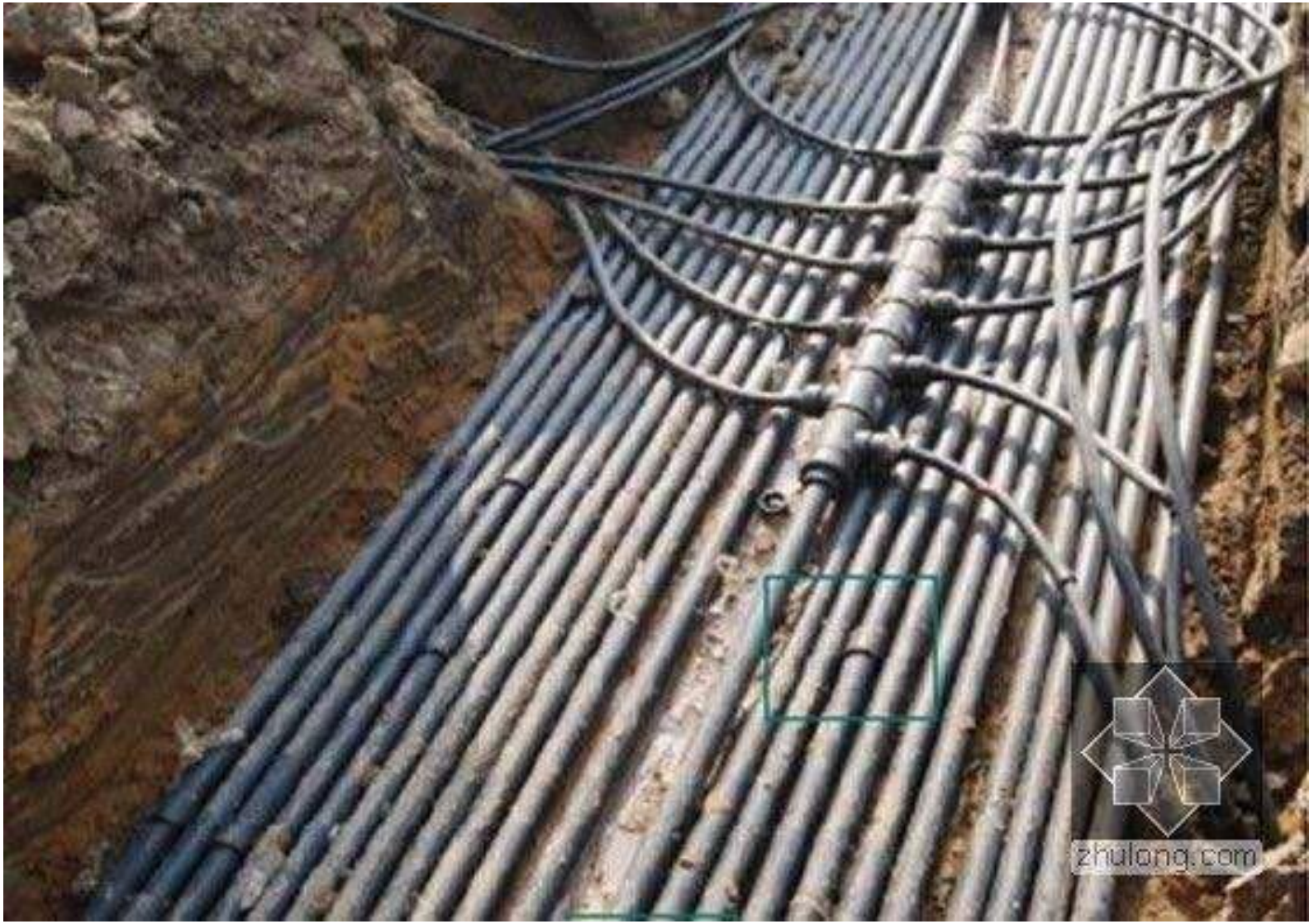


GSHP



Energy Piles


www.ec360.com


zhulong.com

Energy Saving System Guide

1、
Ground Source Heat Pump System

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Sea Water Source Heat Pump System

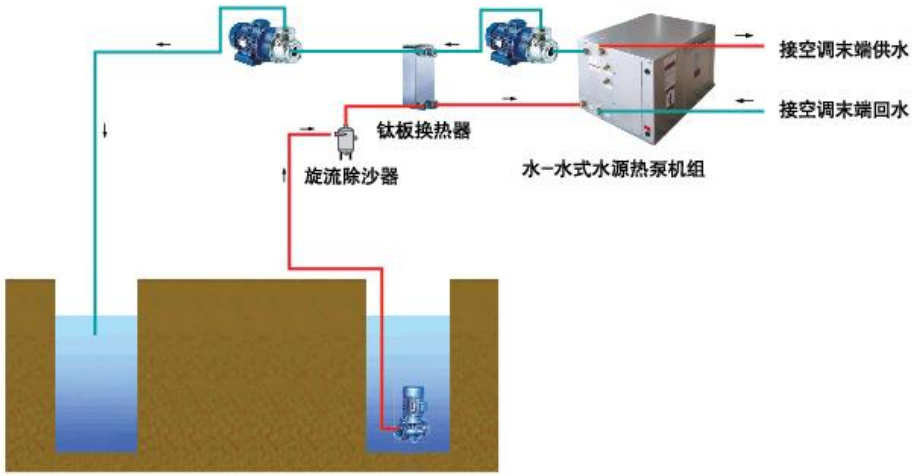
5、
Sewage Water Source Heat Pump

6、
Water Loop heat Pump System

7、
Hybrid System

Ground Water Heat Pump

- Water is pumped from well, city-water, lake or pond, and then discharge to another well/ lake/pond near by.



- Temperature range of the ground water (11℃ - 23℃ all year round)

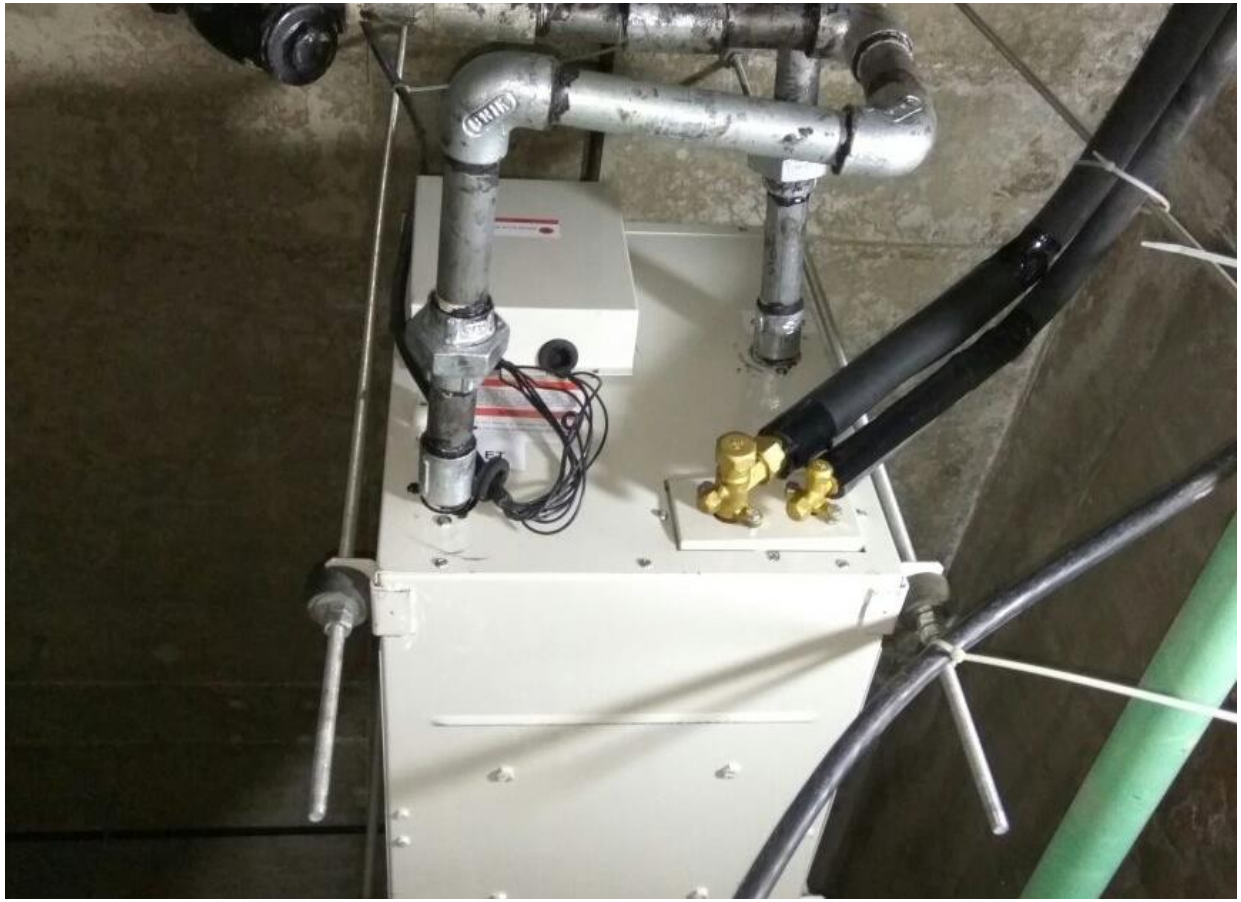
- Low initial cost, low operating cost

Submersible Pump Motor

PVC pipe being inserted in bore with the use of machine.

Heat exchanger

Copmressor Units



Geo Units

Compressor units

Compressor Units


HONDA
HONDA
HONDA

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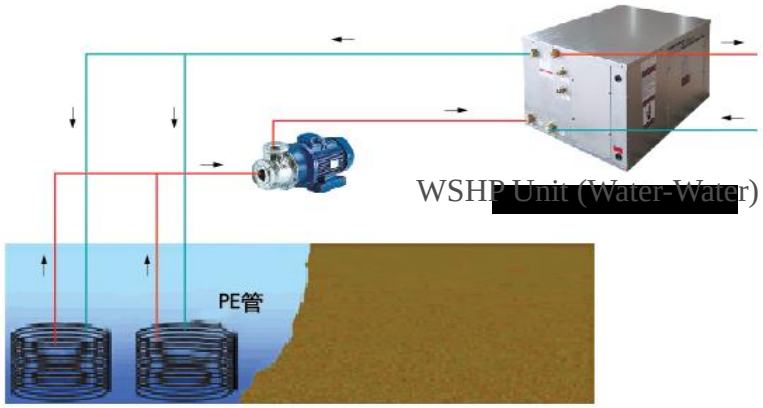
Surface Water Heat Pump

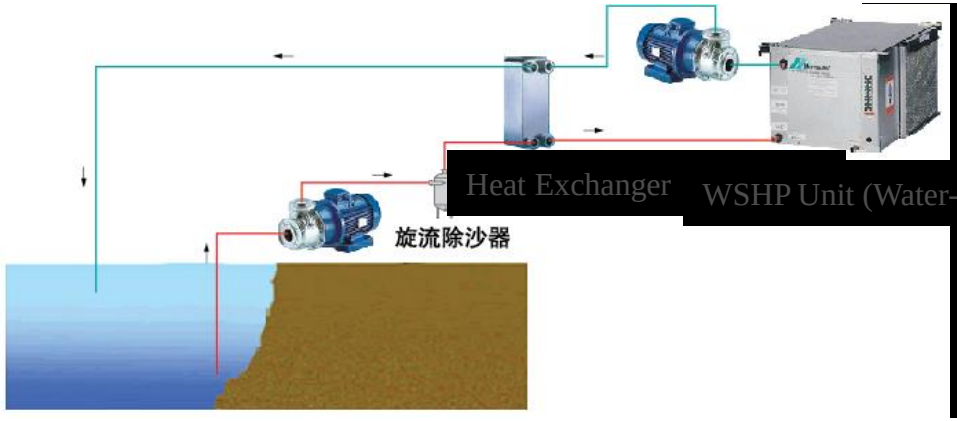


Supply Water (To The Load)

Return Water (From The Load)

WSHP Unit (Water-Water)

