



## HUMAN HEALTH SCIENCE BLDG GEO HEAT PUMP SYSTEMS

May 20, 2010

Principal Investigator

**Jim Leidel**

**Oakland University**

Source Heat Pumps Demo Projects

- **Timeline**

- Geothermal ground array bid package: April 2010
- Geothermal ground array construction: Summer 2010
- Main building construction begins: June 2010
- Substantial completion: Summer 2012
- Performance monitoring & reporting: 2012 through 2014

- **Budget**

- Total project: \$9,778,930
- DOE share: \$2,738,100
- Awardee share: \$7,040,830

- **Barriers**

*(No funds received yet)*

- Lack of experience with: Geothermal projects of this size, VRF heat pumps, large solar thermal systems, & desiccant cooling

- **Architect / Engineer:** Smithgroup

- **Construction Manager:** Christman Company

- **Geothermal Specialist:** Strategic Energy Solutions

## **Geothermal Heat Pump Demonstration**

Utilize a ground sourced heat pump HVAC system.

## **Variable Refrigerant Flow Technology**

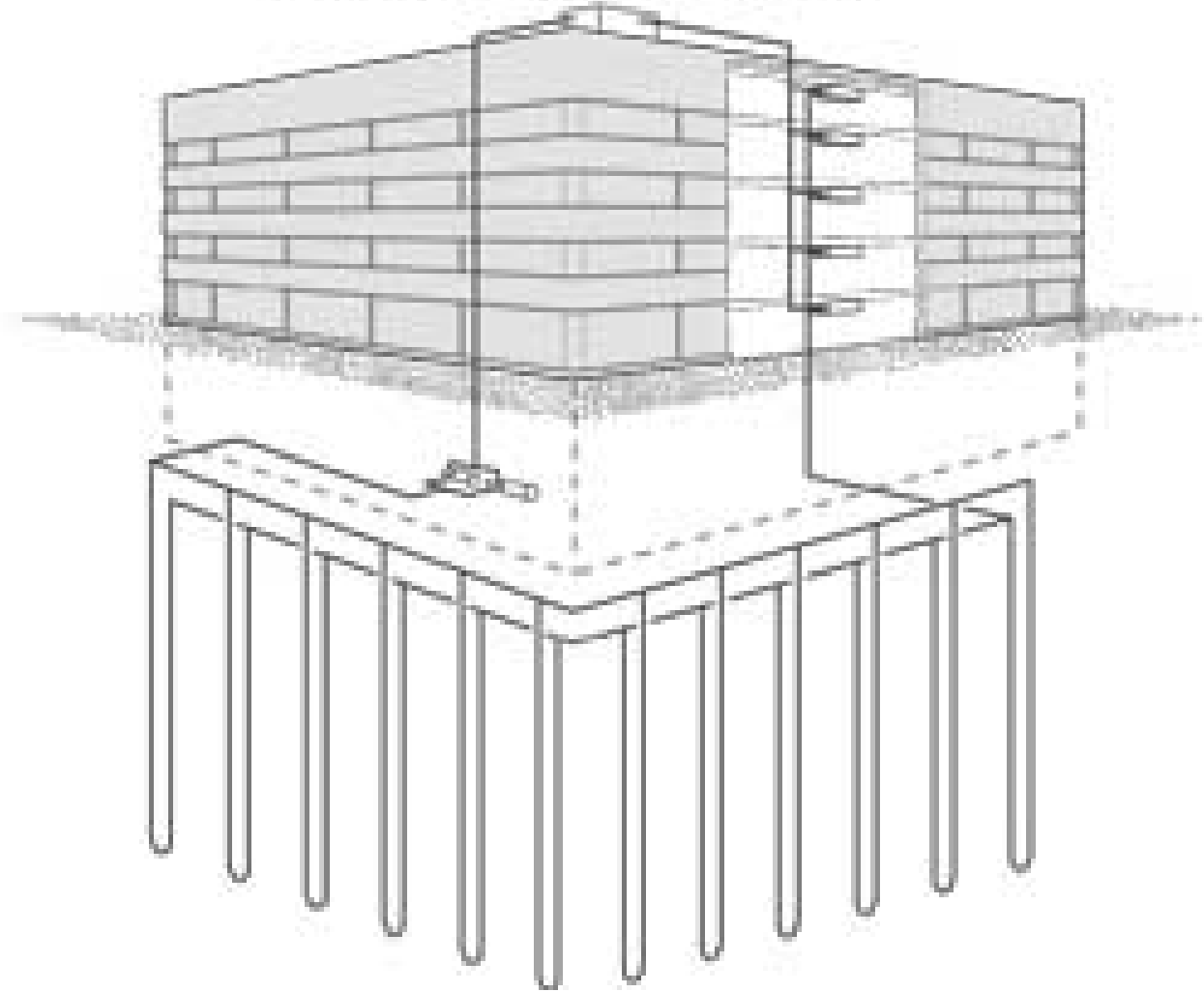
Utilize variable refrigerant flow (VRF) heat pumps, allows for less compressors and enhanced internal heat recovery.

