Shenzhen Museum of Contemporary Art and Urban Planning

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Primary energy need :

90.92 kWhpe/m².

(Calculation method : Other)

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 : Museum
Construction Year : 2013
Delivery year : 2017
Address 1 - street : 184 518000 ,
Climate zone :

Net Floor Area : 89 688 m²

Construction/refurbishment cost : 1 416 960 ¥
Cost/m2 : 15.8 ¥/ m ^{2}

General information

As the demonstration of China's leading architecture technology, "the 2M" is determined to be a low-carbon, intelligent and sustainable architecture since the very beginning to maximize the demonstration. The design team wants to use the influence of "the 2M" to promote the application of sustainable architecture design and construction, the development of sustainable architecture materials and the future of sustainable property management. "The 2M" introduce "green architecture" to non-professionals. "The 2M" also successfully combined sustainable design concept with advanced and integrated architecture technologies, not only does it make "The 2M" get the "Certificate of Green Building Design Label – Three Stars", but also makes "The 2M" an excellent demonstration and leading example of "green building" in Shenzhen and in China.

"The 2M" uses structural components as the main element of its façade to integrate architectural structure, moulding and space. The structural components above the main indoor space are rhythmic and patterned and allows "The 2M" to withdraw from adding decorations as suspended ceilings. "The 2M" adopts steel structure system and optimizes the hanging steel cantilever to ensure an advanced earthquake-absorbing technology. Steel structure system has better functionality and stability and is overall dependable while earthquakes among other structural systems, It can also meet the complex requirements

of architectural functions, spaces and mouldings while can be easily prefabricated, It reduces resources consumption and has less impacts to the environment compared to other structural systems.

"The 2M" mainly adopts the following technologies:

Measures such as closed hollow double-layer glass windows or ventilation noise reduction windows with high silencing volume are adopted to ensure that indoor noise reaches indoor daytime noise control requirement. The thickness of toughened hollow glass shall not be less than 8+9A+8. The air conditioning system of the project adopts centrifugal chillers; The large space adopts an all-air system; In some areas, the runner heat recovery unit is used to carry out full heat recovery on fresh air, which can save 24,211.2kwh of electricity throughout the year. Lighting of public parts of buildings shall adopt high-efficiency light source energy-saving control measures. Domestic hot water adopts solar hot water with air source heat pump for auxiliary heating. An 800 m^3 rainwater collection tank is set up for the rainwater collection system. The reclaimed water source includes roof rainwater and air conditioning condensate. The annual amount of rainwater and air-conditioning condensate that can be collected is 19,053.10 m3, and the utilization rate of non-traditional water sources is 21.54%. The water-

saving irrigation method of sprinkler irrigation is adopted in the project, and the water source of sprinkler irrigation is rainwater. Ready-mixed concrete and ready-mixed mortar are adopted for the project. Civil engineering and decoration are designed in an integrated way. The recycling ratio of recyclable materials is 14.1%. Skin steel structure system is an economic and energy-efficient structure system. The project optimizes the steel quantity of steel structure skin, and the steel quantity can be saved by 10%. The central part of the project is provided with atrium space, and the roof is provided with electric curtain wall opening windows. The total curtain wall opening rate is 11.1%. The building skin consists of aluminum alloy sunshade perforated plate and thermal insulation glass layer. The project will set up 25 light pipes underground. The intelligent system design of the project is complete with Energy meter reading system and Source management system, which performs efficiency analysis on lighting, air conditioning, power, commerce, exhibition and other energy consumption of the two Museums and parks respectively.

Data reliability

3rd part certified

Stakeholders

Contractor

Name :
Contact : 13662601019 zhangying@cohl.com
http://www.coli688.com/

Construction Manager

Name :

Stakeholders

Function : Thermal consultancy agency

15210560274 854624648@qq.com

http://www.thupdi.com/
We carry out technical consultation on green building from six aspects, i.e. four savings, environmental protection and operation management, combining with the actual local climate conditions and the functional orientation of the project, to provide guid

Function : Designer

13600439567 0755-86126806

http://www.huasen.com.cn

Huasen is responsible for deepening and implementing the green building technology consulting program and implementing it in the construction drawing design. Our company has completed the design of photovoltaic power generation system, solar water heating

Owner approach of sustainability

As one of the major construction landmarks of Shenzhen's "12th Five-Year Plan" (2011-2015) planned by Shenzhen government, "The 2M" adopts world-leading energy-saving technology and sustainable design concept and has a profound impact on the future development of green buildings. Compared to other surrounding construction projects, "The 2M" is determined sustainable in the very early stage and set its goal of achieving "Certificate of Green Building Design Label – Three Stars". It focuses on building a low-carbon, intelligent and technological "green building". The "green" vision is planned from the very beginning and is carried out to the end; "The 2M" integrates various professions to carry out a systematic and reasonable co-ordination to sustainable technologies, adopts current advanced scientific and technological achievements, conserves a larger amount of resources (land, energy, water, construction materials and etc.), protects the environment and reduces pollution, provides visitors with healthy, comfortable and efficient indoor spaces, and finally completes a green and healthy building achieving sustainability.

