



# Office Building of Dongguan Eco-park Holding CO., LTD.

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Primary energy need :

## 125.4 kWhpe/m<sup>2</sup>.

(Calculation method : )

**ENERGY CONSUMPTION**

Consumption Range (kWhpe/m <sup>2</sup> )	Grade
< 50	A
51 à 90	B
91 à 150	C
151 à 230	D
231 à 330	E
331 à 450	F
> 450	G

*Economical building* (Grades A-C) | *Energy-intensive building* (Grades D-G)

**Building Type** : Office building < 28m  
**Construction Year** : 2010  
**Delivery year** : 2013  
**Address 1 - street** : 523000 ,  
**Climate zone** : [Cfa] Humid Subtropical - Mild with no dry season, hot summer.

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**Net Floor Area** : 37 664 m<sup>2</sup>  
**Construction/refurbishment cost** : 200 287 700 ¥  
**Number of Work station** : 300 Work station  
**Cost/m2** : 5317.75 ¥/ m<sup>2</sup>

**Certifications :**



## General information

Dongguan ecological park planning area is located in the east of Dongguan City, east of the fast road. The scope of this park is the area enclosed by six towns, namely Liaobu, Dongkeng, Dasan, Shek Pai, Hengli and Qishi. Dongguan Ecological Park is a municipal wetland ecological park, high-end industry supporting service area, this project is the early stage project of Dongguan ecological park.

Dongguan ecological park office building has a total construction area of 37,664 square meters, the main function is for the office and related supporting space use, building has one floor underground, and five floors above ground. The underground space is mainly used as garage and equipment room; the ground floor is the platform layer, used as the main building entrance, exhibition hall, restaurant, etc. ; 2th to 5th floor are divided into four tower buildings, the main function is for office and conference use. The structure of the project is reinforced concrete frame structure. The economic indicators of the project is as follows: total land area of 36925 ; total construction area of 37664 , of which 25173 above ground, 12491 underground, building density of 23.9%, volume rate of 0.682, green rate of 33.47%, parking spaces for vehicles: 19 above ground; 297 underground, 80 parking

spaces for bicycles.

Adhering to the ecological mission, in according to the local condition, it organically combines various technologies, integrated usage of active, passive technologies, to achieve the application of energy saving and environmental protection technology in green practice: optimization of building orientation, wire mesh shell integrated solar shading, efficient ventilation, envelope of high lighting performance, lighting atrium, lighting wells on the platform layer, underground space sunken courtyards to achieve natural ventilation and lighting design; The use of independent control concept of temperature and humidity, combined with high temperature chillers, dry fan coil and full heat recovery of dual temperature fresh air system, to significantly reduce energy consumption of air conditioning; application of lake water source heat pump system In according to local condition; use of high-efficient lamps to reduce lighting energy consumption; use of artificial wetland- waste water treatment system to save water, use of energy management system to achieve building energy monitoring, and so on.

## Data reliability

3rd part certified

## Stakeholders

### Stakeholders

**Function :** Thermal consultancy agency

010-82819000-8853

<http://www.thupdi.com/>

Based on the six principles of land saving, energy saving, water saving, material saving, environmental protection, operation and management, combined with the local climate condition and building function, we provided guidance for the design concept and

**Function :** Developer

0769-22890176

Determining the scale of the project construction and sub-indicators of investment estimation, handling site selection, land pre-trial, environmental protection and energy conservation evaluation report, soil and water conservation programs, preparing fea

**Function :** Designer

138-2645-0315

<http://www.scutad.com.cn/>

Design Institute and consultants have worked in close cooperation to integrate the program concept into design phase. Architects have achieved passive energy-saving design, realized a comprehensive optimization of building orientation and façade design, H

## Contracting method

Lump-sum turnkey

## Owner approach of sustainability

First of all, the biggest highlight of the architectural design is the inheritance of the essence of the Lingnan traditional architecture, by the use of courtyards, atrium, overhead and arcade construction techniques, we have designed an atrium with lighting, shading, ventilation strategies of highly climate adaptability. Secondly, a shell structure of wire mesh is set up in south orientation, as the landmark of the entire building design, it effectively prevents the solar radiation heat in summer, and the whole process of shell optimization reflects the passive design concept, bringing inspiration and reference to other green building design. Thirdly, the use of a variety of passive concepts, efficient air conditioning system and renewable energy application. Passive technologies mainly includes: the use of the lighting atrium, lighting wells and sunken courtyard to improve the indoor lighting and ventilation environment, additionally, a variety of open windows configurations to enhance building ventilation; air conditioning system using advanced temperature and humidity independent control system, combined with magnetic suspension high temperature chillers, greatly improved the COP, system terminal use dry fan coil + dual-temperature fresh air unit with full heat recovery; Considering the local condition, the project has efficiently take the lake water source for renewable energy use. In summer, the pre-cooling coil of the double-temperature fresh air unit uses the lake water to provide the cold load for the refrigerant. In winter, the screw heat pump unit uses the lake water as the heat source to supply heat to the fresh air system. The lake water source is also used as the cooling water source of the high-temperature chiller. At last, in the view of the characteristics of quality-induced water shortage in the south region, combining with the overall positioning of Dongguan ecological park —“the Green lung of Dongguan city”, the artificial wetland - wastewater treatment system and drip irrigation system are used as demonstration.