- Closed Loop

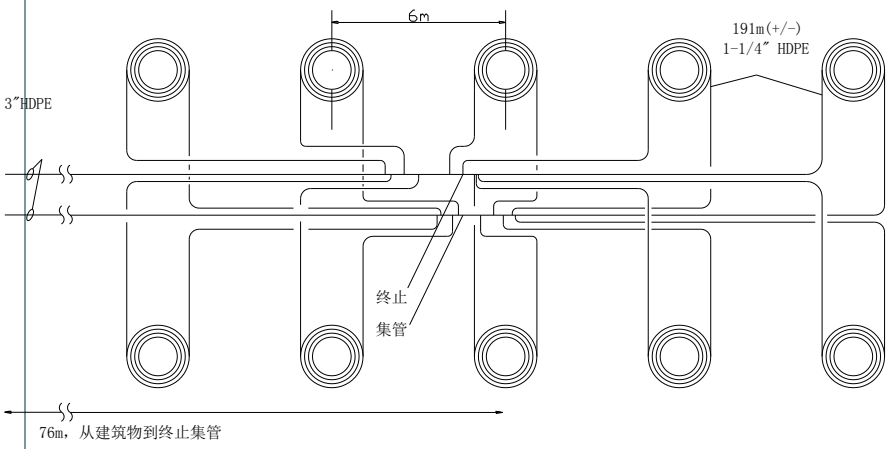


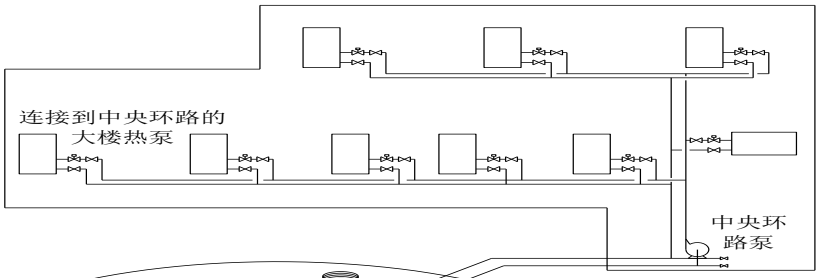
Heat Exchanger

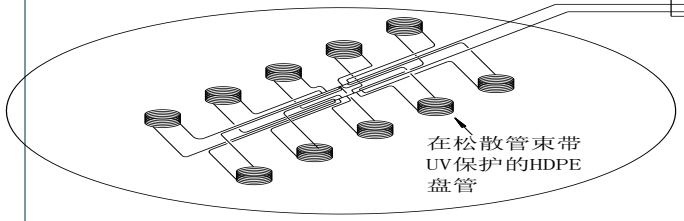
WSHP Unit (Water-Air)

- Open Loop

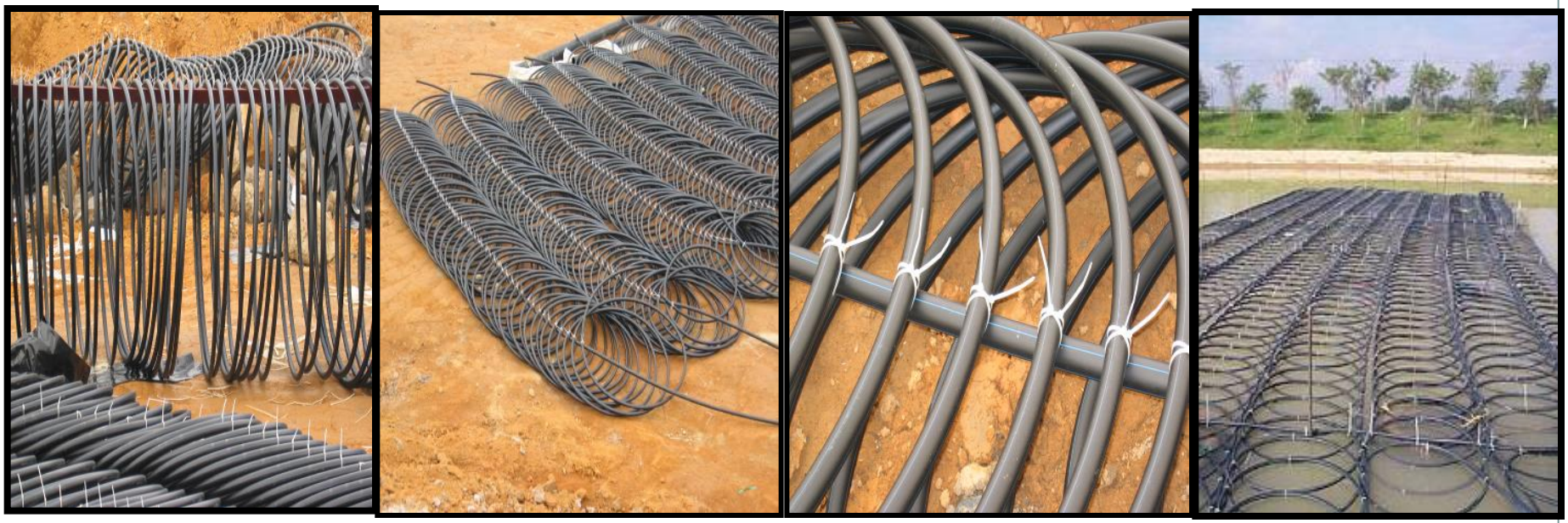
Surface Water Heat Pump







Surface Water Heat Pump



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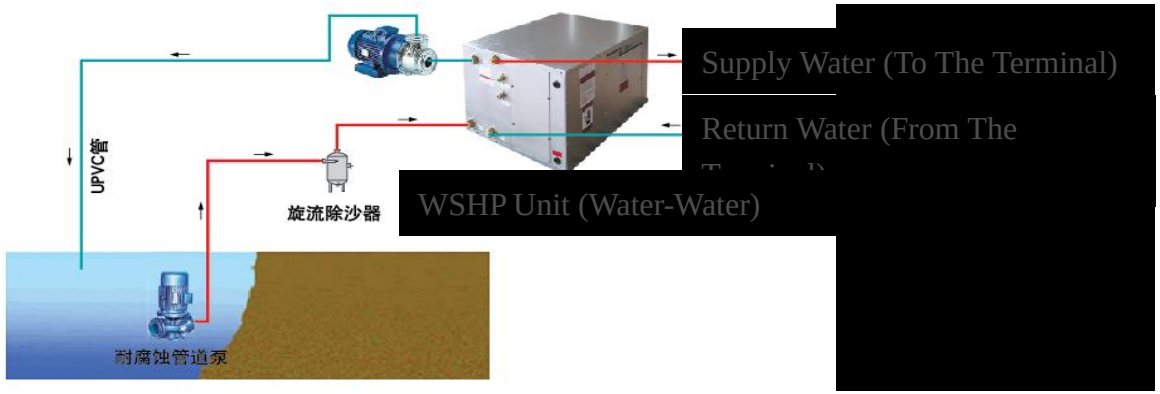
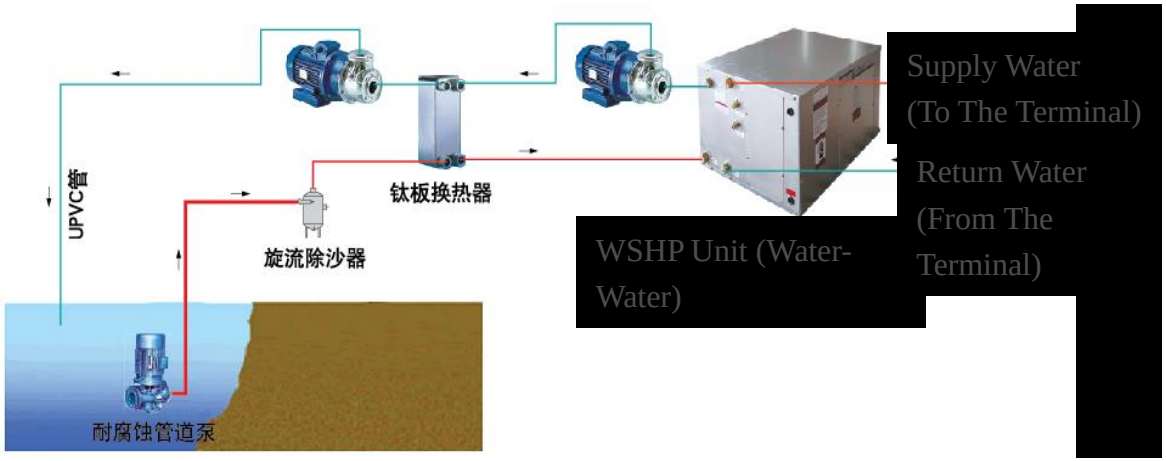
Sea Water Source Heat Pump

No Boiler, No Cooling Tower



- **Without Heat Exchanger**



- **With Heat Exchanger**

Sea Water Mech Room

Sea Water Mech Room

Sea Water Project - Olympic Sail Center

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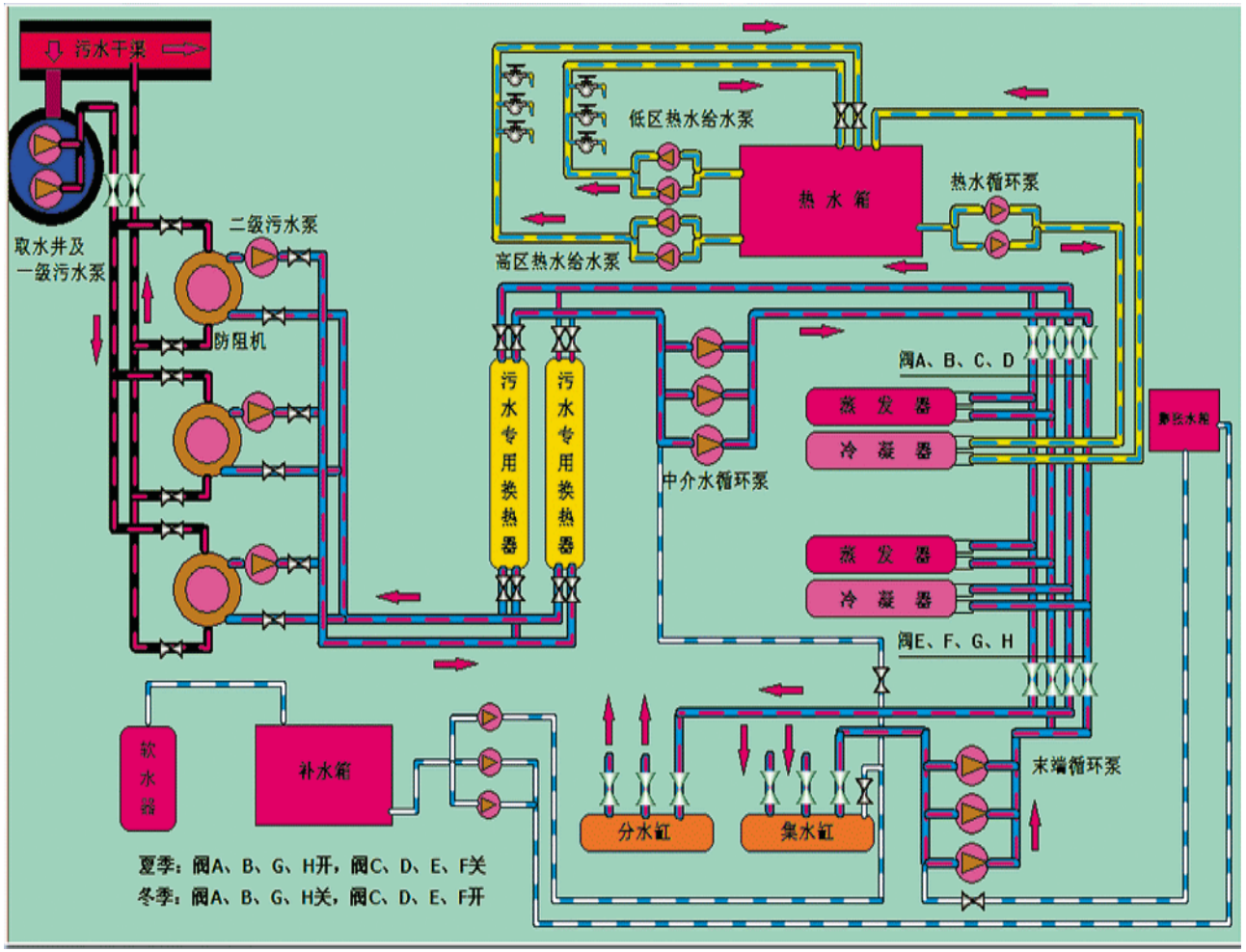
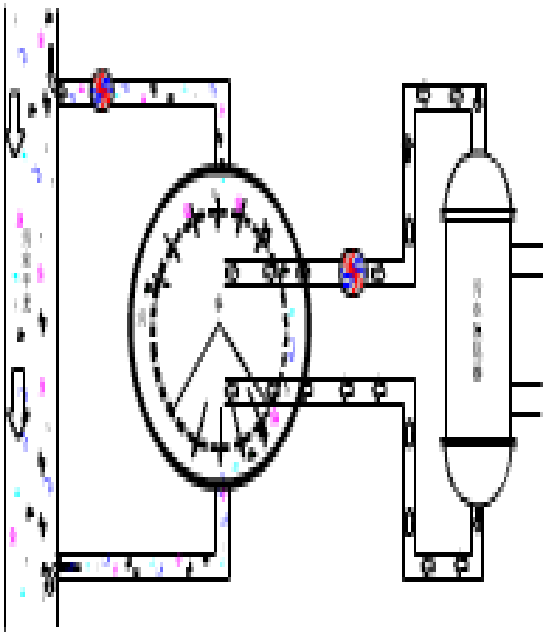
Raw Sewage Energy Recovery Filter Unit