## **Solar Thermal Desiccant Dehumidification**

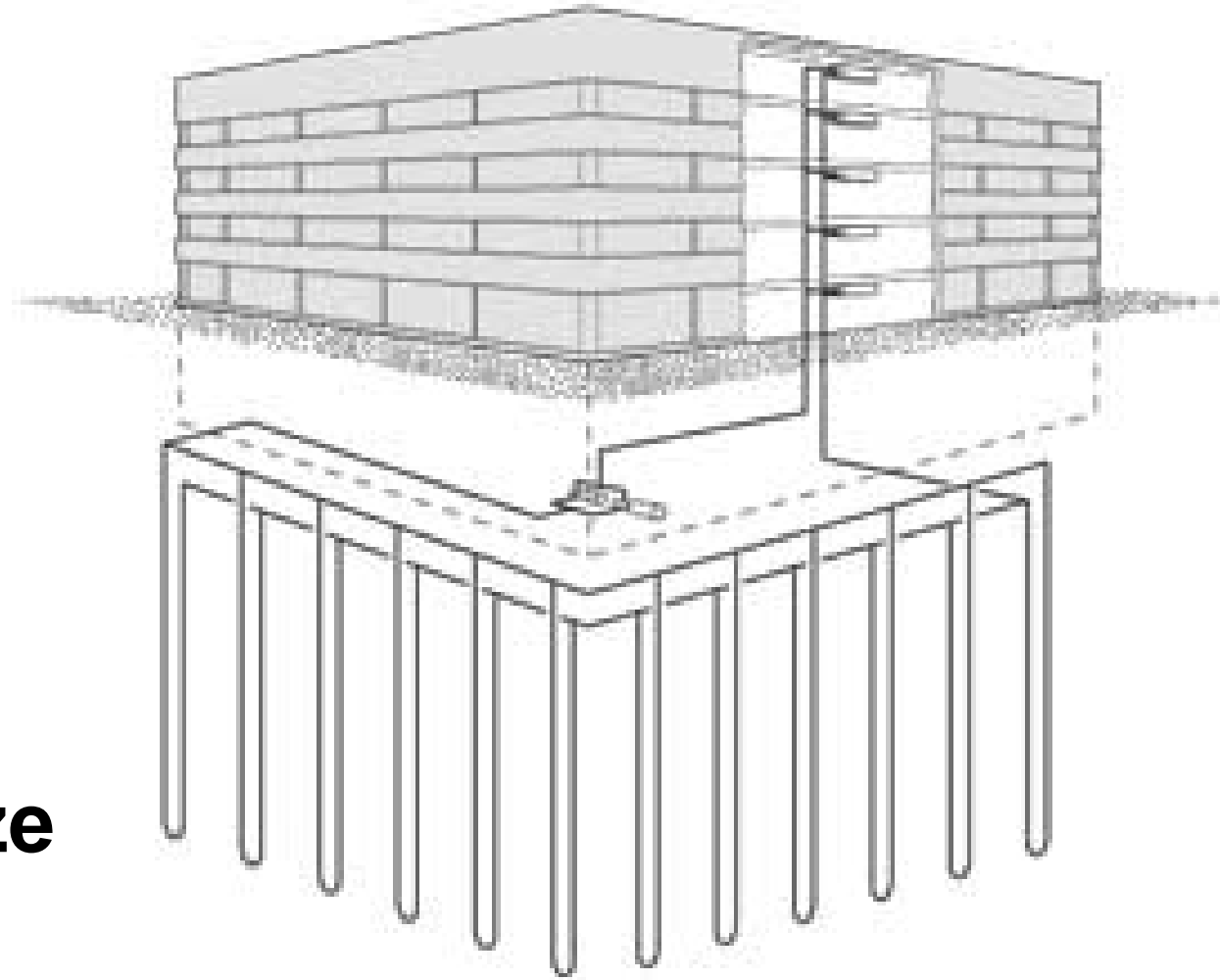
Dedicated outdoor air supply units will utilize a thermally regenerated desiccant dehumidification section. A large solar thermal system along with a natural gas backup boiler will provide the thermal regeneration energy.

