The Main Educational-Laboratory Building of Shandong Jianzhu University (First Phase of Project)

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Primary energy need :

118.67 kWhpe/m².

(Calculation method : Primary energy needs)

ENERGY CONSUMPTION

Economical building *Building*

- *< 50* **A**
- *51 à 90* **B**
- *91 à 150* **C**
- *151 à 230* **D**
- *231 à 330* **E**
- *331 à 450* **F**
- *> 450* **G**

Energy-intensive building

Building Type : School, college, university
Construction Year : 2015
Delivery year : 2017
Address 1 - street : 250101 ,
Climate zone : [Cwa] Mild, dry winter, hot and wet summer.

Net Floor Area : 9 696 m^2
Construction/refurbishment cost : 57 922 087 ¥
Number of Pupil : 1 014 Pupil
Cost/m2 : 5973.81 ¥/ m^2

General information

This project is located on the south side of library information building in the Shandong Jianzhu University campus, adjacent to the eastern slope of the Snow Mountain. The total construction area is 9696.30 . The project is a multi-storey public building, the structure of which is steel frame.

The green land which is open to the public is made up of trees, shrubs and grass. The greening rate of this project is 40.10%. U-value of the building envelope is 10% higher than the current national standard. GSHP system will meet the cooling and heating need of the project by taking full use of the geothermal energy which is one type of the renewables. In addition, the project uses energy-efficient lamps to ensure that the main function rooms' LDP is lower.

This project is the first passive and ultra-low energy green building with fabricated steel structure in China, which combines the dual advantages of passive buildings and fabricated buildings. The advantages include improving the indoor comfort, enhancing staff work efficiency, cleaning indoor air, saving energy, speeding up construction and improving construction precision, reducing construction waste and so on.

Data reliability

3rd part certified

Stakeholders

Stakeholders

Function : Contractor

18601241955

http://ccstc.cscec.com/

China Construction Science Technology CO., LTD. is the EPC contractor of this project. The EPC area is 11936.17 including the main building and the hall classroom. But only the main building will apply for the Sustainable Construction Grand Prize.

Function : Investor

http://www.sdjzu.edu.cn/

Contracting method

General Contractor

Owner approach of sustainability

The target of this project is to build a passive and ultra-low energy green building. Passive design methods minimized the heating and cooling demand. And renewable energy system provided heating and cooling need. And high efficiency fresh air system with heat recovery was used. Compared to the previous construction project, this project has made full use of passive technologies including the reasonable building size, reasonable building orientation and window-wall ratio, reasonable envelope design by using performance optimization design and node design. This project also strictly followed the key points of thermal bridge break design and air tightness. The energy saving rate was 81.05%.
Due to the project was assembled by steel structure system, many difficulties was met in the air tightness and thermal bridge break design. A lot of domestic initiative measures were taken during the design and implementation of this project including assembled steel structure building air tightness measures, embedded window installation form and scaffold pull joint hole airtight insulation treatment measures.
This project is the first passive ultra-low energy building with fabricated steel structure in China, the successful design and construction of which broadens the field and category of the passive ultra-low energy building. Based on actual conditions, bold research and innovation were carried. It is a major breakthrough about passive ultra-low energy buildings. The successful achievement of this project will provide many valuable experiences for other passive ultra-low energy buildings with fabricated structure.

Architectural description

The project is located on the university campus and all the landscape are open. According to the landscape design drawings of the project, the overall greening land area is 7826.35 and the greening land area of the declaration scope is 2581.53 . Shandong Jianzhu University is one of the green campus classics and had been selected into the United Nations Environment Programme green campus classic cases in June 2014.

If you had to do it again?

This project is overall fabricated with steel frame and precast autoclaved aerated concrete wall.
The basic passive house principles are followed in this project which include using high insulation envelope system, air tightness and thermal bridge break treatment methods and high efficiency fresh air system. Compared with other cast-in-place passive buildings, there are many challenges to solve the key issues of passive buildings through fabricated methods. The challenges include the air leakage treatment between precast outer wall board, insulation and air tight treatment of scaffold pull joint hole, the connection of the passive external window and the main structure, insulation and air tight treatment of steel column through wall and so on. There are not similar reference cases. Therefore, the construction of the project is very difficult.
To solve these technical challenges, with the leadership of the company's leading experts, the design and construction teams gave full play to their abilities to innovate and raised various professional programs including airtight strengthening measures of precast wall , setting 5cm thick insulation layer between the overhanging autoclaved aerated concrete and the floor, filling scaffold pull joint hole by using post-grouting after filling insulation material into the hole, embedded installing the exterior windows, thermal bridge break and airtight treatment of the steel beam column through the wall. To ensure the reliability of the technologies above, field tests were carried before the implementation of each special program.