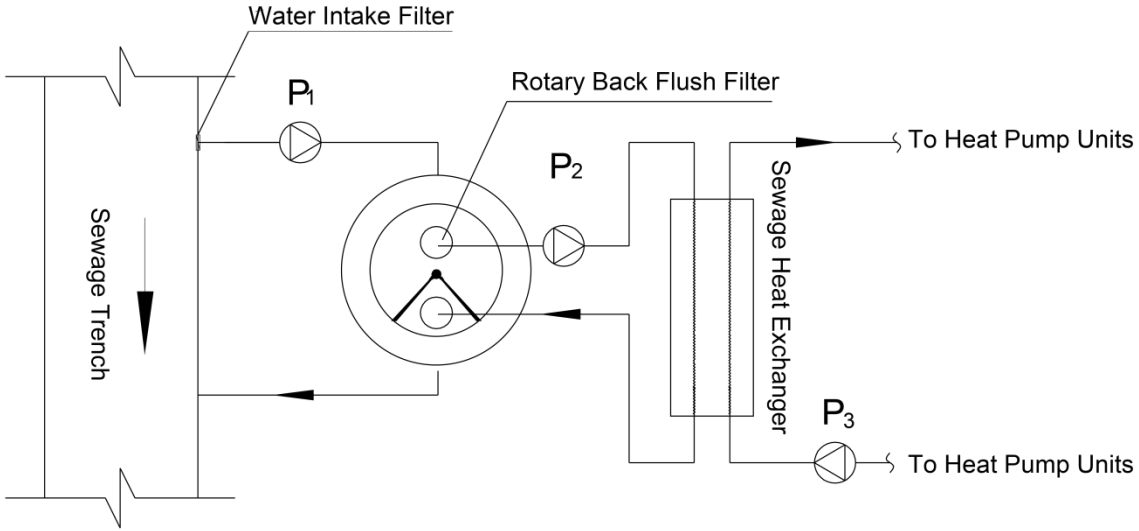




GREEN ENERGY PRODUCTS

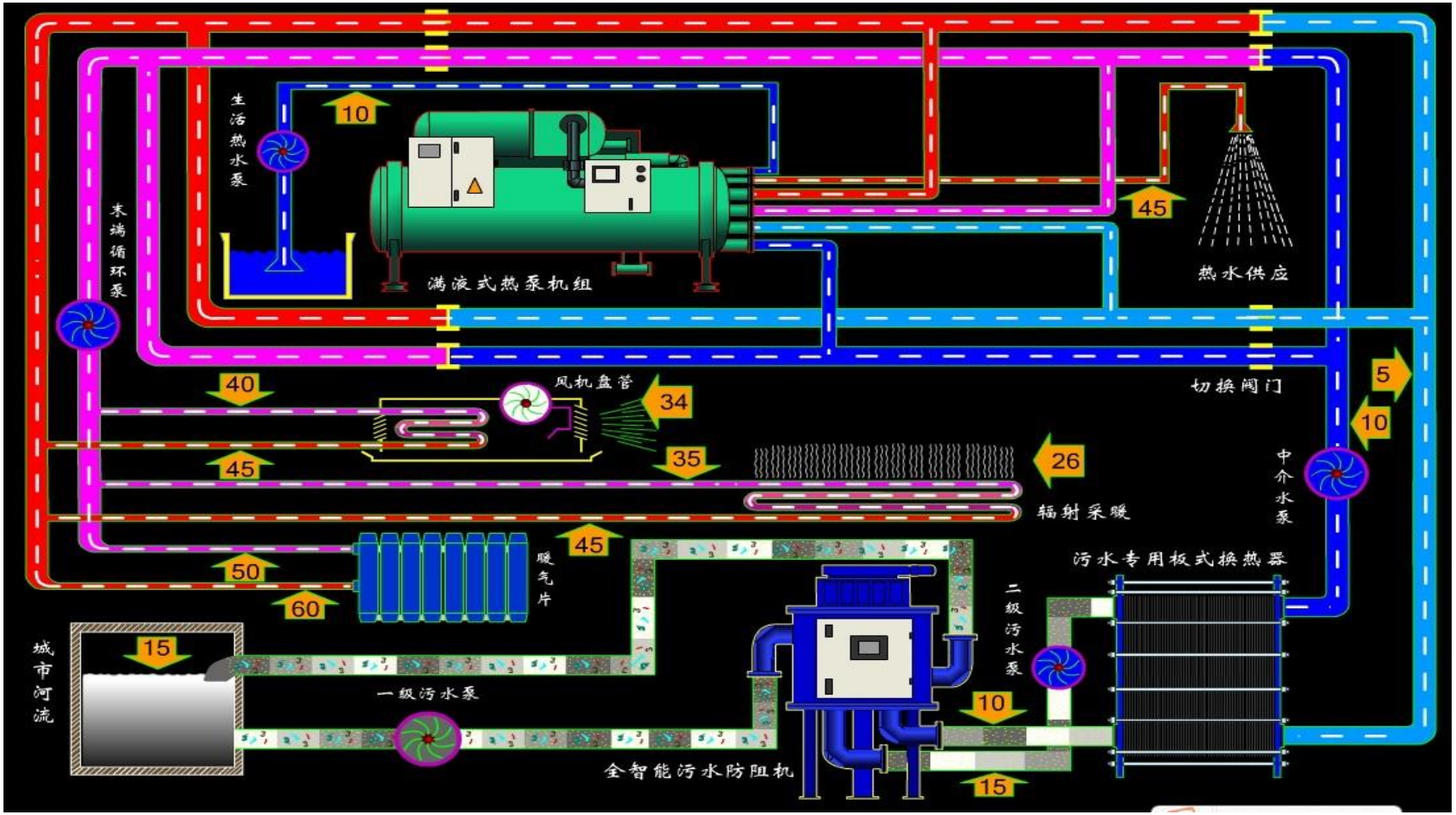
Sewage Energy Recovery Filter Unit

The Auto-Flush (Anti-Clog) Sewage Water Filter Unit is the core equipment of Sewage Source Heat Pump System. It is used to filter raw untreated sewage solids/debris allowing sewage water (without solids/debris) to go thru Sewage Source Heat Pump Units or Sewage Source Heat Exchangers for energy recovery and then to return to auto-flush the filtered solids/debris back to the sewage system. This would ensure a continuous operation without clogging while utilizing Raw Sewage Water as Heat Sink and Heat Source.



GREEN ENERGY PRODUCTS

Raw Sewage Energy Recovery Filter Unit



Beijing Railway Station using sewage Recovery


车次 终到站 开点 检票口 状态
Train To Departs Gate Status
G237 SHENYANG 14:30 20 Stop Che
G143 SHongqiao 14:31 7 Stop Che
G145 SHongqiao 14:36 14 Check In
C2061 TianJin 14:40 19 Check In
G161 ANQING 14:41 10 Check In
G193 QingDao 14:46 16 Check In
C2063 TianJin 14:49 18 Waiting
C2065 TianJin 15:00 23 Waiting
G17 SHongqiao 15:00 12 Waiting
G393 HaErBinXi 15:05 9 Waiting
G35 HANGZHOUDON 15:10 11 Waiting
C2225 TianJin 15:12 22 Waiting
15:15 10 Waiting
15:20 15 Waiting
15:31 8 Check In
15:32 21 Waiting
15:36 7 Waiting
车次 终到站 开点 检票口 状态
Train To Departs Gate Status
C2069 TianJin 15:45 18 Waiting
G147 SHongqiao 15:46 17 Waiting
C2227 TianJin 15:50 19 Waiting
G21 SHongqiao 16:00 11 Waiting
C2071 TianJin 16:02 20 Waiting
G37 HANGZHOUDON 16:05 12 Waiting
C2229 TianJin 16:08 22 Waiting
G195 QingDao 16:10 9 Waiting
C2589 YUJIAPU 16:19 19 Waiting
G149 SHongqiao 16:25 10 Waiting
C2073 TianJin 16:32 23 Waiting
G151 SHongqiao 16:35 7 Waiting
C2075 TianJin 16:41 21 Waiting
G197 QingDao 16:42 13 Waiting
G39 HANGZHOUDON 16:47 8 Waiting
C2077 TianJin 16:49 18 Waiting
G23 SHongqiao 17:00 16 Waiting
广告
中国梦·梦之蓝
足球梦想 激情中超
车次 终到站 开点 检票口 状态
Train To Departs Gate Status
G239 JILIN 17:00 19 Waiting
C2231 TianJin 17:09 22 Waiting
G9005 TianJinXi 17:10 17 Waiting
G153 SHongqiao 17:15 11 Waiting
G155 SHongqiao 17:20 15 Waiting
C2079 TianJin 17:23 21 Waiting
G199 QingDao 17:25 10 Waiting
C2233 TianJin 17:31 23 Waiting
G267 HeFeiNan 17:38 12 Waiting
G157 SHongqiao 17:43 8 Waiting
C2081 TianJin 17:45 19 Waiting
G159 SHongqiao 17:48 9 Waiting
C2235 TianJin 17:52 18 Waiting
G201 NanJingNan 18:05 11 Waiting
C2613 TianJinXi 18:06 22 Waiting
G9917 TangShan 18:10 10 Waiting
C2083 TianJin 18:14 20 Waiting
车次 终到站 开点 检票口 状态
Train To Departs Gate Status
G331 JiNanXi 18:18 7 Waiting
C2591 YUJIAPU 18:22 21 Waiting
C2237 TianJin 18:28 19 Waiting
G203 NanJingNan 18:28 12 Waiting
G269 HeFeiNan 18:35 9 Waiting
C2085 TianJin 18:40 22 Waiting
G9007 TianJinXi 18:49 11 Waiting
C2087 TianJin 18:52 23 Waiting
G271 HeFeiNan 18:55 8 Waiting
G7 SHongqiao 19:00 7 Waiting
G1567 SHANGQIU 19:05 17 Waiting
C2089 TianJin 19:06 20 Waiting
G207 XuZhouDong 19:10 10 Waiting
C2131 TianJin 19:14 18 Waiting
C2239 TianJin 19:26 22 Waiting
G9009 TianJinXi 19:26 15 Waiting
G4961 JiNan 19:31 14 Waiting
检票口 10
检票口 11
商务座候车区
Business Class Lounge
(5:30-17:00)
前方70米
请您接受液体安检

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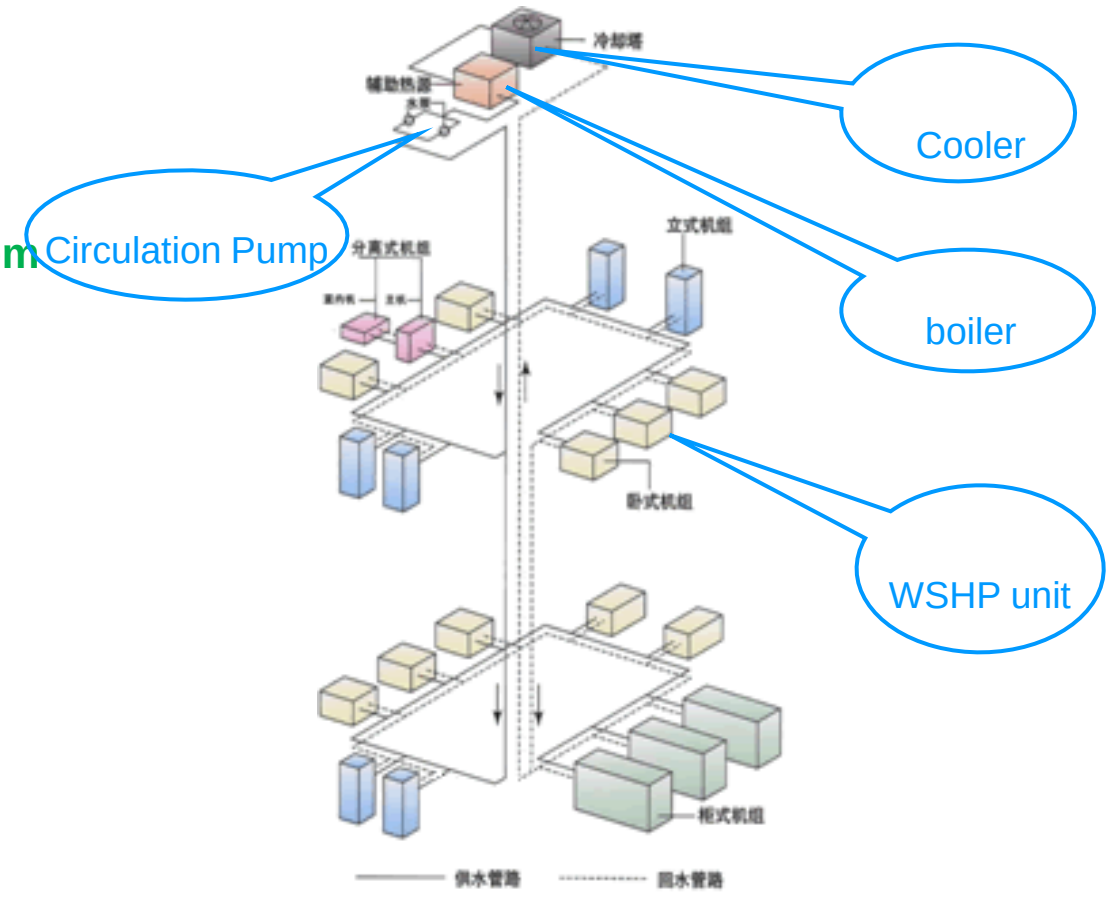
WSHP Principle