## Closed Hybrid Loop

### Original Concept

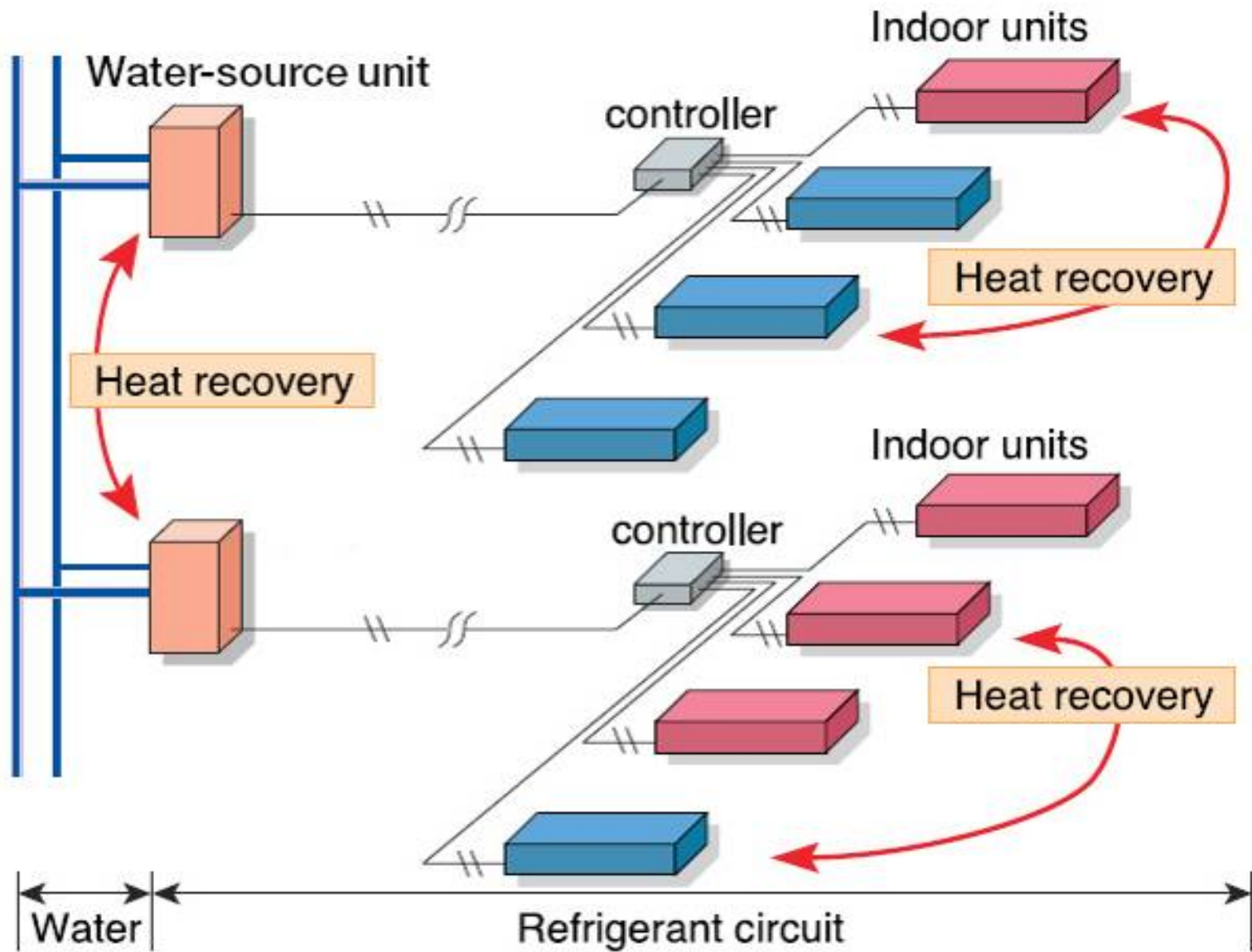


## Closed Ground Loop

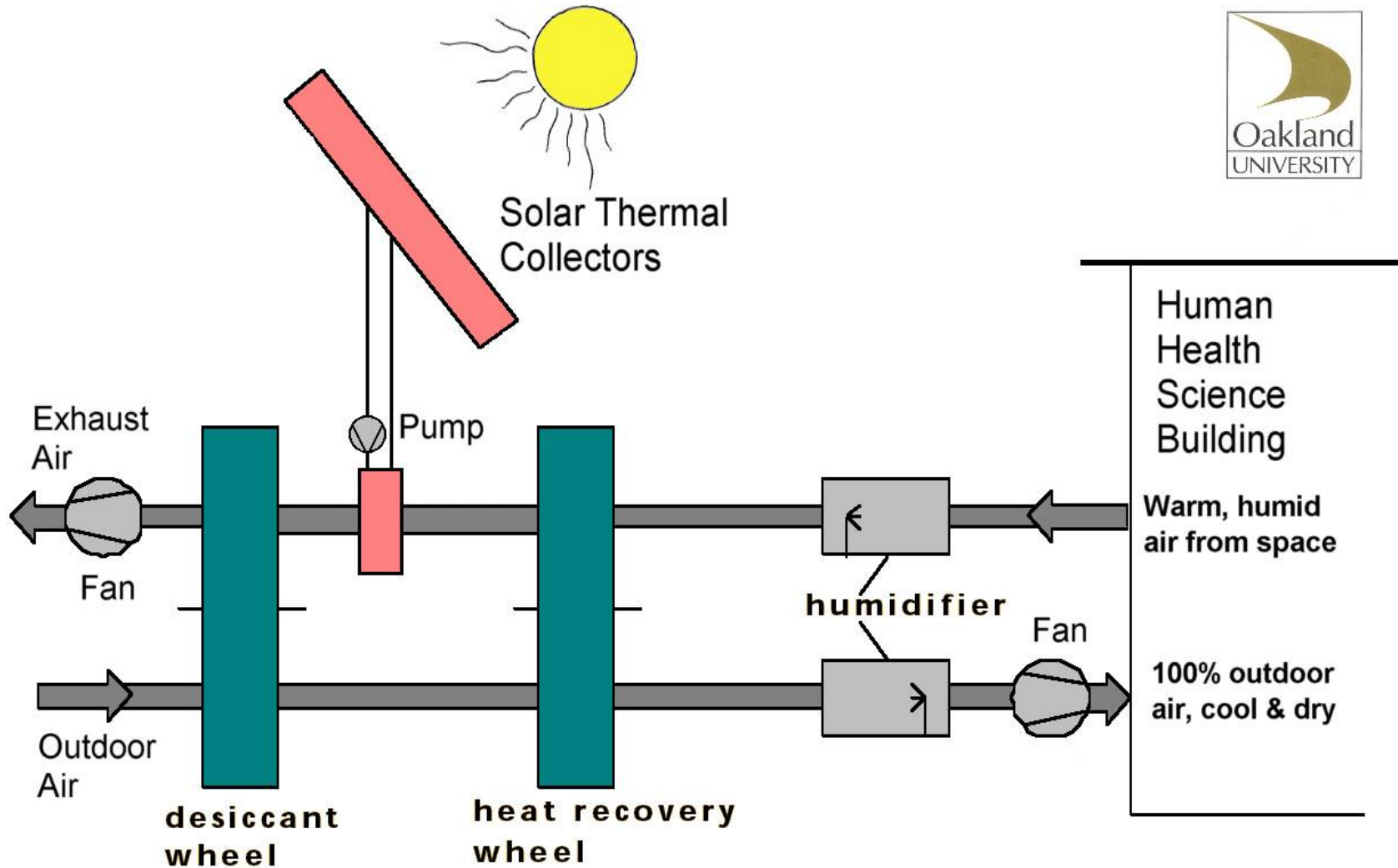


**Water  
Only, No  
Antifreeze**