The Project uses multiple green technologies in combination with climate, site and other conditions, among which the high-efficiency material-saving structural system, runner heat recovery fresh air system, rainwater collection and recycling system and solar domestic hot water system are provided with strong project characteristics in setting light pipes to enhance the lighting of underground space. In particular, the highly efficient and stable steel structure design system provides a reference and replicable learning sample for large-space exhibition hall buildings. The concrete implementation effect of these green technologies will provide a good reference for the construction of green buildings in the future. Therefore, the Project has good promotion value for green buildings.

Architectural description

Shenzhen Museum of Contemporary Art and Urban Planning has four unique design innovations:

1) Architectural skin with double twisted faces and giant cloud sculpture

"The 2M" have unique skin shape, which is similar to that of hurricanes. They are not only curved, but also concave on the elevation. The skin of the building is composed of the main structure and glass curtain wall. The smooth transition between the skin and the main space

is the key to the success of this project. The soul of the inner space is led by the giant cloud sculpture in the center of the 12,000 square meters entrance space. Independent supporting structure and large cantilever are also its technical focal points. Stainless steel seamlessly polished giant sculpture has become the first architectural exhibition in the exhibition hall.

(2) Integration of building and structure

In the projects, the structure, instead of wrapped with architectural decoration, is directly exposed to express the aesthetic perception of space. This requires the construction of steel structure itself to be exquisite and accurate. This not only reflects the power transmission aesthetics of the building itself, but also saves a lot of decorative materials. The exhibition space is a column-free space, and the outer skin is self-supporting system, which transfers the vertical load of the floor only by the four columns of the central core tube. Great spatial variability was set aside for the exhibition. By optimizing the structure, the steel consumption can be saved by about 10%, which has an important contribution to reduce carbon emissions in the material production stage.

(3) Combination curtain wall and perforated plate

The double curtain wall of “The 2M” is a sandwich multi-layer structure system, which consists of three levels: main steel structure, glass curtain wall and metal perforated sunshade. The main steel structure of the skin acts as both the vertical component of the structure bearing load and the base of the curtain wall, and undertakes the function of the building envelope structure. Perforated aluminium plate can play a very good role in shading, greatly reducing the energy consumption of indoor air conditioning system; at the same time, not affecting the indoor natural lighting, it avoids direct sunlight indoors, and the perforation rate also takes into account the user's penetration from indoor to outdoor.

(4) Simulation analysis and green design

Comprehensive use of various green ecological technologies and simulation analysis software to rationally organize the relationship between buildings and natural factors such as light and wind so as to make buildings and environment an organism with good indoor climate conditions and strong ability to adjust the biological climate. This project has been awarded Three-star Level of National Green Building Design Label.

The positive impact of Shenzhen Museum of Contemporary Art and Urban Planning on users and environment:

(1) Efficient and economical structural system:

The professional structural consulting team of the Project has optimized the structural system to save about 10% of steel consumption, which has made an important contribution to reducing carbon emissions in the material production stage.

(2) Perforated aluminum plate shading system:

The exterior skin of the building adopts a shading system of perforated aluminum plates, which can play a very good shading role and greatly reduce the energy consumption of the indoor air conditioning system. Meanwhile, indoor natural lighting is not affected, and thermal

discomfort caused by direct sunlight to indoor personnel is avoided.

(3) Energy-saving and efficient air conditioning system:

The high-efficiency and energy-saving centrifugal water chiller with COP of 6.06 is adopted. Cooling column, water pump and fan all operate with frequency conversion according to load, thus greatly reducing energy consumption of air conditioning system under partial load. Most areas of the building adopt all-air system, which can adjust the fresh air ratio by 50-100%. Shenzhen has no heating demand in winter, with a longer transition season throughout the year. The fresh air operation can greatly reduce the energy consumption of the air conditioning system during the transition season under the condition of meeting the thermal comfort needs of indoor personnel.

(4) Runner heat recovery fresh air system

The Project adopts a full heat recovery runner fresh air system, which can save 24,000 kWh of power consumption during the whole year.