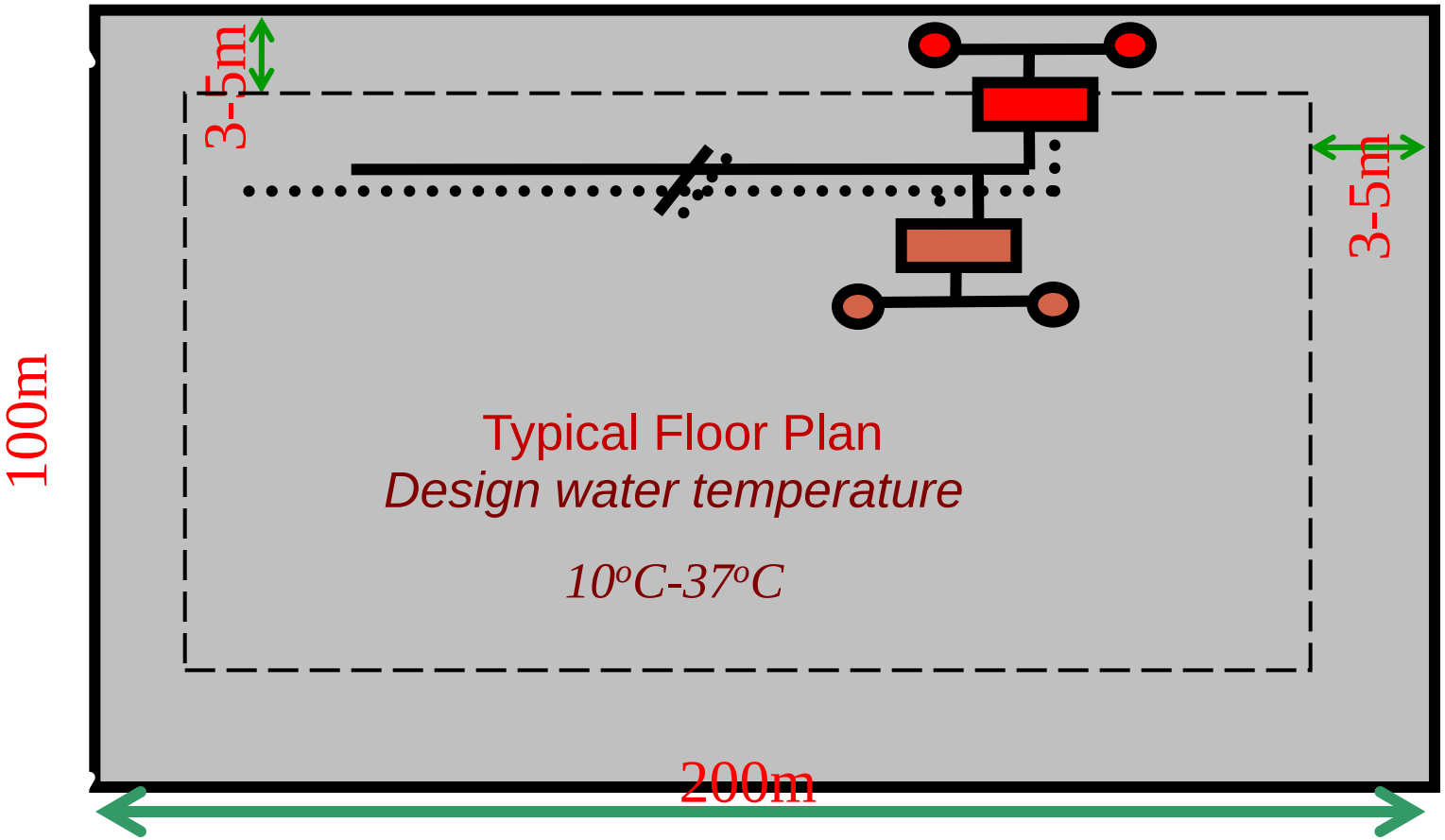
- **Piping system**
- **System control box & Room thermostat**

KISS

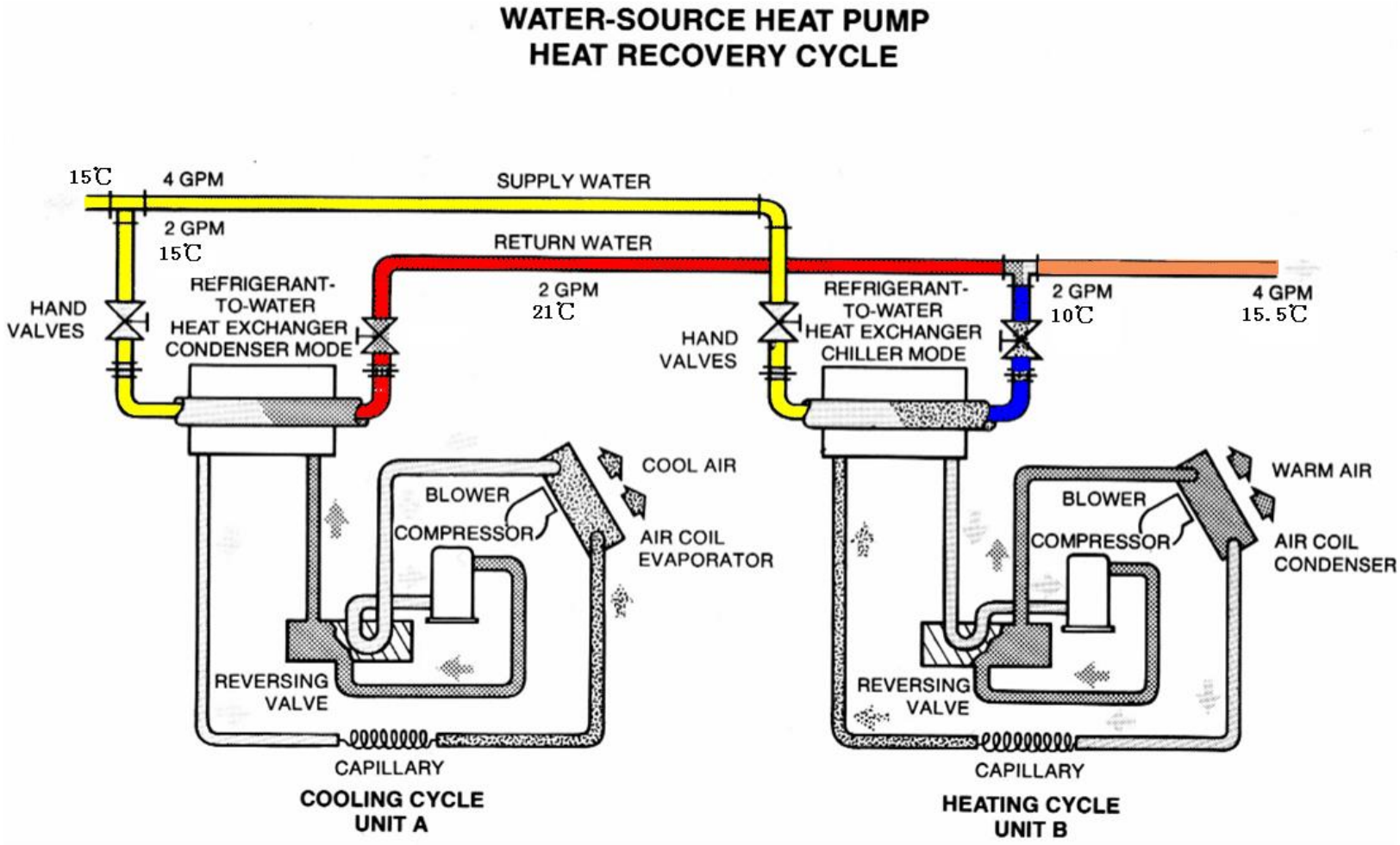
Keep It Simple & Safe



WSHP Principle



WSHP Principle



Nanjing Int'l Center (I) 220,000 sq.m.

WSHP System

Cooling Tower + Plate Heat Exchanger

Gas Fired Boiler

Total Area：450,000m^2

Phase I： 220,000m^2

Two 38 Storey & Podium

Energy Saving System Guide

1、
Ground Source Heat Pump System

2、
Ground Water Source Heat Pump System

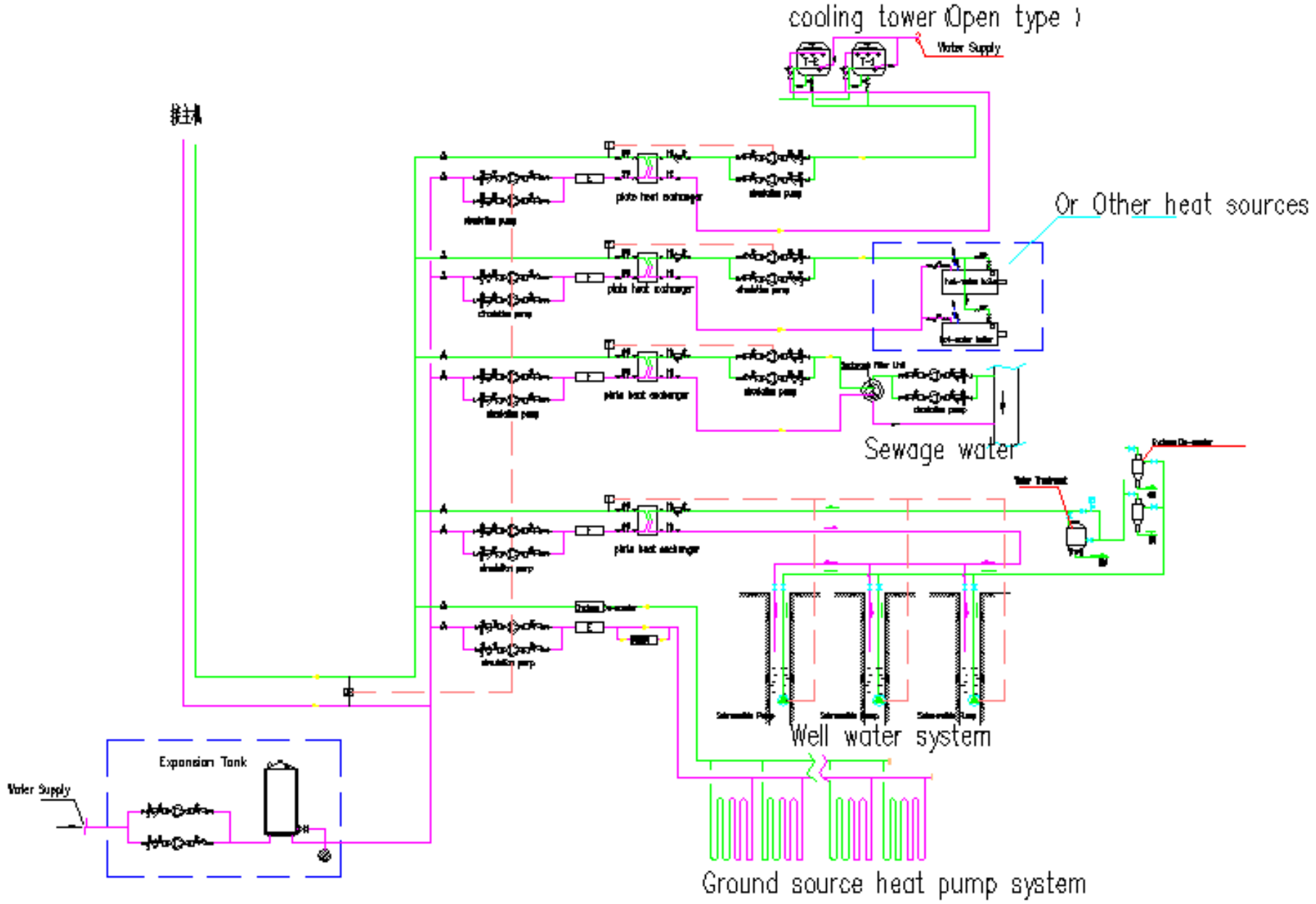
3、
Surface Water Source Heat Pump System

4、
Sea Water Source Heat Pump System

5、
Sewage Water Source Heat Pump

6、
Water Loop heat Pump System

7、
Hybrid System



Water source Heat Pump Energy Saving System Diagram

Annexure- I

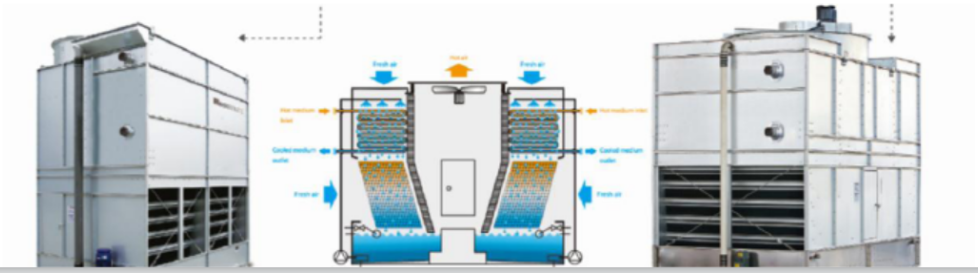
Project and design description

Design Parameters

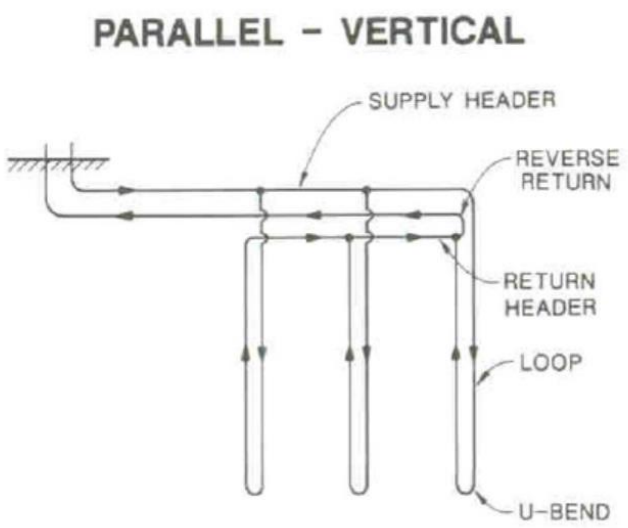
Out Side Temperature : 45 deg. C, 18% RH.
Inside Temperature : 25 deg. C, less than 60% RH.