# Variable Refrigerant Flow

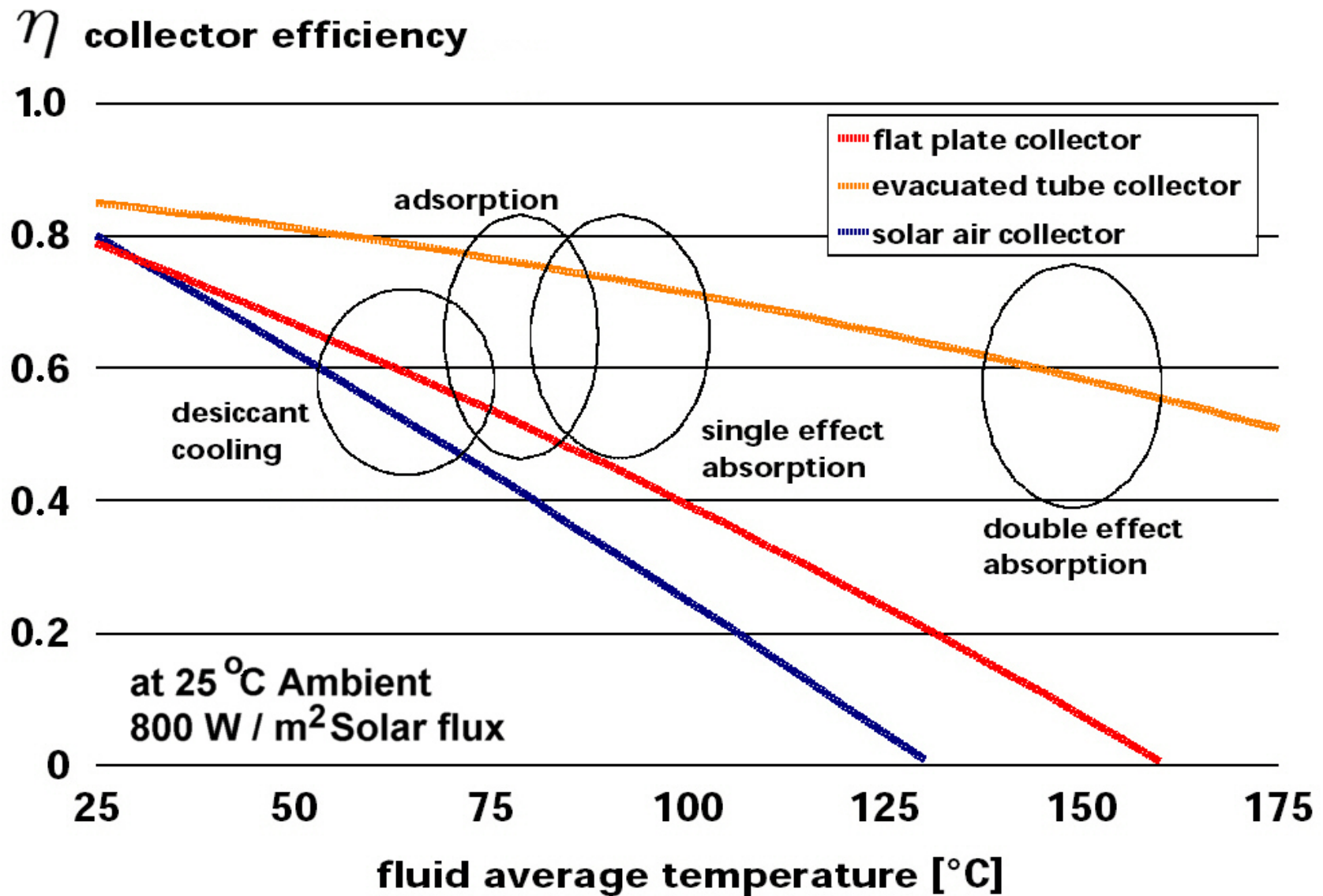


# Solar Thermal Desiccant Cooling

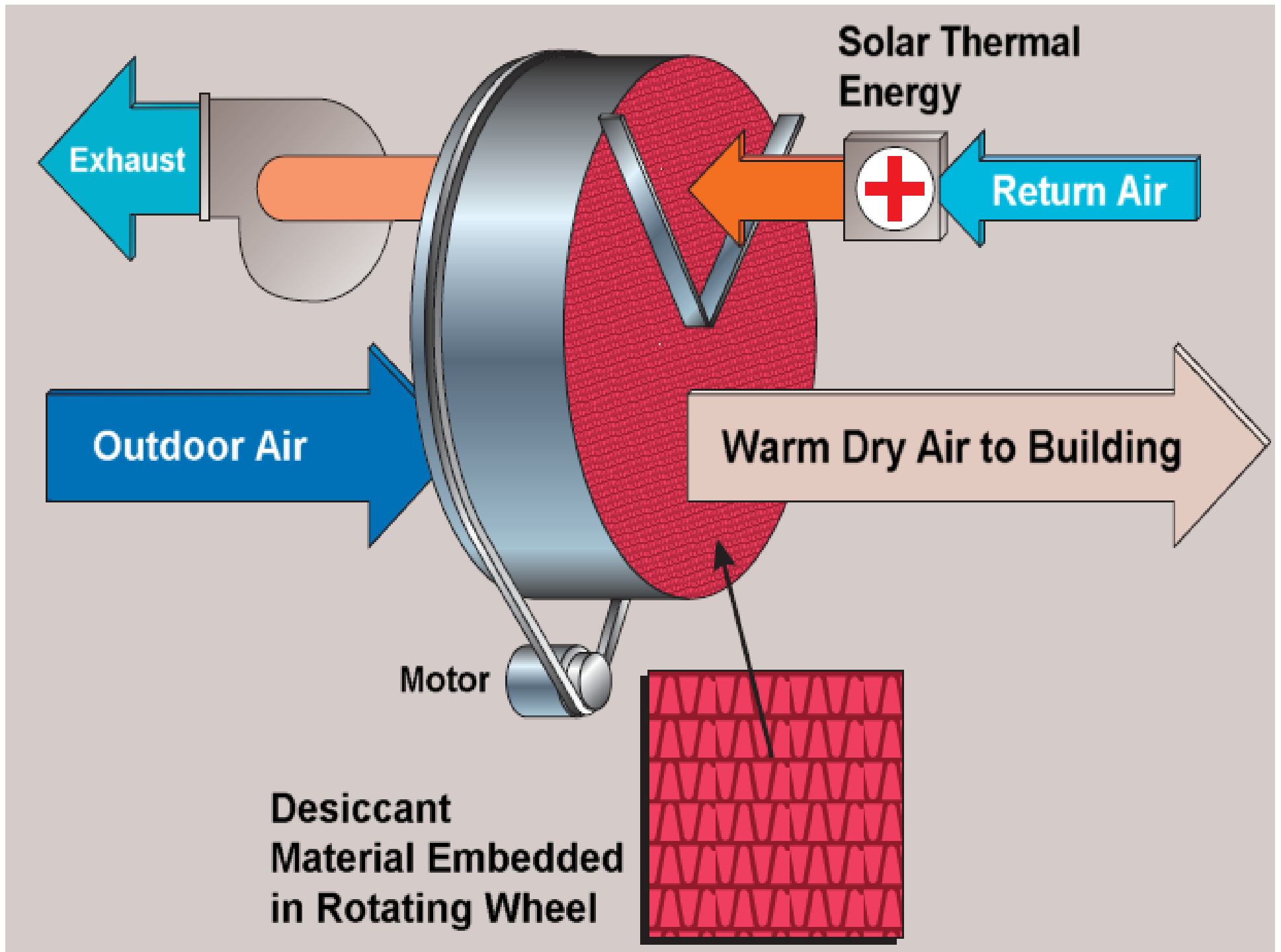


## *Dedicated Outdoor Air Supply