(5) Solar water heating system

The Project adopts solar water heating system and air source heat pump for auxiliary heating, thus completely eliminating the use of electric heating system and greatly improving the utilization grade of energy. About 268GJ of heat is saved annually.

(6) Light pipe system

Part of the underground space of the building adopts a light pipe natural lighting system, which can greatly reduce the lighting energy consumption of the underground garage during the daytime.

(7) Intelligent system

The application layer of the system is composed of meter reading server, database server and interface, and implements consumption statistics and energy saving analysis.

Building users opinion

The indoor sound, light, heat and air quality of the project can meet the design requirements, and the satisfaction rate of users to the above aspects is very high. The project was opened in late 2017, which attracted people from the industry, cultural enthusiasts and even fashion circles to visit and shoot. Also, many academicians and architectural experts came to visit. Cui Kai, academician of the Chinese Academy of Engineering, highly appraised the completeness of the design, the solution of structural integration and the variability of the architectural space. At the present stage, there is an endless stream of visitors, with the maximum number of visitors exceeding 20,000 per day.
The Project adopts measures such as closed hollow double-layer glass windows/ventilation noise reduction windows with high noise elimination volume to ensure that indoor noise can reach indoor daytime noise control requirement. The exterior skin of the building adopts a shading system of perforated aluminum plates, which can play a very good shading role,

without affecting indoor natural lighting, and also avoids thermal discomfort caused by direct sunlight on indoor personnel. Part of the underground space of the building adopts a light pipe natural lighting system, which provides a better light environment due to better lighting effect of natural light. All-air system is adopted in most areas of the building, and the fresh air ratio can be adjusted by 50-100%. The fresh air operation can greatly reduce the energy consumption of the air conditioning system in the transitional season and effectively reduce the concentration of indoor CO2 and other pollutants under the condition of meeting the thermal comfort requirements of indoor personnel.

Energy

Energy consumption

Primary energy need : 90,92 kWhpe/m^2.

Primary energy need for standard building : 122,47 kWhpe/m^2.

Calculation method : Other

Final Energy : 58,40 kWhfe/m^2.

Breakdown for energy consumption :
HVAC 28.38 Kwh/m2/year
General lighting socket equipment 17.50 Kwh/m2/year
General power equipment 5.59 Kwh/m2/year
Others 6.93 Kwh/m2/year

Envelope performance

Envelope U-Value : 0,52 $W.m^{-2}.K^{-1}$

More information :
Roof: 140mm thick semi-hard mineral (rock) cotton board
Exterior wall: 50-100mm thick semi-hard mineral (rock) cotton board
Outer window: common aluminum alloy window frame +Low-E hollow glass

Building Compactness Coefficient : 0,07

Real final energy consumption

Real final energy consumption/functional unit : 58,20 kWhfe/m^2.

Year of the real energy consumption : 2 018

Renewables & systems

Systems

Heating system :

- No heating system

Hot water system :

- Heat pump
- Solar Thermal

Cooling system :

- Others

Ventilation system :

- Single flow

Renewable systems :

- Solar Thermal
- Heat pump

Renewable energy production : 0,70

Solutions enhancing nature free gains :

1. Perforated aluminum plate shading system: The exterior skin of the building adopts a shading system of perforated aluminum plates, which can play a very good shading role and greatly reduce the energy consumption of the indoor air conditioning system.

Smart Building

BMS :

Intelligent meter reading system: the application layer of this system consists of meter reading server, database server and interface. It has the functions of real-time meter reading, disconnection detection, power failure saving, automatic charging, report printing, operation management, etc. It receives the data of each ammeter/cold meter remotely transmitted and reported by each intelligent acquisition terminal, and is responsible for completing the tasks of system operation and maintenance, report printing, etc. and implementing consumption statistics and energy saving analysis. Energy management system: This system uses B/S server working mode and is built on the dedicated network of BMS system. It directly obtains building energy consumption information from intelligent meter reading system, power supply and distribution monitoring system and building equipment control system, and performs efficiency analysis on lighting, air conditioning, power, commerce, exhibition and other energy consumption of the two Museums and parks respectively.

Users' opinion on the Smart Building functions :

The intelligent control system of the building operates well, and the users are very satisfied with the operation of the control system.

Environment

GHG emissions

GHG in use : 53,63 $KgCO_2/m^2/$

Methodology used :

Standard for Measuring, Accounting and Reporting of Carbon Emission from Buildings CECS 374-2014

GHG before use : 21,17 $KgCO_2$ $/m^2$

Building lifetime : 50,00

, ie xx in use years : 0.39

The calculation is carried out by using the Green Building Window software. The software is based on the Standard for Measuring, Accounting and Reporting of Carbon Emission from Buildings (CECS 374-2014) compiled by China Institute of Architectural Design

Water management

Consumption from water network : 137 075 000,00 m^3

Consumption of grey water : 3 160,00 m^3

Consumption of harvested rainwater : 3 160,00 m^3

Water Consumption/m2 : 1528.35

Water Consumption/Visitor : 9453.45

Products

Product

Centrifugal chiller

Product category :

Power: 650KW Refrigerating capacity: 3516KW, COP5.4.