Closed Circuit Cooling Tower:

a) **Make:** Rosemex Cooling Towers.
b) **Capacity:** 3 nos x 125 TR.



Geothermal Energy Piles:



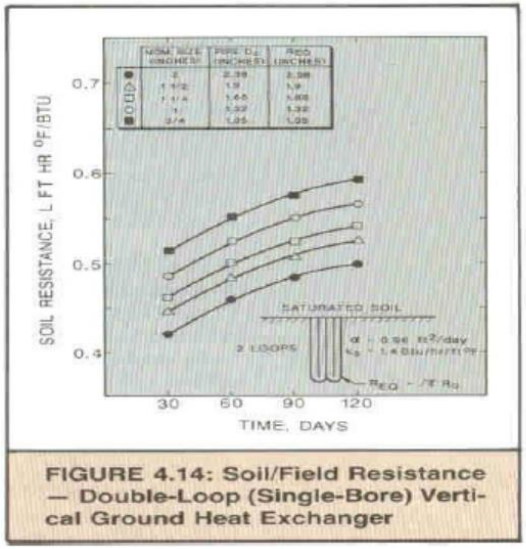
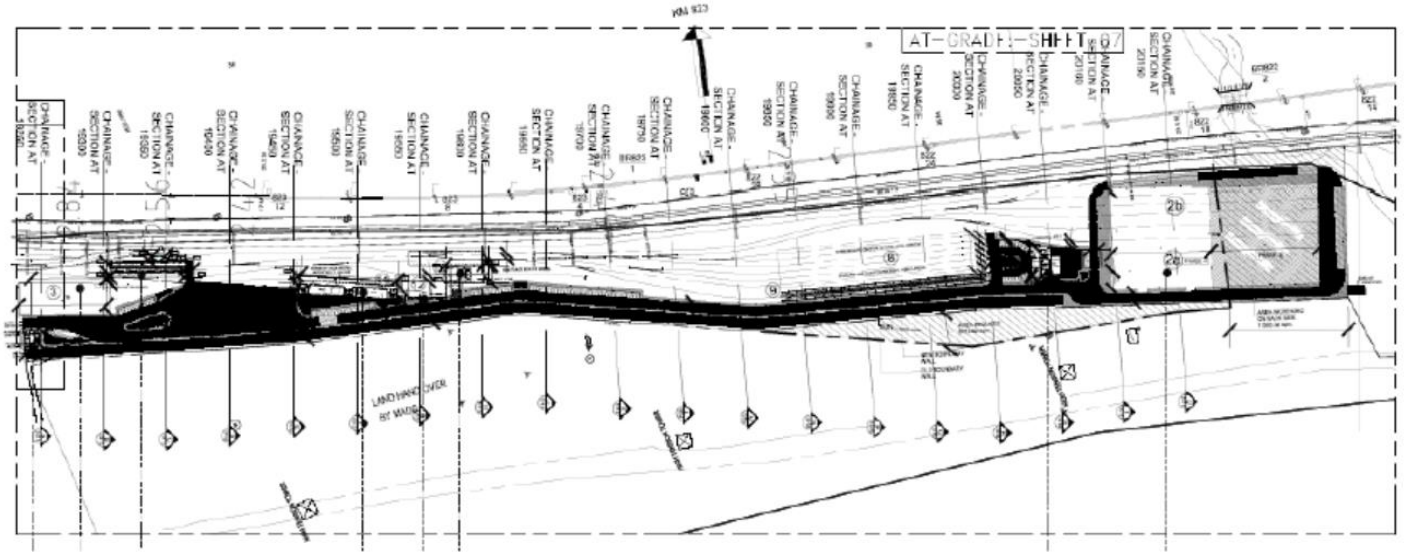


FIGURE 4.14: Soil/Field Resistance — Double-Loop (Single-Bore) Vertical Ground Heat Exchanger

Project outline

The proposed project is an office building. The air conditioning system of this project is designed with Energy Piles and closed circuit cooling tower with Water Cooled VRF units.



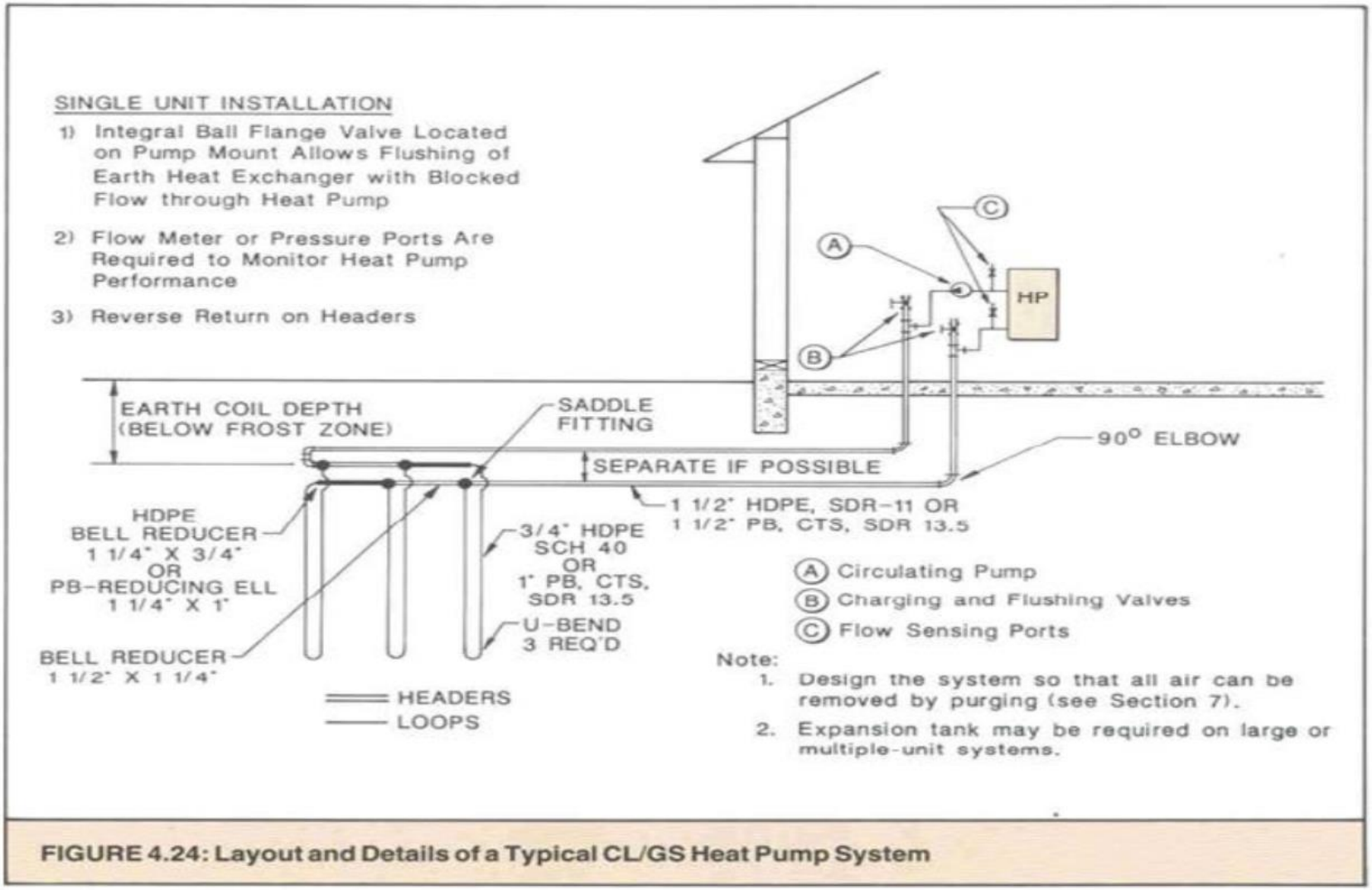
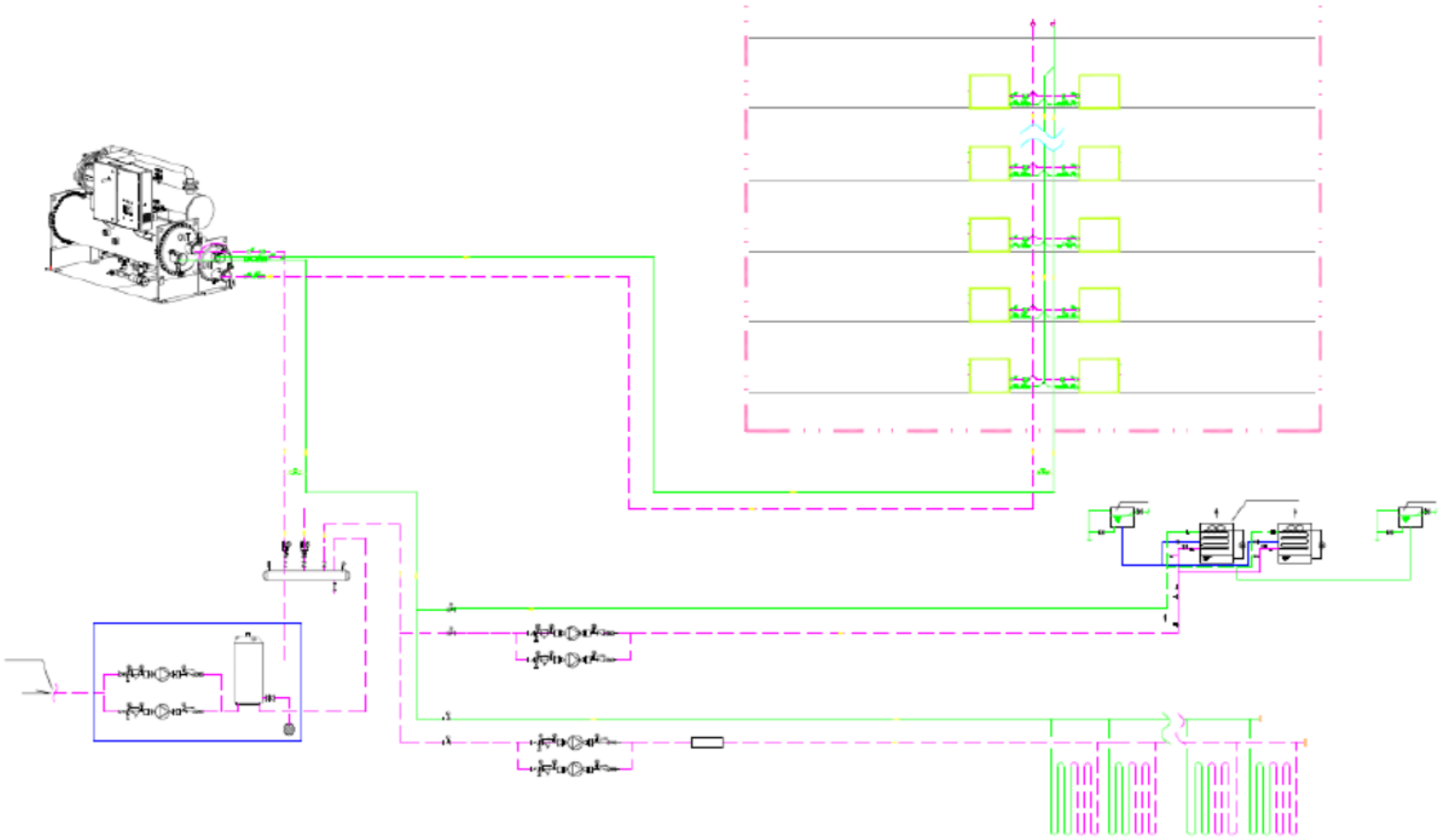


FIGURE 4.24: Layout and Details of a Typical CL/GS Heat Pump System



Case in point

- Large Hospital In Delhi
  - Tonnage – 4000 TR, Heating 600000 Kcal
  - Energy Consumption
  - Summer (8 months)
    - Electricity – 12 Crores for Cooling
    - HSD – 0.9 Crores for Hot Water
  - Winter (4 months)
    - Electricity - 2 Crores for Cooling
    - HSD – 0.8 Crores for Hot Water

Case in point – with 4 Pipe

- Large Hospital In Delhi
  - Tonnage – 3000 TR, 100% heat Recovery of 1000 TR, Geo Thermal for 650 TR, Sewage for 350 TR, Closed circuit for 3000 TR
  - Energy Consumption
  - Summer (8 months)
    - Electricity – 10 Crores for Cooling (saving in Geo thermal 0.75 C, Sewage 0.4 C & CCCT – 0.85 C)
    - HSD – 0.1 Crores for Steam
  - Winter (4 months)
    - Electricity - 1.6 Crores for Cooling (saving in Geo thermal 0.15 C, Sewage 0.08 C & CCCT – 0.17 C)
    - HSD – 0.05 Crores for Steam
- Extra Cost for spent in Capital Cost over Chiller + Hot water Generator : Rs 3 Crores
- Yearly Savings : Rs. 3.95 Crores
- **Payback : 9 months**
- **Savings in 25 years : Rs 96 Crores**