Energy

Energy consumption

Primary energy need : 118,67 kWhpe/m^2.

Primary energy need for standard building : 219,14 kWhpe/m^2.

Calculation method : Primary energy needs

Final Energy : 35,96 kWhfe/m^2.

Breakdown for energy consumption :
HVAC: 28.7%
General lighting socket equipment: 37.0%
General office equipment: 34.3%.

Envelope performance

Envelope U-Value : 0,16 $W.m^{-2}.K^{-1}$

More information :

The integrated U-value of the wall is 0.16 W/ •k and the U-value of transparent windows is 1.0 W/ •k. To ensure the exterior wall meet the thermal design requirements, this project uses autoclaved aerated concrete wall panels which has low thermal conductivity and the graphite polystyrene board as exterior insulation materials. In addition, the project adopts the thermal bridge break and air tightness assurance technology.

Building Compactness Coefficient : 0,22

Indicator : GB/T 7106-2008

Air Tightness Value : 0,43

Renewables & systems

Systems

Heating system :

- Geothermal heat pump

Hot water system :

- No domestic hot water system

Cooling system :

- Geothermal heat pump
- Fan coil

Ventilation system :

- Double flow heat exchanger

Renewable systems :

- Heat pump (geothermal)

Renewable energy production : 16,93

Smart Building

BMS :

BMS (building management system) monitors the cold and heat source system and fresh air system. To achieve energy saving and comfortable office environment, indoor environment

parameter is controlled by setting temperature and humidity sensors and air quality sensors. A special energy management platform is also set to collect energy consumption and classify monitoring data.

Environment

Urban environment

The project is located on the new campus of Shandong Jianzhu University. The campus is equipped with commercial services, sports and other places of service. The campus has public transport vehicles No. 317 and K161, which make people easy to travel. The new campus of Shandong Jianzhu University is located in No. 1000, Fengming Road, Lixia District and had been selected into the United Nations Environment Programme green campus classic case in June 2014.

Land plot area

Land plot area : 6 439,20 m^2

Green space

Green space : 2 581,53

Parking spaces

There are 23 outdoor parking spaces in the project area and 23 parking spaces. The project is located on the campus, the area is open nature, the campus part of the resources are shared state, so you can use the number of parking spaces not only 23.

Products

Product

Qinheng Shoulder insulation panel

http://www.qinheng.com/

qishunhang@qinheng.com

Product category :

Qinheng Shoulder insulation panel is a kind of flame retardant polystyrene foam which is made of expandable polystyrene beads along with graphite through thermoforming in the mold after being expanded by steam. This product has the characteristics of good thermal insulation performance, cost-effective, extensive use and so on.
Raw material suppliers are well-known companies in the world, which can guarantee the quality of products. The heat conductivity coefficient of the product is less than 0.033 W/m•K and the combustion performance grade is B1 .

well accepted by the user with high performance

Velux skylight

http://www.velux.com.cn/

21 support@VELUX.com.cn

Product category :

This product with a hidden motor can be opened and closed by electric controlling. The whole window is simple and neat. It can be opened through the upward push. It has a large open angle, good ventilation effect, high standard of thermal insulation and sound insulation performance. The frame timber is made of fine Nordic pine and completed through 301 processes and check procedures such as lamination, tenon, drilling, shaping, grinding, antiseptic treatment, termite prevention treatment and so on. The cover plate and drain plate are made of precision manufacturing process, and are subjected to 1080 hours salt mist test and ultraviolet irradiation test. The sealing system consists of seven sealing strips which will be strengthen through built-in nylon thread. U-value of the product is less than 1 W/ •K.

Can be produced commercially in large scale.
With high energy-efficient waterproof performance
Because the product modulus is fixed, high construction accuracy is required, therefore the construction is slow.