The performance parameters of this chiller are 10% due to the national energy saving design standard. With good regulation performance, high COP energy efficiency ratio and high stability, it is a very good energy-saving water chiller.

Runner type air treatment unit

255 4 1 A 6 021-23063000

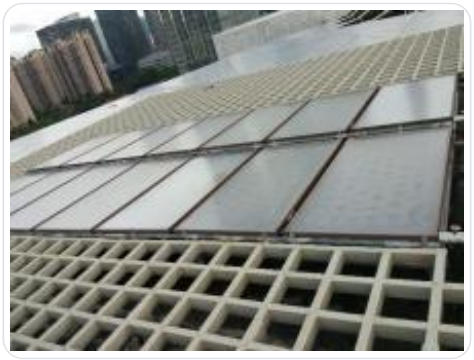
http://www.carrier.com.cn

Product category :

Refrigerating capacity: KW, air volume 2000 m3/h; It is in good condition and has not broken down since it was put into operation.

The system pressure is relatively stable, the failure rate is very small, and the technology is very mature.

Solar photo thermal panel



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http://www.syexny.com

Product category :

The absorption ratio is 0.95, the core of the heat collector is made of domestic high-quality copper and is welded by international advanced laser welding technology, with good forming quality, low thermal resistance and a service life of more than 30 years; The core is provided with the most advanced blue titanium coating in China, with high absorptivity and low emissivity; 1.2Mpa pressure test shall be conducted after the core is manufactured to ensure reliable quality of the heat collector; The frame of the heat collector is made of aluminum-magnesium alloy processed by special technology, which is elegant in appearance and durable in use; The glass cover plate is made of 3.2mm thick domestic high-quality brand tempered glass with low iron cloth grain, with a transmittance of over 89%, hail resistance and aging resistance; The back plate of the heat collector is designed with glass wool insulation layer, and the frame is insulated with polyethylene and coated with aluminum

foil, which has good insulation effect and little heat dissipation loss.

The product has high stability, stable hot water output, high absorption, friendly operation, low failure rate and simple maintenance.

Air source heat pump hot water unit

shwarm@shwarm.com

http://www.shwarm.com

Product category :

Rated power: 9.28KW; Rated heat production: 40KW; Rated water yield: 860L/h; Effluent temperature: 55℃. The shell is made of stainless steel panel, which is beautiful, durable and corrosive. The unit adopts international scroll compressor. It adopts low noise aluminum alloy fan blades and the unit adopts top-out air structure, with installation not limited by wind direction. The evaporator adopts a blue hydrophilic membrane internally threaded heat exchanger, which has high heat exchange efficiency and is not easy to freeze in winter. The unit uses electronic expansion valve to throttle. All kinds of protection for the unit are complete. The unit is equipped with intelligent chips imported from the United States. It is fully automatic, automatically detecting the water temperature and hot water load, automatically adjusting the energy, automatically starting and stopping the unit, and automatically defrosting. After the detection parameters of the exhaust probe are processed by CPU, the opening degree of the electronic expansion valve is directly controlled to ensure stable operation in high temperature environment. The heat exchanger is a coaxial heat exchanger, i.e. the inner tube is sleeved with the outer tube, with refrigerant in the outer tube, and the water in the inner tube, so that the refrigerant and the water run in reverse and the heat exchange is more sufficient. It is with strong corrosion resistance, strong scale resistance, high pressure resistance, good oil return, more stable, safe and durable system.

This air source heat pump unit, as the supplementary heat system of the solar water heating system, has high stability, stable effluent temperature and high efficiency, and is a very good energy-saving product.

Light pipe

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http://www.east-view.com.cn/

Product category :

The light pipe lighting system collects natural visible light in the sky through an outdoor optical lighting device, and after the light pipe is efficiently reflected and transmitted, the natural light

is evenly scattered indoors after being secondarily distributed by device at the bottom of the system.

It saves the cost of electric lighting. It is also perfectly combined with the building, with seamless docking and convenient replacement, simplifying the installation procedure of the system; It has a crystal drill type light collector with patented design and a flat plate type light collector with super load-bearing capacity, which fully coordinates with various building surfaces to enhance building quality.