ORC Technology

Clean Renewable Power Generation

170 °F to 600 °F Heat Source Input Range

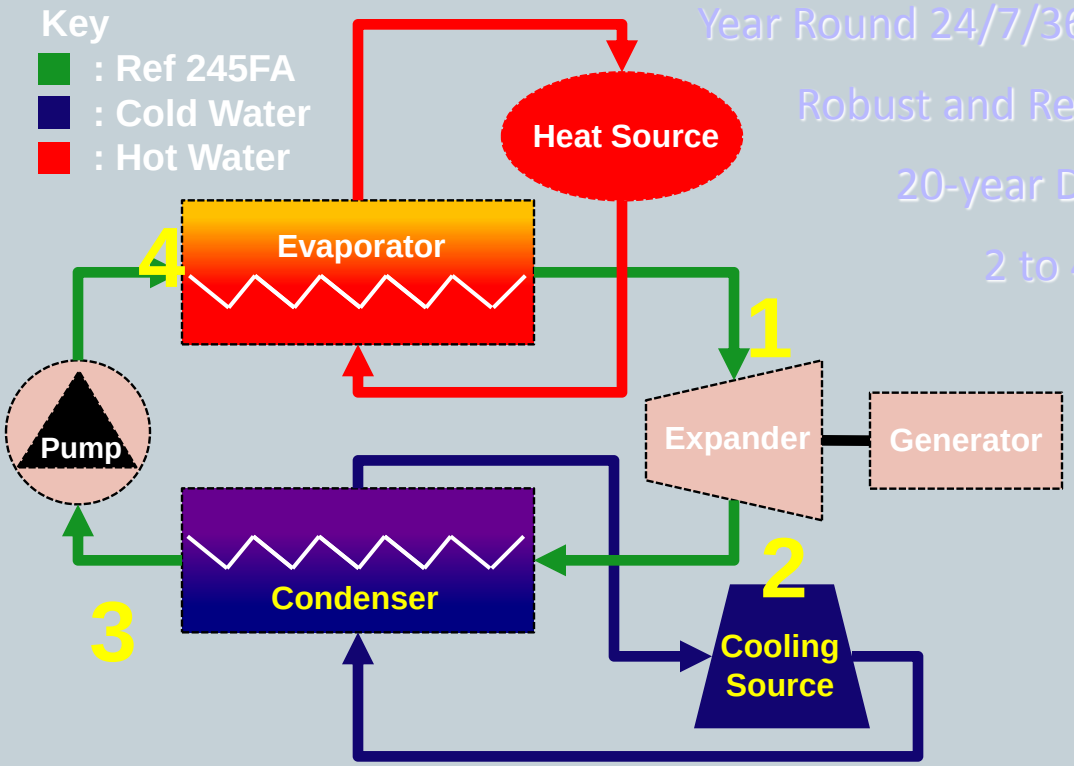
Modular and Scalable to Larger Plants

Year Round 24/7/365 Operation

Robust and Reliable Components

20-year Design Life

2 to 4 Year Payback



Low-Quality Sources

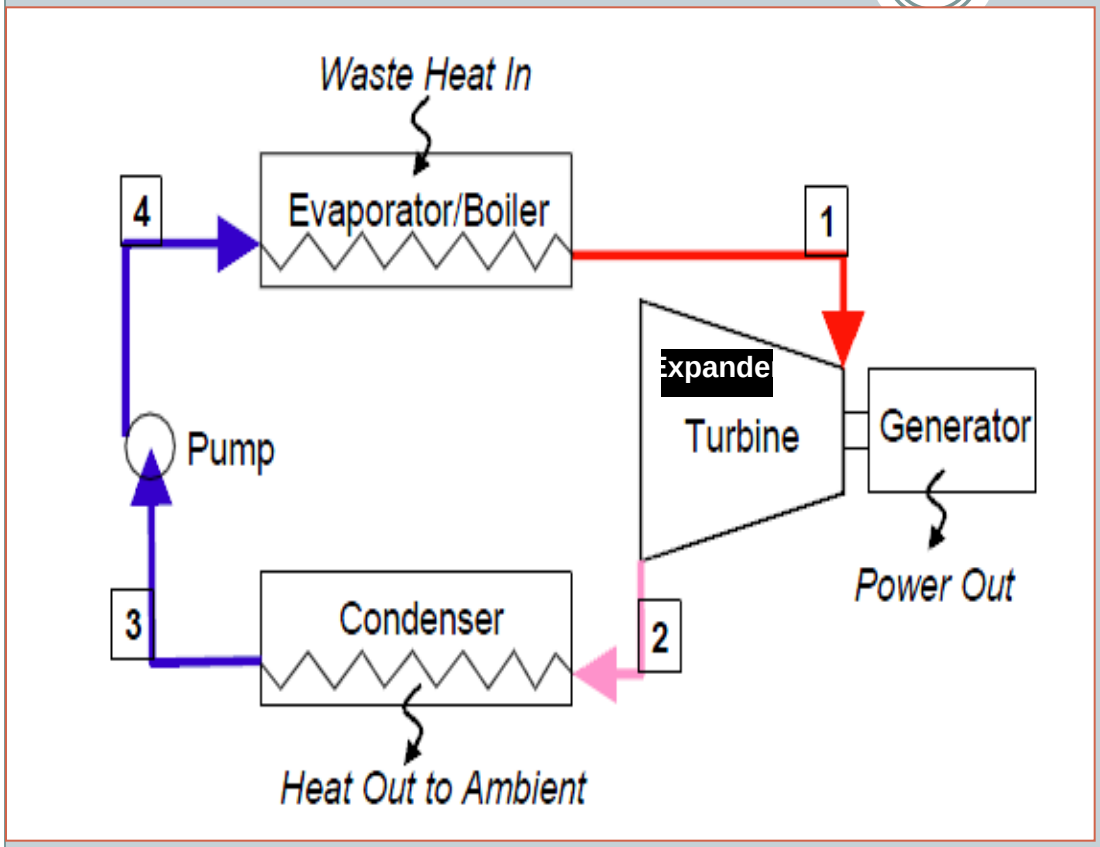
Bio-Mass

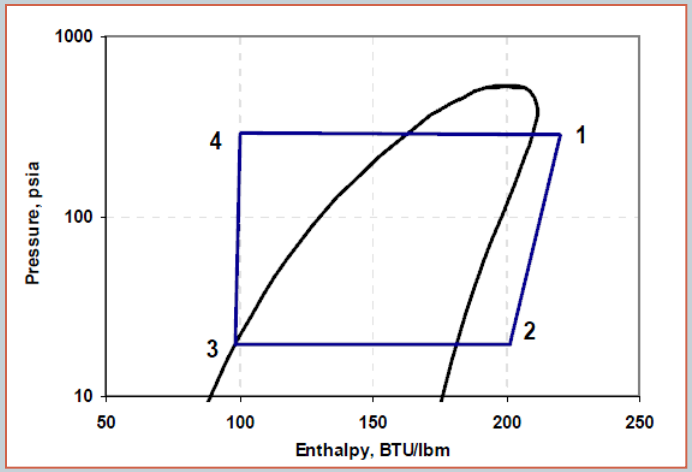
Geo-Thermal

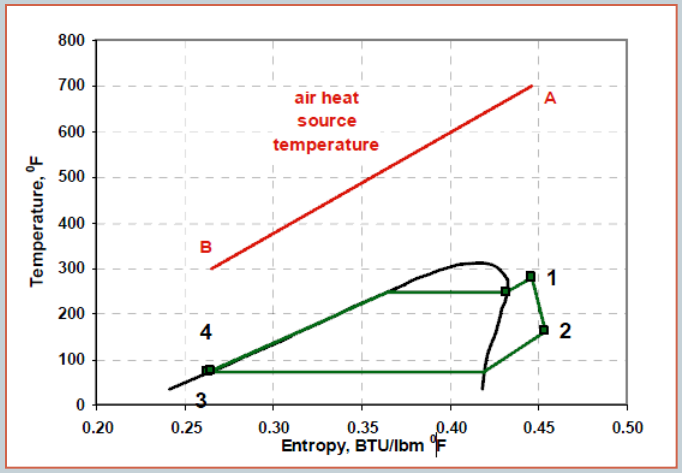
Industrial Process

Stack Exhaust

ORC Technology: *Standard cycle*

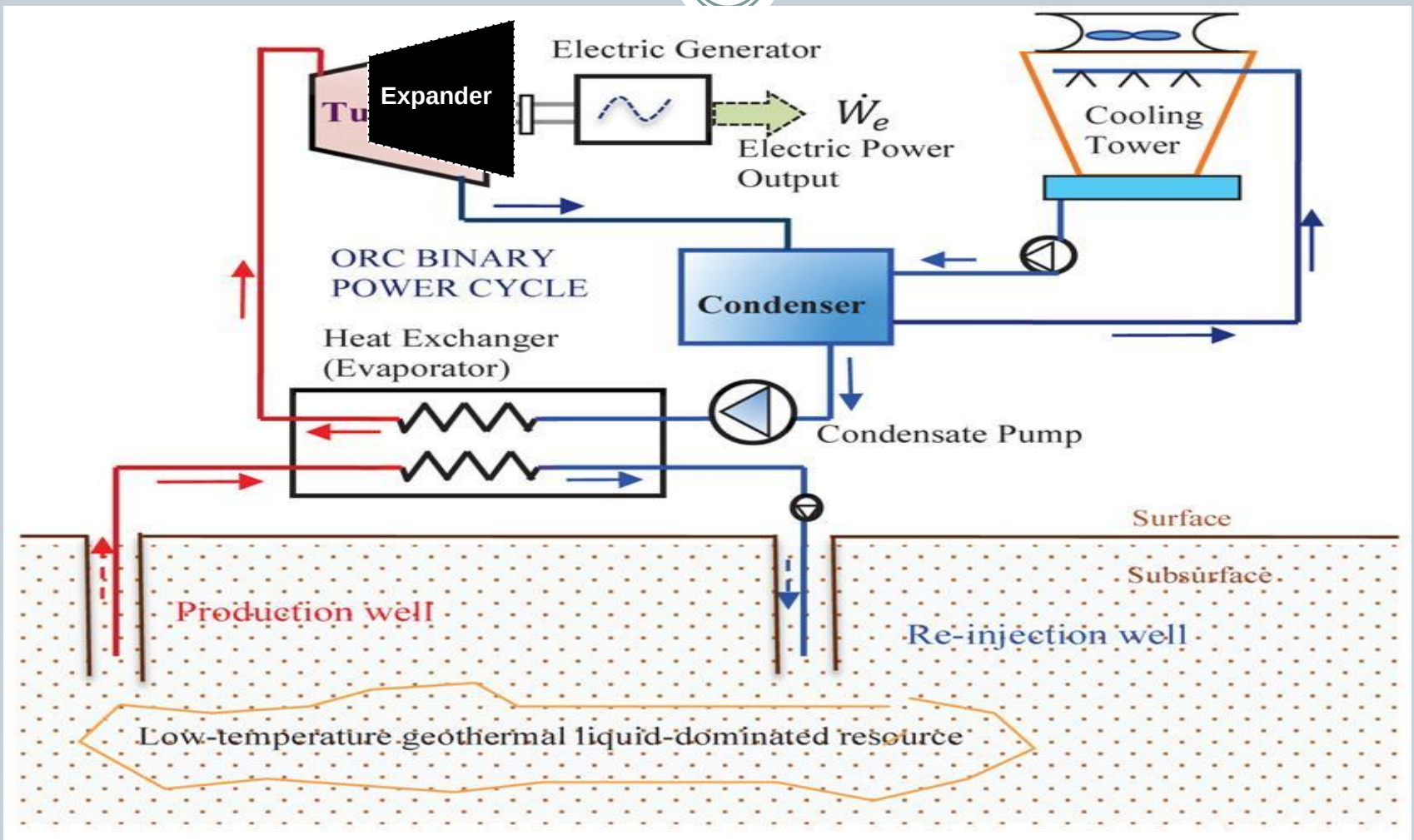






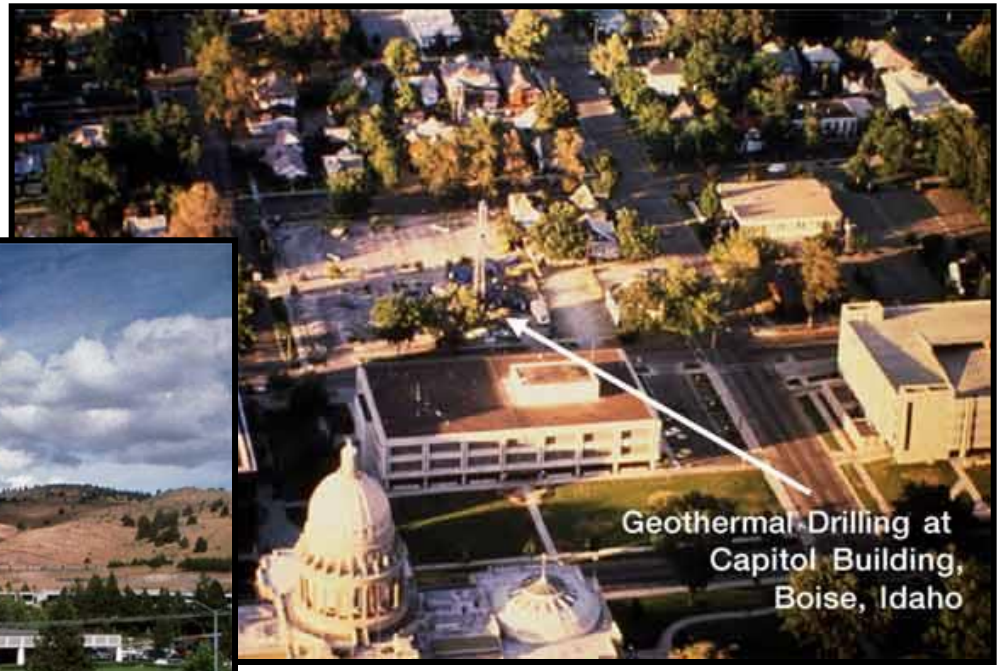
Sensible heat is lost in condenser limiting maximum cycle efficiency.