Unit*

# Choice of Thermally Activated Technology – Desiccant Cooling

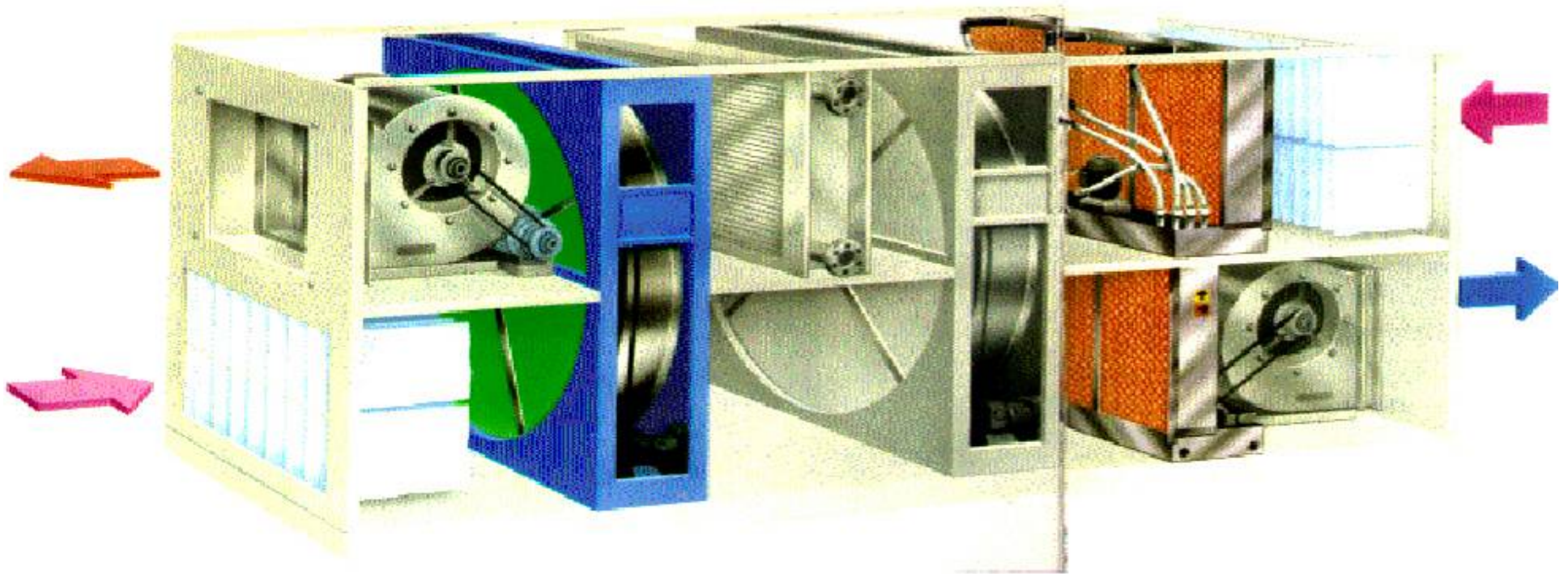






**Exhaust Air**

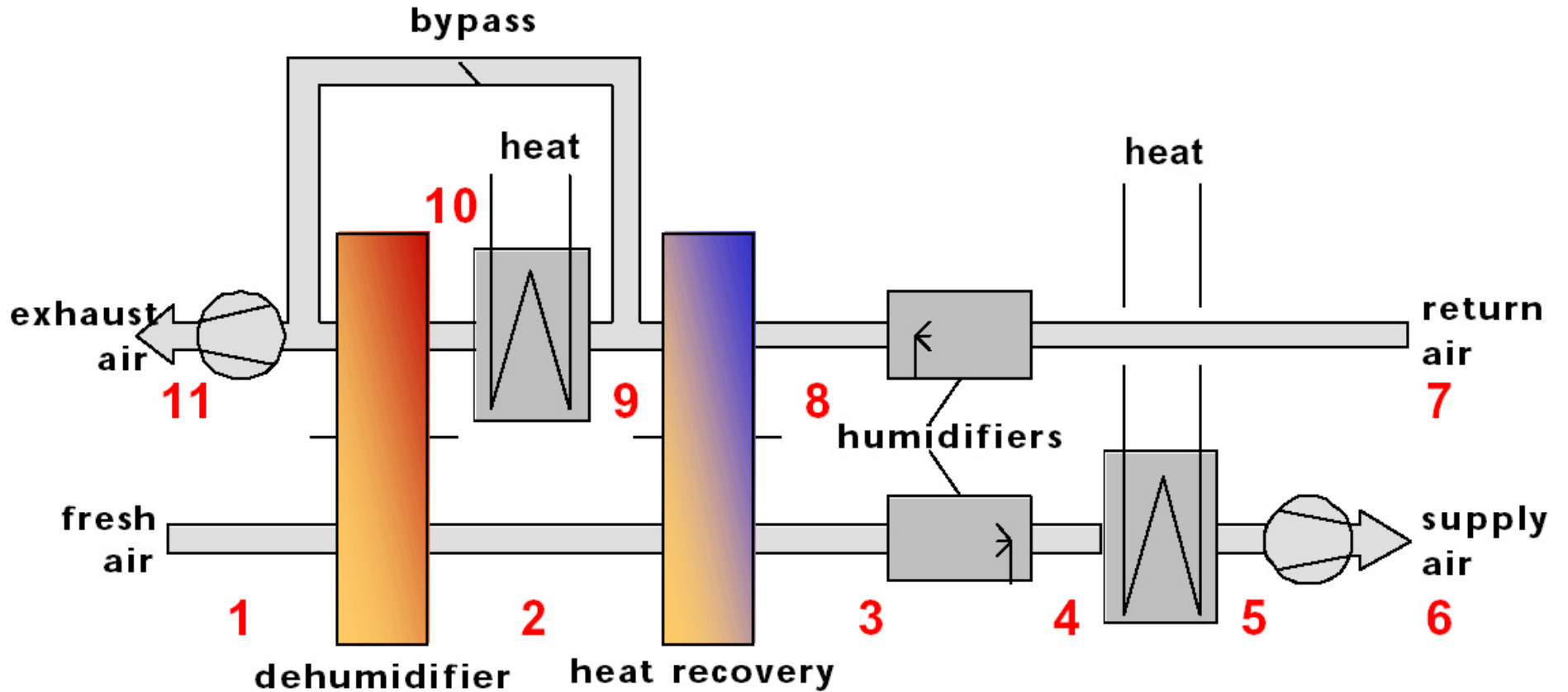