Electric window

(

1688

https://www2.g-u.com/

Product category :

The safety has passed inspection and certification: natural smoke exhaust and heat removal equipment specified in DIN EN 12101-2 is a building product mentioned in Part 1 of List B of Building Standards. According to the provisions of this standard, it is only allowed to use the overall certified system solution consisting of drive unit (including fixing material), window profile, glass and seal, and window hardware (diagonal tie rod, hinge, etc.) in vertical elevation. GU's natural smoke exhaust and heat removal equipment system solution can be used for European standard groove aluminum profiles, wood profiles and aluminum-clad wood profiles of well-known system suppliers. All systems can ensure extremely high working reliability in case of fire.

The automatic exhaust system is an important part of the fire prevention system. Where it is required that the smoke exhaust system can work most reliably and exhaust smoke rapidly in case of fire, the automatic smoke exhaust and heat removal system can ensure the automatic and reliable opening of the smoke exhaust port. The system is an integral part of the fire prevention plan, which can ensure that the escape route is free of smoke, prevent personnel from inhaling toxic smoke, and help protect physical assets. Meanwhile, it can also work in the daily ventilation mode to ensure the supply of the required fresh air. It saves the cost of electric lighting. It is also perfectly combined with the building, with seamless docking and convenient replacement, simplifying the installation procedure of the system; It has a crystal drill type light collector with patented design and a flat plate type light collector with super load-bearing capacity, which fully coordinates with various building surfaces to enhance building quality.

Rainwater recycling system

46 service@nanfang-pump.com

http://www.nanfang-pump.com/

Product category :

Power: 4KW Speed: 900r/min Flow: 40m/h. It has been with no trouble since use, and is in good use.

The rainwater is well collected, purified, supplied and replenished, which can effectively collect rainwater and reasonably save cost.

Costs

Construction and exploitation costs

Renewable energy systems cost : 869 000,00 ¥

Cost of studies : 11 138 000 ¥

Energy bill

Forecasted energy bill/year : 6 106 000,00 ¥

Real energy cost/m2 : 68.08

Real energy cost/Visitor : 421.1

Urban environment

Shenzhen Museum of Contemporary Art and Planning Exhibition is located in Futian Cultural District, Shenzhen, and is located in the core cultural and commercial district of Shenzhen. The transportation of the exhibition hall is very convenient. it is located at the interchange station of Lines 3 and 4, the Children's Palace station. Facilities around the exhibition hall are complete. The south side of the building is adjacent to the civic center and the civic square, which is the main recreational and sports activity area for citizens. The building lies to Shenzhen Children's Palace in the north and to Shenzhen Book Mall and other commercial complex areas in the west. The green area around the building is with perfect functions and is about 400m away from Lianhuashan Park in Shenzhen City. Lianhuashan Park covers an area of 60 hectares and is open to the public for free.

Land plot area

Land plot area : 29 688,40 m^2

Green space

Green space : 8 906,50

Parking spaces

The parking lot is located on the first and second floors underground, with 326 parking spaces.

Building Environnemental Quality

Building Environmental Quality

- water management
- renewable energies
- integration in the land
- mobility
- products and materials

Contest

Reasons for participating in the competition(s)

Shenzhen Museum of Contemporary Art and Planning Exhibition is the last major public building project in Futian Central District.. It lies to the Citizen Center in the south, the Children's Palace in the north and Shenzhen Book Mall in the west. The construction land covers an area of 29,688 square meters, and its construction functions mainly include contemporary art museum, urban planning exhibition hall, public service area and its supporting facilities.

This building has obtained a three-star evaluation and identification project for green buildings. It is with advanced technical concept, remarkable energy saving effect, and an annual energy consumption per unit area of 58.6kWh/ . It has a wider popularization value in similar meteorological conditions and similar functional buildings, including perforated

aluminum plate shading measures and screen hollowing rate design, atrium automatic opening skylight to strengthen ventilation passive measures design, underground garage using light pipes for natural lighting, and runner total heat recovery fresh air system greatly reducing fresh air energy consumption. Structural optimization design reduces steel usage by 10%.

Since the Shenzhen Museum of Contemporary Art and Planning Exhibition was completed and put into operation, it has successively held many large-scale activities at home and abroad, including: Fortieth Anniversary Sculpture Commemoration, Shenzhen Fashion Week, Shenzhen Design Week, and the "Exceeding the Rules" Han Tianheng Painting and Calligraphy Exhibition. After the completion of the Project, it will serve as a model of perfect combination of ecology and architecture and become a landmark building in Shenzhen. The green ecological technology adopted by the Project has also become a model project for industry personnel to visit and study.

Building candidate in the category