Applications: Geothermal



ORC Installations: *Steel Mill (3000 KW)*

Projects Overseas



Projects Overseas

Opus Corporation

20,000,000

- **Minneapolis 600,000 sqft**

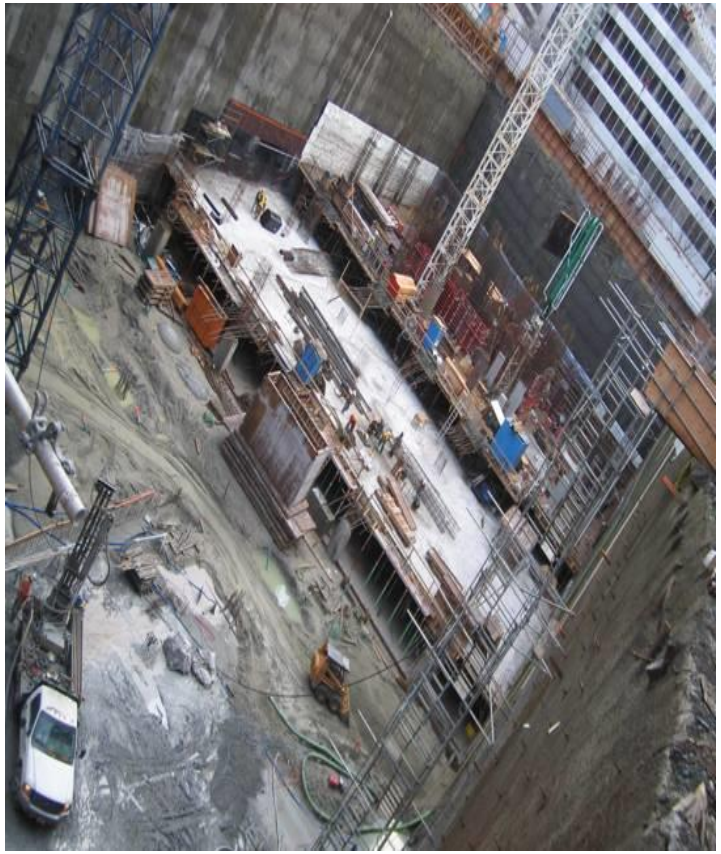
Projects Overseas

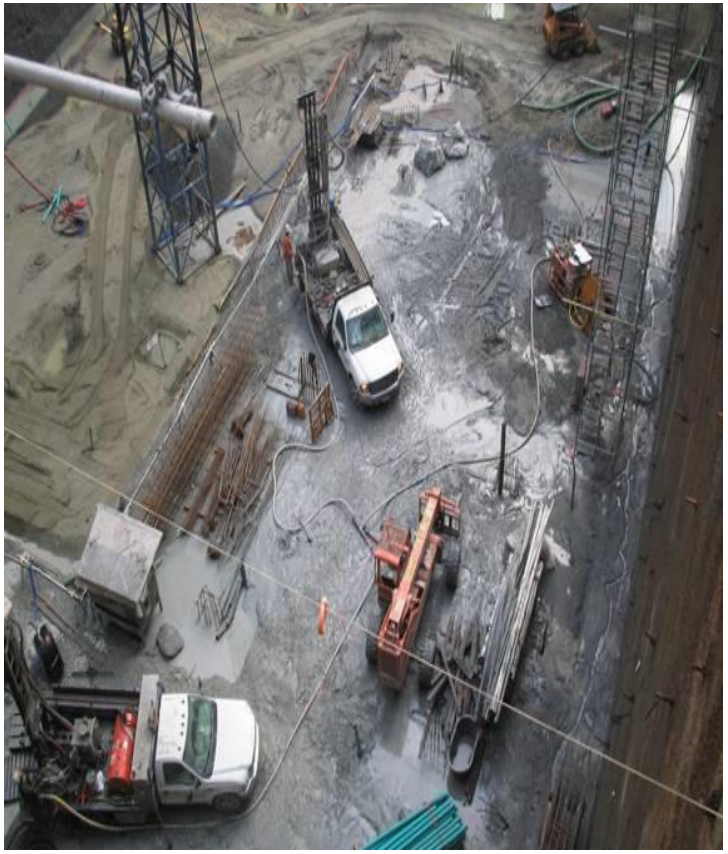
Columbia Seafirst Center

•76 stories, 1,500,000 sqft

Projects

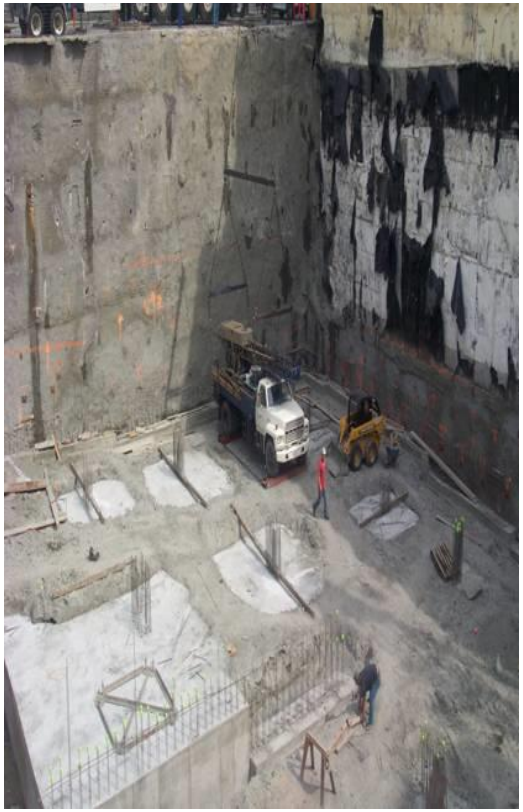
Shangri-la Hotel Apt





Projects

Shangri-la Hotel Apt



Part One

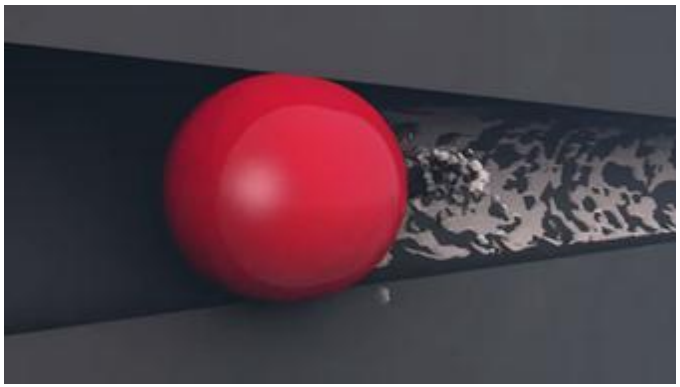
Performance of HVAC Systems at ASHRAE HQ

BY L.E. SOUTHARD, P.E., MEMBER ASHRAE, XIAOBING LIU, PH.D., MEMBER ASHRAE; AND J.D. SPITLER, PH.D., P.E., FELLOW ASHRAE

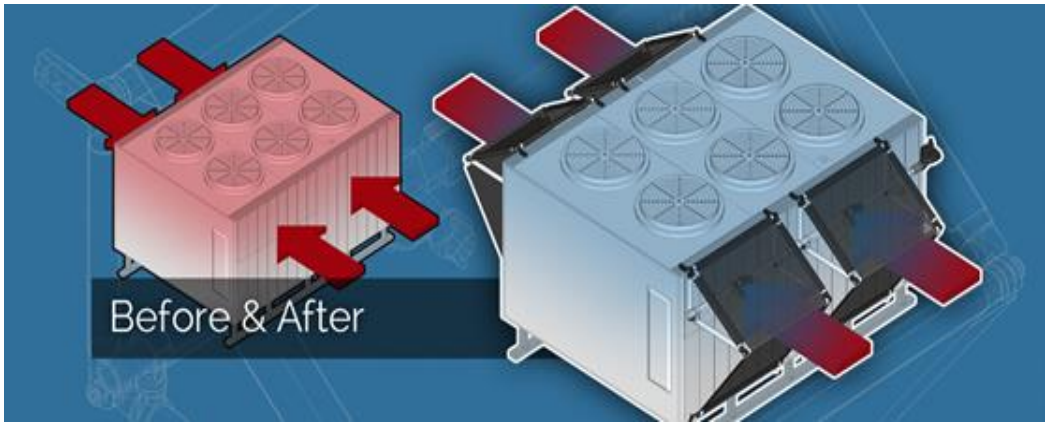
When ASHRAE headquarters in Atlanta was renovated in 2008, one goal was to create a living lab that could be accessed by members to learn about commercial building performance and state-of-the-art sustainable technology. As a part of this living lab concept, the building uses three separate HVAC systems: a variable refrigerant flow (VRF) system for spaces on the first floor, a ground source heat pump (GSHP) system, primarily for spaces on the second floor, and a dedicated outdoor air system (DOAS), which supplies fresh air to both floors.

“During the two-year study period, the GHP system used 29 percent less energy in the summer and 63 percent less energy in the winter/shoulder seasons than the VRF system while maintaining similar zone temperatures,” Spitler said.
“The underlying difference between the geothermal system and the air-source VRF system lays in the heat sink and source: ground vs. ambient air,” Spitler continued. “Though the control strategy for the VRF system resulted in longer runtimes compared to the geothermal system, it is clear that ground-loop water supply temperatures were more favorable than ambient-air temperatures for heat-pump operation. This allows the geothermal equipment to operate at higher efficiencies.”
“Final Report, Performance of the HVAC Systems at the ASHRAE Headquarters Building” is available at https://www.geoexchange.org/library/download-info/performance-hvac-systems-ashrae-headquarters-building/.

1. Online Condenser Tube Cleaning Balls: Sponge-ball type tube cleaning system technology has been a widely-adopted best practice for optimizing condenser performance in the power generation industry for decades. Advances in tube cleaning system technology have resulted in more effective and reliable systems with enhanced scalability. Case studies from across the US demonstrate realized energy efficiency gains up to 15% or more in HVAC applications. Coupled with increasing energy costs and intensifying focus on energy conservation, sponge-ball type cleaning system represents a good opportunity for facility managers to save energy, reduce maintenance costs, and lengthen chiller life expectancy.
   Application: Cleaning system for Water Cooled Chiller.
   Savings: 15% Annual cost savings.
   Payback: One year.
   Advantage: Heat transfer continuously occurs at maximum efficiency, Online heat exchanger cleaning requires no process shutdown, Chemical-free no chemical handling or disposal hassle, Fully automatic for effortless maintenance

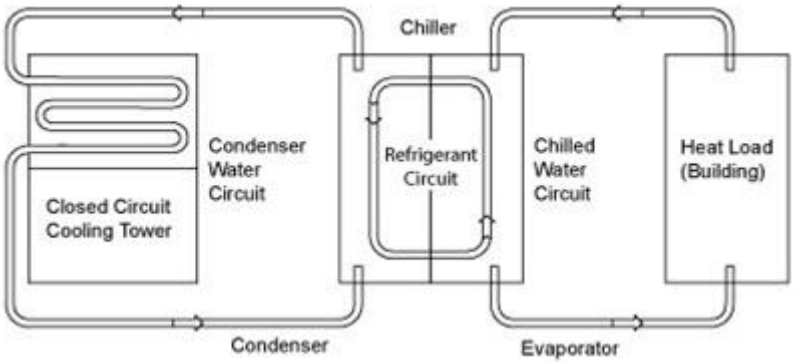


1. Adiabatic Kit for Air Cooled Chiller: The Adiabatic Kit for Air Cooled Chiller is equipped with an innovative evaporative system which allows considerable energy savings, exploiting the natural process of adiabatic cooling: the hot and dry air withdrawn from the environment passes through spray of fine mist. This can cool the ambient air by as much as 30°C from 43°C ! The cooling effect allows to reduce the condensing temperature obtaining a considerable reduction of the pressure ratio of the compressor, with many energetic benefits. By regulating the spray of a fine water mist onto the mesh we can adjust the adiabatic cooling properties of the Air cooled Chiller.
   Application: Energy saving kit for Air Cooled Chiller.
   Savings: 15-25% Annual cost savings.
   Payback: 4-6 months.