Viewmax Passive house energy-saving window

http://www.view-max.net

lu.houchang@view-max.net

Product category :

The research purpose of P series passive energy saving window is to reduce energy consumption of heating and cooling, so as to save energy and protect environment. P series of passive energy-saving window adopted a number of advanced energy-saving technologies which include PVC co-extrusion technology, special PUR foaming technology, Low-E glass, inert gas and warm middle edge and so on. P series passive energy saving windows possess characteristics of fireproof, heat insulation, thermal insulation, corrosion resistance, climate change resistance, excellent insulation and smooth appearance, which can make room form a healthy indoor micro climate environment, and achieve the best energy saving effect. U-value of the product is less than 1 W/ •K.

Energy saving window for passive house with high performance. Many colors for building envelop fitting

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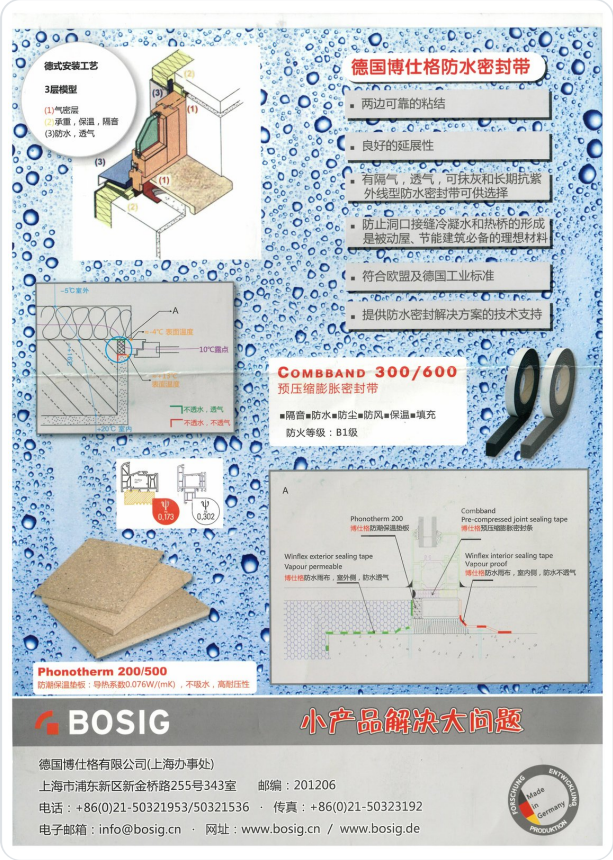
Bosig waterproof vapor retard/permeate material

http://www.bosig.cn

255 343 info@bosig.cn

Product category :



This product is imported from Germany and conforms to the European Union and German industrial standards. The product has good ductility, reliable adhesive strength, and a wide range of options including vapor retard, vapor permeable type, plastering or long-term UV resistance. The products are ideal materials for passive house or other energy-saving building which will mainly be used in windows, doors and wall holes and which can effectively prevent vapor condensed.

Because the dimension is limited, it applies to window and door openning.

Tsinghua Tongfang fresh air units with heat recovery and the double temperature cool sources with an inner condenser

http://www.gztfrf.com

581 101 gztfrf@gztfrf.com

Product category :

The unit conducts advanced treatment of fresh air which is based on two types (high and low temperature) of cold source, and mainly bear indoor wet load. Two stage full heat recovery device has been set. In the summer, the new exhaust air conducts full heat exchange through a plate full heat exchanger and achieve the primary recovery of cooling capacity. A compressor condenser which cool the amount of discharged air the second time is arranged in the exhaust side. The total heat recovery efficiency can be up to 80%. This product adopts the direct evaporation condensing double temperature fresh air unit which is unique to Tsinghua Tongfang. That is, the precooling direct evaporation condensation technology can effectively prevent the fouling of condenser.

This product has been used in many projects, the quality is mature which ensure an using effect

Costs

Construction and exploitation costs

Renewable energy systems cost : 2 340 000,00 ¥

Total cost of the building : 57 922 087 ¥

Subsidies : 10 000 000 ¥

Energy bill

Forecasted energy bill/year : 348 700,00 ¥

Real energy cost/m2 : 35.96

Real energy cost/Pupil : 343.89

Building Environnemental Quality

Building Environmental Quality

- consultation - cooperation
- acoustics

- energy efficiency
- renewable energies
- integration in the land
- mobility
- products and materials

Health and comfort

Water management

Consumption from water network : 11 645,70 m^3

Water Consumption/m2 : 1.2

Water Consumption/Pupil : 11.48

Contest

Building candidate in the category

Date Export : 20230517121156