APEC Energy Smart Community (ESCI) Best Practice Award Application

Tanggu Bay Area Exhibition Center (TBAEC)

Building Owner:
China Construction Xintang (Tianjin) Investment Development Co., Ltd.

Presented by: Yan Ding (丁研), Ying Yin (殷莹)
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1. Project Overview

• This demonstration building have geographical advantages while responding to the requirements of national and local policies.
Tanggu Bay Area Exhibition Center (TBAEC) is the first building of Tanggu Bay New Town of Binhai New District. This building is located in the middle of the downtown area and the Bay Area.
Building layout

This building has 1 underground floor and 4 aboveground floors. The building area is approximately 8,677 square meters.

The building is a multi-functional building with offices, entertainment and culture exhibition. And its main function is to display the planning and green building technology of Tanggu Bay Ecological New Town.
Fitting National and Local Policies

• “The Green Building Action Plan” issued by Chinese State Council

• President Xi pointed out that “Lucid waters and lush mountains are invaluable assets, the construction of ecological civilization should be further emphasized and new development advantages should be constantly cultivated”

• Financial and Financial Support Measures for Encouraging the Development of Green Economy and Low-carbon Technologies issued in Tianjin Binhai New District
2. Innovative points and uniqueness

"Priority for passive techniques and optimization for active techniques"
10 major features in TBAEC

(1) Innovative energy-saving skin structure
(2) Building envelope with high performance
(3) Ground-source heat pump system
(4) Thin-film Photovoltaic system
(5) Green roof
(6) Daylighting and natural ventilation optimization
(7) Integrated shading system
(8) Energy-saving lighting and control system
(9) Energy consumption monitoring control system/smart office system
(10) Comprehensive Utilization of Water/Rainwater in Ecological Ponds
(1) Innovative energy-saving skin structure

- Decorative concrete light hanging board (as shown in figures on the left), which is made up of waste concrete stone powder.

- The tilt angle of stone surface rack is designed according to the solar height angle of Tianjin in winter and summer.
(2) Building envelope with high performance

According to the principle of passive architectural design, the exterior wall design of the building adopts a strategy to enhance the thermal insulation performance and different facades have also been treated differently.

- Roof: Concrete roof 200 thick SF cement expanded perlite insulation, K=0.38 W/ (m²·K)
- Scuttle: LOW-E insulating glass skylight, thin film photovoltaic covered, U=1.8 W/ (m²·K)
- Single frame window with double LOW-E glass, K=1.7W/ (m²·K)
- Aerated concrete block, insulated by rock wool board, light concrete hanging board on outside surface, K=0.37 W/ (m²·K)
(3) Ground-source heat pump system

- Two ground-source heat pump units are installed, the cooling capacity of each unit is 260 kW, and the heating capacity is 292 kW, which can achieve stepless speed regulation within 25%-100% of the maximum cooling capacity.

- The vertical double U plastic pipes are used to bury 71 heat exchangers into a depth of 100 m.
(4) Thin-film Photovoltaic system

- Photovoltaic power generation system is set up on the roof of the exhibition hall.
- 231 BIPV components with 12.705kW rated power and 380V three-phase inverter output voltage were installed on the skylight.

- The annual average generating power is expected to accounted for 3% of the total energy consumption. According to our test, photovoltaic power generation reached almost 2%.
(5) Green roof

- Various types of landscape greening such as roof agriculture, roof gardens, roof lawns, and ecological grass slopes were set up respectively.
- The area of roof greenery accounts for 95% of the area where the roof can be used for greening.

- Such design not only saves energy but also improves the vertical level of green landscape. It is also a visual green demonstration.
(6) Daylighting and natural ventilation optimization

- Natural ventilation is strengthened by adjusting the position of exterior windows based on simulation results by **Fluent** software.
- **Ecotect** lighting simulation software is used to improve indoor daylighting.
(7) Integrated shading system

Building shading system is the most simple, direct and effective way to reduce the energy consumption of air conditioning in summer. It is also an important part of architectural modeling. In this project, a set of integrated shading systems that combine the shape, orientation and internal functions of the building are designed.