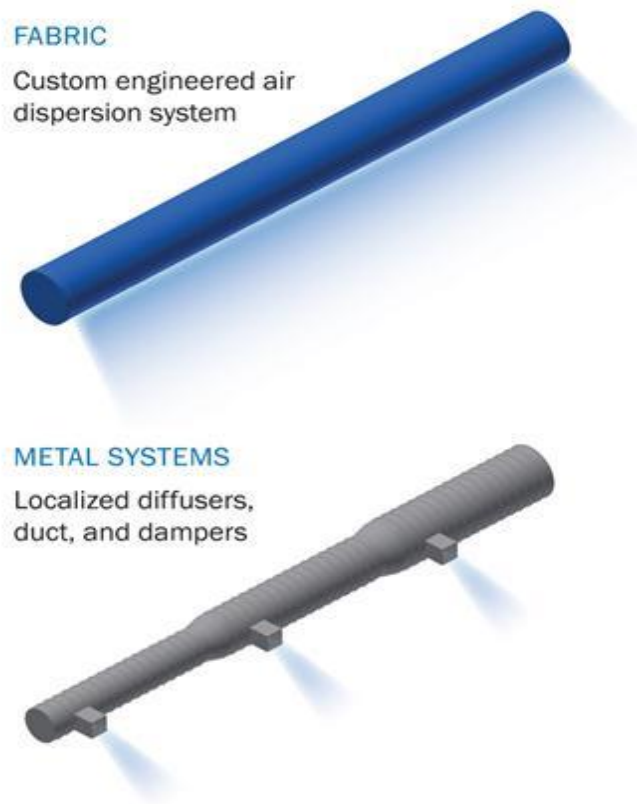


1. Aerco Tankless Boiler: AERCO was the first to introduce condensing, fully modulating boilers and continues to improve upon its advanced designs. From the smallest elementary school to the largest of Las Vegas' hotel casinos, AERCO provides the highest-quality products and system designs that deliver energy-saving, compact space heating with the greatest efficiency and performance.
   Application: Hot water generator to eliminate tank losses.
   Savings: 15-25% Annual cost savings.
   Payback: less than one year.
   Advantages: 96-99% efficiency – lower fuel bills, High turndown air/fuel valve– lowest cycling losses, Tankless design – lower standby losses, Scale resistant design –maintains performance.

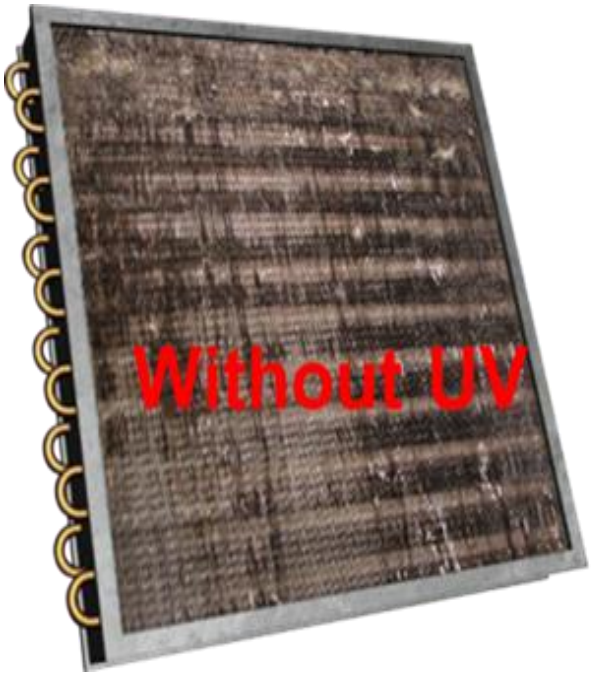
1. Closed Circuit Cooling Tower: A closed circuit cooling tower involves no contact between the air and the fluid being cooled. It has two separate fluid circuits, one in which the fluid is recirculated on the outside of the second circuit, which is a bundle of tubes through which the hot water is flowing. The air drawn through this cascading water provides evaporative cooling similar to an open cooling tower, except that the cooled water never makes direct contact with the air.
   Application: Cooling Tower.
   Savings: 14% Annual cost savings. Longer life of water cooled chiller.
   Payback: One year.
   Advantages: Corrosion-free leak free service, Dry Cooling Capability, Keeps the condenser clean and contaminant free (increase the chiller life), Noise level < 66 dB, Water consumption less than 40-30%, Increase the chiller efficiency upto 14%, Quick installation, Single Piece Equipment and Low maintenance costs.

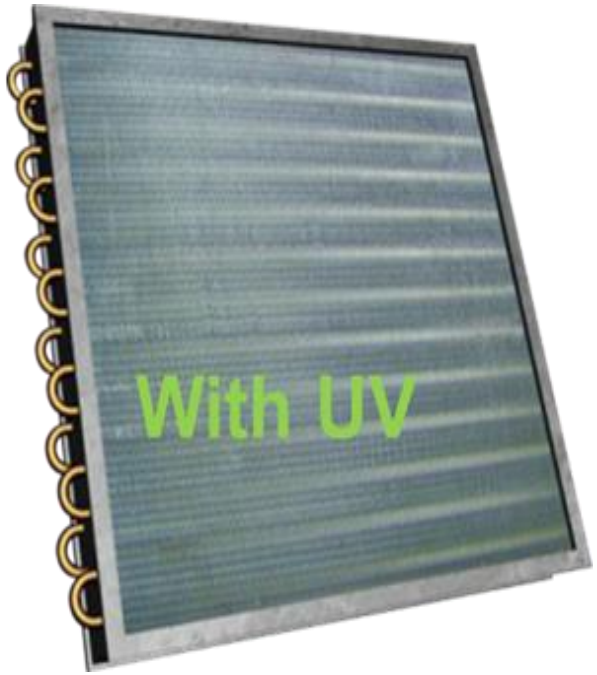


1. Fabric Duct: In open ceiling architecture, traditional metal duct systems discharge air through side mounted metal diffusers typically spaced 10-15 feet apart. The air is directed to specific zones resulting in less efficient mixing of air causing drafts and hot/cold spots. With a Textile System, the air is discharged more uniformly along the entire length providing consistent and uniform air dispersion.
   Advantage: Simplified Design/Uniform Air Dispersion, Cost Savings/Minimal Labor Hours, Lightweight/Easy to Ship, Quiet, Air Porous (zero condensation), Hygienic, Easy to Maintain/Clean, Ease of Use.

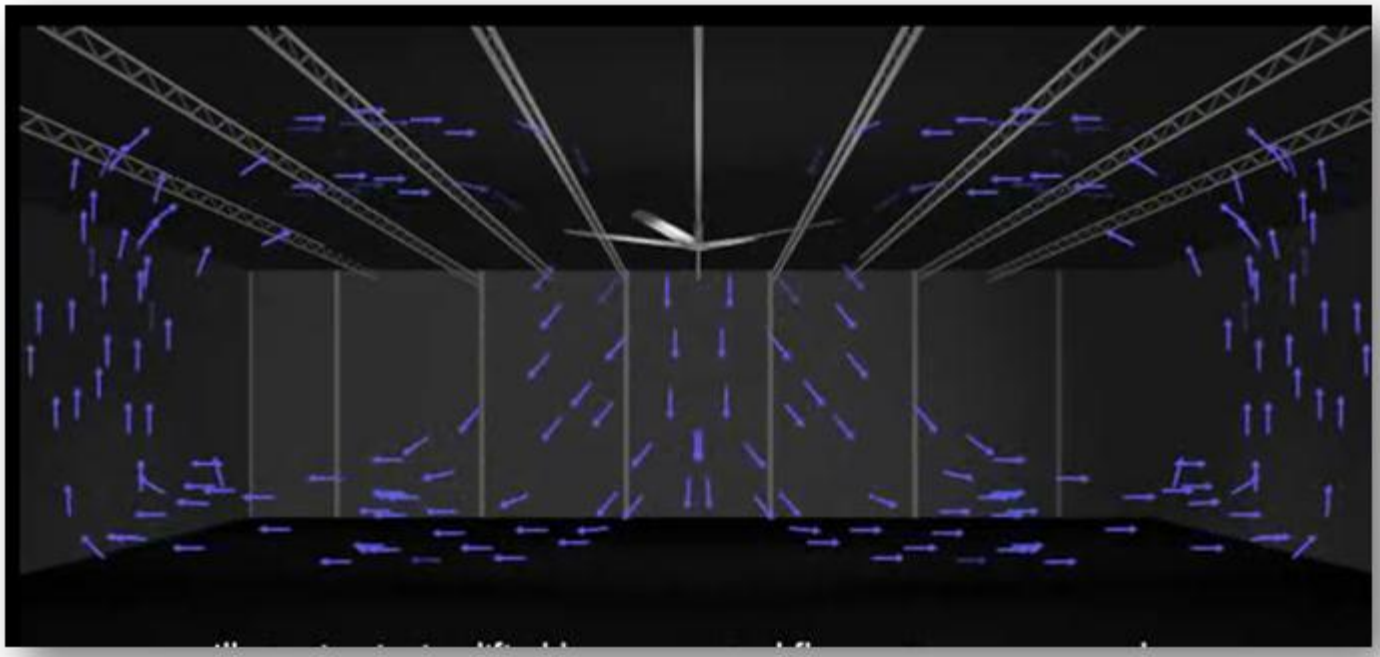


1. FreshAire UV light for Coil Cleaning & Air Purification: For over a century scientists have known that certain frequencies of light have a devastating effect on microbial life. We now know that exposure to ultraviolet light in the range of 254 NM (UV-C band) disrupts the DNA of micro-organisms thus preventing them from reproducing, thereby effectively killing them.
   Savings For Coil Cleaning: Save 10% on chiller consumption & 20% fan energy consumption.
   Payback: 4-5 months.
   Advantage: Improve Indoor Air Quality, Reduce HVAC System Maintenance, Extend System Life, Help to Reduce Energy Costs.



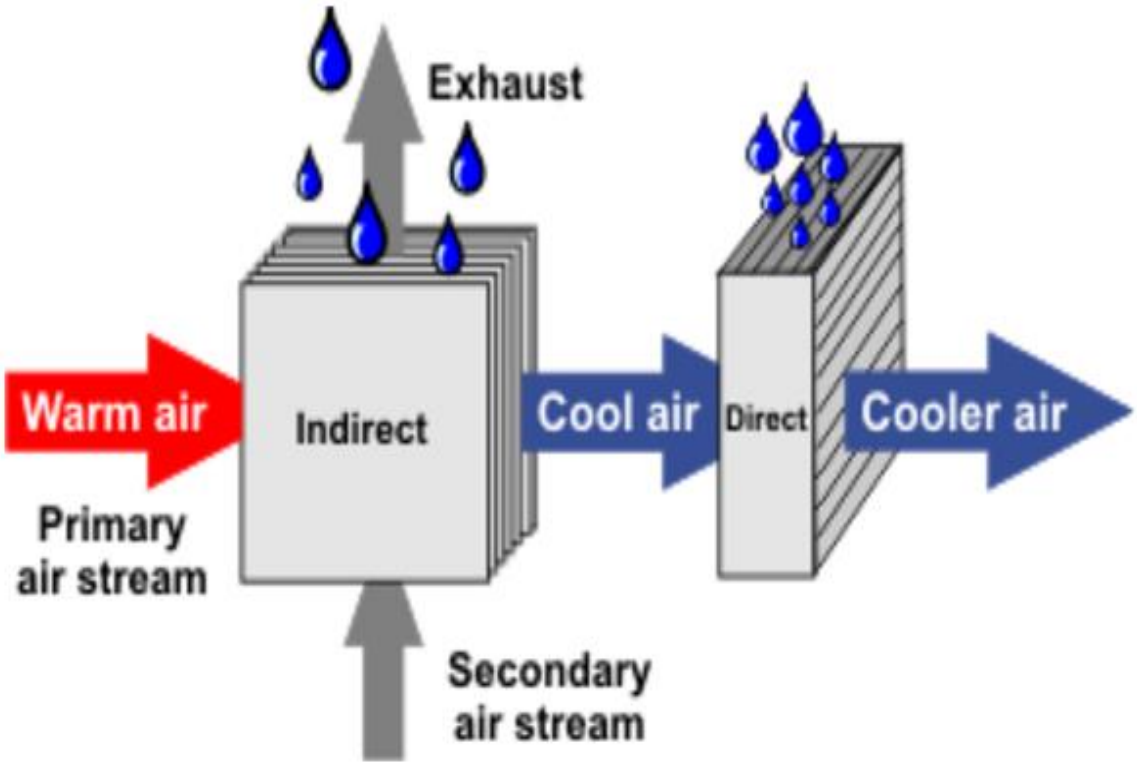


1. High Volume Low Speed (HVLS) Fans: HVLS fans produce a massive, cylindrical column of air that flows down to the floor and outward in all directions, consistently circulating air in large spaces. Balanced air circulation reduces stagnant air, hot and cold spots, and condensation, keeping food and produce dry and fresh and reducing spoilage. Available size for HVLS fan is from 8 ft to 24 ft. Single HVLS fan cover upto 2651 Sqmt area.
   Application: For Commercial and Industrial use.
   Savings: For the same air flow it consumes 1/5 power consumption than ceiling fans.
   Payback: One year.
   Advantage:



1. Heat Pump Water Heaters: The heat pump's operation is based on absorbing and transferring a certain amount of thermal energy from a low-grade source (air or underground layers) to a heating element (pump's coolant) with a higher temperature . As long as an air source heat pump has a COP of higher than 1 then it should be cheaper than electricity and reduce carbon emissions. Compared with higher carbon fuels such as oil burners or coal fires heat pumps perform well, reducing costs and carbon.
   Application: For hot water generation.
   Savings: A conventional boiler has an efficiency of 85%, whereas heat pump works on 300% efficiency.
   Payback: Months not years.

1. 2 stage Air washer: In two stage cooling, the primary air stream is first pre-cooled sensibly by indirect evaporative cooling. Since this pre-cooling adds no humidity to the air, it can still be subsequently direct evaporatively cooled, which is carried out in a direct evaporative section with a rigid pad. However, since the pre-cooled air can hold less moisture, the final relative humidity is lower (about 60% to 65%) than that reached with direct evaporative cooling.



Thank you!

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9810134084