Green Campus with GSHP:
Practice of an American School in China

Shawn Y. Xu, Ph.D.
University of Missouri
American Schools in China

- Private school with permission of Chinese governments
- Children of employee’s of U.S. and foreign companies and organizations in China
- American curriculum
- American teachers and staff
Concordia International School

- Located in Pudong (Eastern Shanghai)
- Jingqiao Export Manufacturing Region
Concordia International School
Building Space

- Existing building space: 230,000 sft
- New construction space: 140,000 sft
- Total GSHP conditioned: 370,000 sft
Building Functions

- Class rooms
- Administration offices
- Teacher’s offices
- Art center
- Gymnasium
- Laboratories
- Library
Conventional Systems

- Oil furnace for heating in winter
- Central chiller for cooling
- Small units of water loop HP with cooling tower
- Roof-top AC system
Motivations for GSHP

- Green campus, on-site fossil fuel free;
- Utility saving and 5-6 years payback
- Education tool and energy efficiency course
Implementation Team

- GSHP design: Shawn Xu, Ph.D.
- Contractor: Asia Clean Utility Solutions
- Mechanical: ZE Engineering
## Space and Load

<table>
<thead>
<tr>
<th></th>
<th>New Construction</th>
<th>Retrofitting</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blok 4</td>
<td>Blok 1</td>
<td>Blok 2 &amp; 3</td>
</tr>
<tr>
<td><strong>Floor space</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sft</td>
<td>12,716</td>
<td>6,000</td>
<td>15,670</td>
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<tr>
<td>M2</td>
<td>136,875</td>
<td>64,584</td>
<td>168,672</td>
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<tr>
<td><strong>Cooling load</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kw</td>
<td>2,085</td>
<td>940</td>
<td>2,398</td>
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<tr>
<td>Ton</td>
<td>593</td>
<td>267</td>
<td>682</td>
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<tr>
<td><strong>Heating load</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Kw</td>
<td>903</td>
<td>760</td>
<td>1,880</td>
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<tr>
<td>Ton</td>
<td>257</td>
<td>216</td>
<td>535</td>
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</tbody>
</table>
System Configuration

New Construction

- Fan/coil
- Water pump
- Vertical ground loop

Retrofitting

- Fan/coil
- Water pump
- Horizontal
- Wall Standing

Shawn Xu, University of Missouri
Loop Location

- Located under the soccer field
- Underground space of 80,000 sft
Soil Property Test
Site Survey
Loop Field Excavation
Loop Installation
Loop Details

- Number of boreholes: 900
- Depth of boreholes: 250 ft
- Pipe length (DN1-1/2’): 198 km (650,000ft)
- Pipe length (DN6.0’): 3.2 km(10,200ft)
- HDPE valves: 1830
- Total joints: 9570
- Drilling machines on site: 18
Mechanical Room
Ductwork and Terminal System
Test and Start-Up
Green Roof
Green Roof
Visitors to the School
Potentials

- Higher energy prices
  - Natural gas: $0.3-0.5/Nm³
  - Electricity: $0.10-0.15/Kw-hr
- Lower labor cost: $2.0-3.0/hr
- Typical payback year: 2-5
Potentials

- Private and public schools
- Winter and summer operation
- Third party investment and utility services
Contact

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