**Exhaust from  
Space**



**Outdoor Air  
Intake**

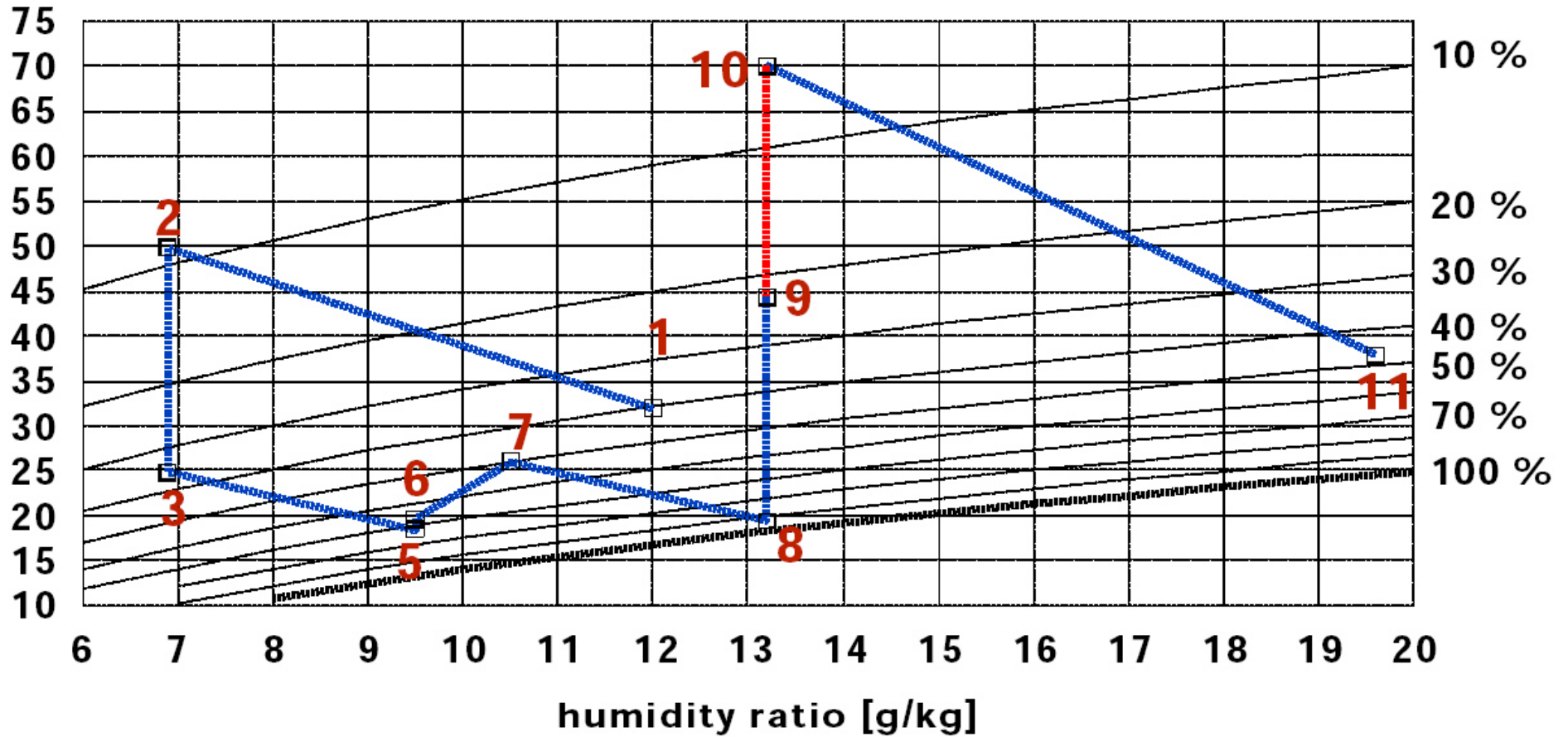
**Conditioned Air  
to Space**

# Technical Approach



# Technical Approach

temperature [°C]