Folding active shading system

Track-type sunshade curtain of the roof skylight

Vertical wing type electric sunshade
This project adopts intelligent lighting automatic control system.

The control strategy includes partitioned lighting, grouping control, illumination induction, timing and scene control.
Energy consumption monitoring control system + smart office system

- An energy consumption monitoring system is set up in TBAEC, which is able to provide energy data for each terminal and provide data display combined with an intelligent office system.

(a) Light-sensing control,
(b) Air quality, temperature, wind speed, rainfall control
(c) Human sensors, motion sensors, sensor controls
(d) Timing control
(e) Centralized control
(f) Decentralized control
(g) Remote control
A reclaimed water reuse facility was built to realize the recycling of rainwater in this building.

The rainwater recycling will increase the reliability of urban flood control systems by reducing the load on rainwater pipe networks.
3. Energy saving effect

• The annual building energy consumption is low.
• The utilization rate of non-traditional water is high.
• Take fully advantage of renewable energy resources.
### Energy Utilization Indexes

<table>
<thead>
<tr>
<th>HVAC system</th>
<th>Power consumption (kWh)</th>
<th>Power consumption ratio</th>
<th>Single consumption (kWh/(m².a))</th>
<th>Quota in the same area (kWh/(m².a))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water chiller unit</td>
<td>181501</td>
<td>55%</td>
<td>21</td>
<td>16—19</td>
</tr>
<tr>
<td>Cooling water pump</td>
<td>64446</td>
<td>19%</td>
<td>7</td>
<td>3—5</td>
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<tr>
<td>Chilled water pump</td>
<td>64388</td>
<td>19%</td>
<td>7</td>
<td>4—6</td>
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<tr>
<td>Air conditioning terminal</td>
<td>19974</td>
<td>7%</td>
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<td>4—10</td>
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<tr>
<td>Other power consumption</td>
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<td>0</td>
<td>2.5—5.4</td>
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<tr>
<td>HVAC power consumption</td>
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<td>100%</td>
<td>38</td>
<td>30—45</td>
</tr>
</tbody>
</table>

- Average daily energy consumption: Summer 147 kWh, Winter 42kWh, Spring/Autumn 28kWh.
- Non-heating energy consumption index of buildings is 49 kWh/(m².a), at the national leading level.
The use of non-traditional water

The use of the non-traditional water source in this building includes indoor flushing, outdoor greening irrigation, sprinkling road and landscape water using medium water and the utilization rate reaches 58%.
The use of photovoltaic panels

- During the period of use, the photovoltaic panel power generation capacity was 2,025 kWh, while the total building power consumption was 99,050 kWh. The photovoltaic power generation accounted for about 2% of the total power consumption.
4. Regional influences

- TBAEC is of great significance to the entire region and will surely become a landmark building of the entire region.
Feasibility of adopted building technologies

a. Energy-saving technology has high reference value.

b. The design fully considers the local characteristics of Tianjin.

c. The building energy-saving technology adopted has good scalability and reproducibility in Tianjin and similar climate environments.
The landmark in Tanggu Bay New Town

- TBAEC, as the first demonstration project by Xintang Co., will become the image representative of the entire region, reflecting the style and quality of Xintang Co..

- Through energy-saving and emission-reducing effects revealed by TBAEC, it leads the direction of development of future buildings.

- As a milestone in the green exploration of CSCEC, it represents the vanguard concept and advanced technology of green buildings and is a display window for CSCEC.
Awards won by TBAEC

2015: Three-star green building design logo

2016: The first prize of Tianjin Haihe cup for excellent survey and design

2017: "A passive energy-saving external thermal insulation structure" utility model patent
Thank you for your attention!