IEQ Control & Operation Performance on Industrial Project Case

Hui WANG 王惠
Green Building Engineer
BlueScope Building System(Xi’an) Co., Ltd.
June 6, 2017
Project Introduction
Brief Introduction

• Project location: Xi’an high-tech development zone with total land area of 126,667m² and total building area of 52,120m²

• Total capital expenditure: 400M RMB, including green feature investment capital 13.5M RMB for LEED platinum and Chinese 3 star certificates

IEQ Control Efforts and Performance
High-reflection Roof
High-reflection Roof

Requirements

• **Energy Star**: Use Star compliant (highly reflective) and high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM E408) for a minimum of 75% of the roof surface. The reflectivity and emissivity requirements are shown below.

• **LEED**: Use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

<table>
<thead>
<tr>
<th>Rating System</th>
<th>Roof Type</th>
<th>Slope</th>
<th>SRI</th>
<th>Reflectivity–ne</th>
<th>Reflectivity–age</th>
<th>Emissivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Star</td>
<td>Low-Slope</td>
<td>≤2:12</td>
<td>None</td>
<td>0.65</td>
<td>0.50</td>
<td>None</td>
</tr>
<tr>
<td>Energy Star</td>
<td>Steep-Slope</td>
<td>&gt;2:12</td>
<td>None</td>
<td>0.25</td>
<td>0.15</td>
<td>None</td>
</tr>
<tr>
<td>LEED</td>
<td>Low-Slope</td>
<td>≤2:12</td>
<td>78</td>
<td>0.65</td>
<td>0.50</td>
<td>0.9</td>
</tr>
<tr>
<td>LEED</td>
<td>Steep-Slope</td>
<td>&gt;2:12</td>
<td>29</td>
<td>0.25</td>
<td>0.15</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Note: Aged reflectivity is measured after at least three years of exposure.

---

Test Result of Roof Panel: SRI = 94

<table>
<thead>
<tr>
<th>Sample</th>
<th>Summer White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Reflection</td>
<td>0.77</td>
</tr>
<tr>
<td>Thermal Emittance</td>
<td>0.87</td>
</tr>
<tr>
<td>Solar Reflectance Index (SRI)</td>
<td>94</td>
</tr>
</tbody>
</table>

*<M=1.5, Convection Coefficient (medium wind): h_c=12W/(m²·K), ASTM E1980*
Enhanced Insulation System-Roof

1. Roof Panel (Zincalume)
2. Panel Clip (Moveable)
3. Spacer Block for Cold Bridge
4. Fiberglass Insulation
5. Hi-Tensile Spanning Member
6. Fiberglass Insulation
7. Support Bracket
8. Vapor Retarder
9. Hi-Ten Roof Liner
10. Hi-Ten Purlin
**Enhanced Insulation System-Wall**

<table>
<thead>
<tr>
<th>Insulation Layer Thickness</th>
<th>Heat transfer coefficient $K (W \cdot m^{-2} \cdot K^{-1})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Roof 150mm</td>
<td>0.262</td>
</tr>
<tr>
<td>Masonry Wall 100mm</td>
<td>0.270</td>
</tr>
<tr>
<td>Metal Wall 100mm</td>
<td>0.386</td>
</tr>
</tbody>
</table>

Flyash Brick Wall (200mm)
Thermal Insulation Layer (100mm)
Aerated Concrete Steam Pressure plate (50mm)
Cold Bridge Treatment

The cold bridge is formed by insulation compressed and construction gap on the interface. It is usually located on gutter, purlin, roof opening, lite-panel, windows and the interface of steel wall and brick wall. This will make the coefficient of heat transfer at some parts in the cladding system greater than others, resulting in rapid heat transfer and loss from these parts. The cold bridge depresses the building’s thermal performance and increase the energy consumption of air-conditioner and heating system. A more serious problem is the condensation in the warm side (most interior side) of the cold bridge. The condensed water will influence the performance of thermal material and the indoor activity of manufacturing.
Interior Temperature Monitor

Record in July 2016

* Set 5 monitors in plant to measure temperature at 10am, 2pm and 4pm every day
Radiation Heating System in Winter

Radiant heating system can heat indoor environment by burning natural gas inside. The programmable controller regulates temperature automatically:

- 44 sets for cladding workshop
- 40 sets for frame workshop

Record in Jan. 2017

Design Temp.: 7°C
- AVG. Temp. Indoor
- AVG. Temp. Outdoor
- Difference
Natural Lighting

**SUNLITE STRIP™ CURBLESS DAYLIGHTING SYSTEM**

<table>
<thead>
<tr>
<th>Performance Values</th>
<th>Double Dome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dome Type</td>
<td>acrylic</td>
</tr>
<tr>
<td>U-Factor (W/cm·K)</td>
<td>0.74</td>
</tr>
<tr>
<td>Solar Heat Gain Coefficient</td>
<td>0.42</td>
</tr>
<tr>
<td>Visible Light Transmission %</td>
<td>68%</td>
</tr>
</tbody>
</table>
Natural Ventilation

Natural Ventilator developed as low-cost and easy to install product, with stable and reliable performance and other advantages. It runs entirely on gravity, and does not need any electricity consumption. Use proper numbers and types of ventilators to match architectural features and airflow requirements to ensure a comfortable and healthy indoor environment.
Natural Ventilator
Indoor Pollutants Control

Dust-handling System in Shot-blasting Cleaning Unit

Fume Collector in Manual Welding Station

Paint Spray Treatment System
Employee Health Management
Investment & Rewards
How much we paid?

Green TECH Investment Increment (Unit: K RMB)  Annual Operation Saving (Unit: K RMB)
### Green TECH Investment Increment and Recovery Period of Xi’an Plant

<table>
<thead>
<tr>
<th>Capital of Green Item</th>
<th>Traditional Capital</th>
<th>Green TECH Investment Increment</th>
<th>Annual Cost Saving</th>
<th>Recovery Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMB K</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13,541</td>
<td>4,056</td>
<td>9,993</td>
<td>2,266</td>
<td>4.4</td>
</tr>
</tbody>
</table>

### Energy saving every year of Xi’an Plant

<table>
<thead>
<tr>
<th>Category</th>
<th>Water Saving (T)</th>
<th>Electricity Saving(KW.H)</th>
<th>Natural Gas Saving(m³)</th>
<th>Ground Saving (Mu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>7,360</td>
<td>1,562,815</td>
<td>76,072</td>
<td>4.5</td>
</tr>
</tbody>
</table>

- **Water Saving**: 7,360 T
- **Electricity Saving**: 1,562,815 KW.H
- **Natural Gas Saving**: 76,072 m³
- **Ground Saving**: 4.5 Mu

What we can get:
- **Annual CO₂ Save**: 1190.4 T
- **CO₂ Reduced**: 1190.4 T
- **Reduce CO₂ of 212 Cars Emission**
Thank you