## Geothermal Heat Pump Demonstration

<b>HEAT EXCHANGER INFORMATION</b>	
Configuration	Vertical Closed Loop
Borehole Quantity	256
Borehole Depth	320 feet
Borehole Separation	25 feet
Number of Circuits	20
Thermal Conductivity *	1.23 BTU / (hr-ft-deg F)
Soil Diffusivity	0.83 foot <sup>2</sup> / day
Undisturbed Ground Temperature *	53.0 deg F
GHX Pressure Drop	42 feet of head
<b>FLUID INFORMATION</b>	
Total Flow	1,225 GPM
Fluid	Water only
Minimum HP Unit Inlet Fluid Temp	40 deg F
Maximum HP Unit Inlet Fluid Temp	90 deg F

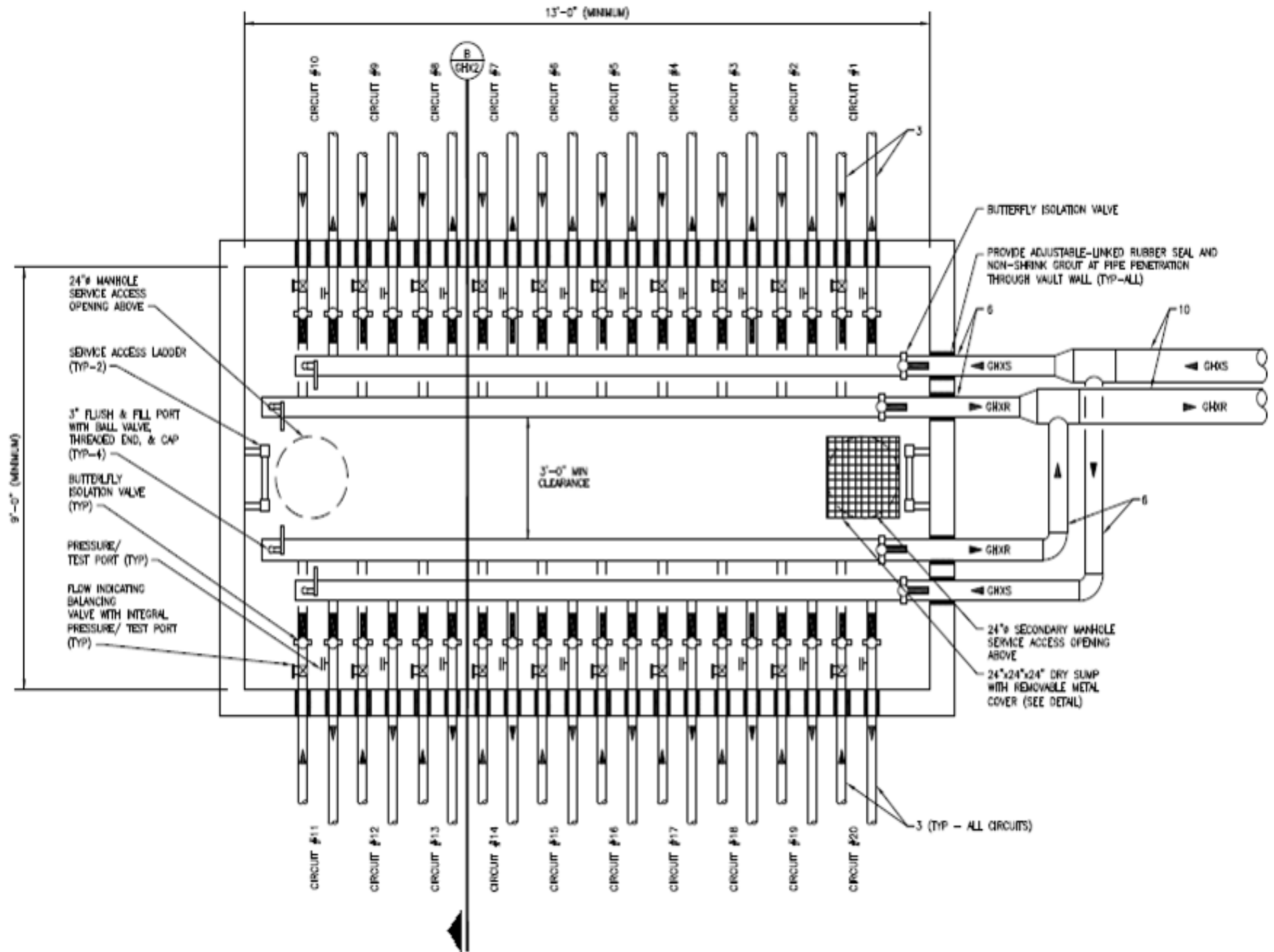
\* From formation thermal conductivity test data taken July 30, 2009

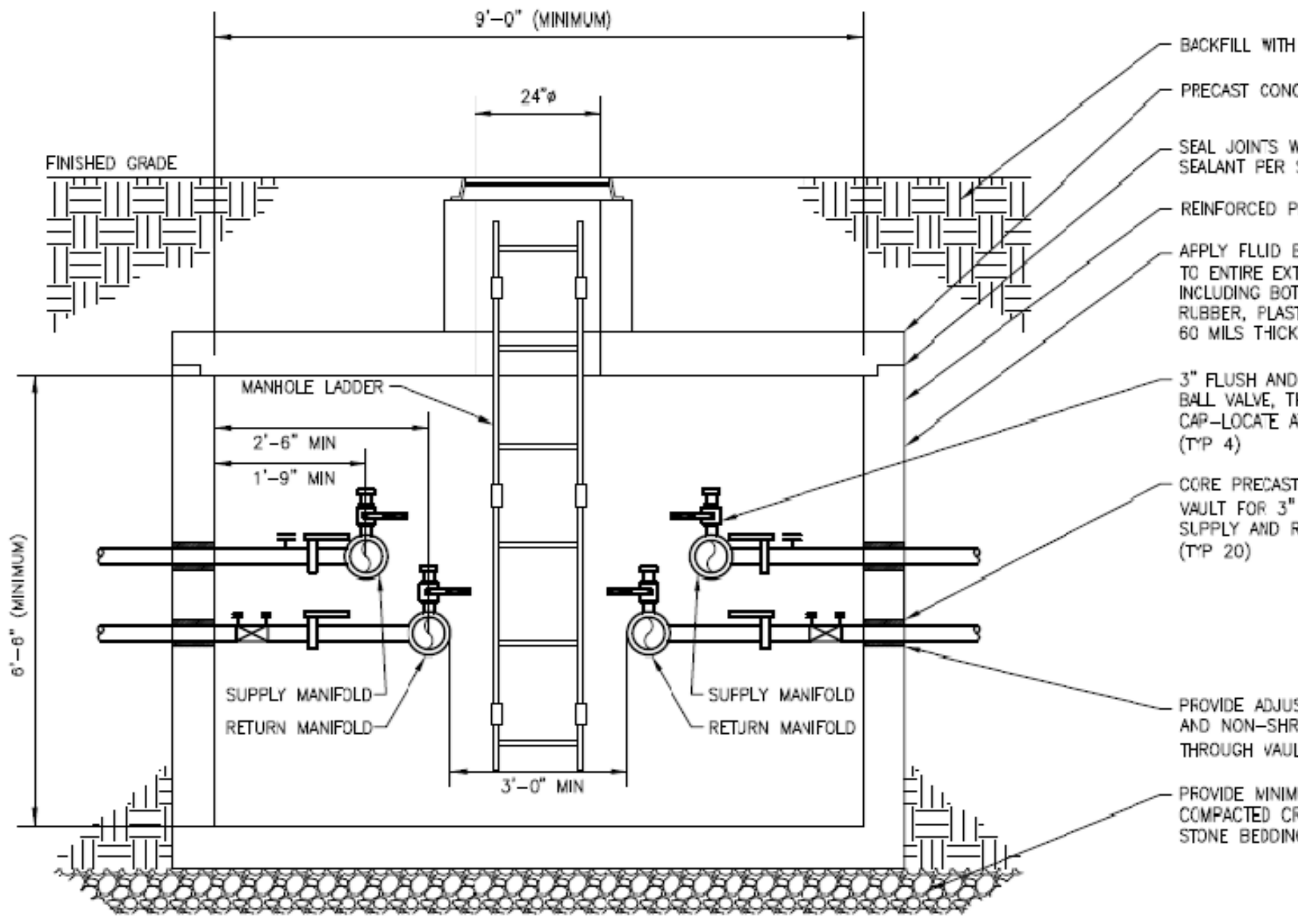
## Geothermal Heat Pump Demonstration

<b>GROUT INFORMATION</b>	
<b>Grout Type</b>	<b>Thermally Enhanced Bentonite</b>
<b>Minimum Thermal Conductivity</b>	<b>0.88 BTU / (hr-ft-deg F)</b>
<b>FLUSH &amp; PURGE INFORMATION</b>	
<b>Minimum Fluid Velocity</b>	<b>2 feet / second</b>
<b>Minimum Purge Flow (per circuit)</b>	<b>75 GPM</b>
<b>Purge Pressure Drop (per circuit)</b>	<b>47 feet of head</b>
<b>GHX CAPACITY INFORMATION</b>	
<b>Peak Heating</b>	<b>2,000,000 BTU / hour (166 tons)</b>
<b>Peak Cooling</b>	<b>4,920,000 BTU / hour (410 tons)</b>
<b>Heating EFLH</b>	<b>1,455 hours</b>
<b>Cooling EFLH</b>	<b>929 hours</b>









- **Three Test Bores – Geothermal Conductivity Tests Completed**
- **Geothermal System Design is Complete**
- **Geothermal Bid Package Issued**
- **Full Project Design 90% Complete**
- **Formal Ground Breaking in April 2010**

- **Geothermal Well Field to be Constructed & Completed by September 2010**
- **Site Work & Foundation Bid Package Due to be Issued in May 2010**
- **Full Construction Bid Package Due to be Issued in Summer 2010**
- **Substantial Completion by Summer 2012**
- **Three Full Years of System Monitoring & Reporting**

- **Innovative Project with Proven Technologies, but New the United States**
  - **Variable Refrigerant Flow Heat Pumps**
  - **Desiccant Dehumidification of Outdoor Air Ventilation with Solar Thermal Regeneration**
- **Large 400 Ton System**
- **USGBC LEED Building Gold or Platinum Rating**

# Construction Photos – Summer 2010

U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency &  
Renewable Energy



# Construction Photos – Summer 2010

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# Construction Photos – Fall 2011





# Construction Photos – Fall 2011



# Construction Photos – Fall 2011

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***Thank you***  
**[www.oakland.edu/energy](http://www.oakland.edu/energy)**

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