## Architectural description

1.Optimization of building orientation

In the initial design stage, the building is oriented 45 ° south west, Considering the longer summer, in order to prevent the overheating of west façade, the building orientation is optimized from 45 ° south west to 15 ° south east.

2. Optimization of south shell structure and solar shading

In the initial design stage, the south shell is made of glass. It would inevitably lead to excessive solar radiation incidence in summer and reduce the indoor thermal comfort, the glass shell is changed to shell of wire mesh, according to different solar radiation heat received in different parts of shell, different shading measures and mesh rate of wire mesh shell are used.

### 3.Passive design enhanced natural ventilation and day lighting

Lighting atrium in the building tower, light well on the 2th floor platform, sunken courtyard improving the ventilation and lighting condition of underground space, high side window of the atrium corridor enhancing ventilation, Horizontal open window connecting the ground floor cafeteria and atrium, to enhance the air exchange in cafeteria.

### 4.High efficient air conditioning system

the 4 building tower use independent temperature-humidity control air conditioning system, combined with dry fan coil and dual temperature fresh air handle unit with full heat recovery, to largely reduce the energy consumption of air conditioning.

### 5.Renewable energy - water source heat pump application

There are a lot of lakes around the project, after hydrogeological investigation, the water is verified to be suitable for lake water source heat pump. The lake water is utilized for the pre-cooling of dual temperature fresh air unit, and provide cooling water source for the high temperature chillers, in winter season provide heat for fresh air unit, that can effectively reduce the cooling & heating energy consumption, and omit the cooling tower set, saving the cooling water consumption

## If you had to do it again?

Problem occurs during the operation of wastewater treatment system, filtered water appears to be yellow. After investigation, it is found that it is the problem of activated carbon adsorption, water from the membrane through the activated carbon adsorption, it can be deodorized deodorized, and the colloidal material in water can also be absorbed. (If the activated carbon adsorption system set in front of the membrane system, 1 kg activated carbon could treat 8-12 Ton of water, the life of activated carbon will be very short, and soon be replaced, and system set in the backside is about 20 times more efficient than that in the front, to improve the life of activated carbon, activated carbon should be set up after the membrane, 1 kg activate carbon of dechlorination could handle about 30 tons of water) The process of activated carbon can be designed to wash once a day, every time 10 minutes. Due to the lack of maintenance-related professional and experience, after regular cleaning and replacement of activated carbon according to the design requirements, filtered water quality restored to the using standards.

## Building users opinion

The quality of project indoor sound, lighting, thermal, air can meet the design requirements, the users are satisfied with the various aspects. The project is located in the ecological park, away from the noisy city center, no adjacent buildings, so indoor and outdoor environment is very quiet. Each of the 4 tower buildings has lighting atrium, and sets up a number of lighting wells on the platform of 2th floor, underground garage is also equipped with sunken courtyards, and all the measures contribute to an indoor daylighting environment of high quality, it can meet the demand of users in daytime without artificial lighting. The project uses air conditioning system with independent temperature-humidity control, system terminal is dry fan coil, providing a good indoor thermal comfort. In the main functional space, such as the open office, conference room and exhibition hall on the ground floor, VIP room and other space where the occupied number is relatively unfixed, CO2 monitoring devices are set up in the return conduct of the fresh air handling unit, to prevent an exceeded indoor CO2 concentrate by adjusting the amount of indoor fresh air volume.

## Energy

### Energy consumption

Primary energy need : 125,40 kWhpe/m<sup>2</sup>.

Primary energy need for standard building : 164,80 kWhpe/m<sup>2</sup>.

Calculation method :

Final Energy : 38,01 kWhfe/m<sup>2</sup>.

Breakdown for energy consumption :

HVAC: 37.4%

General lighting socket equipment: 43.5%

General power equipment: 14.6%

Others: 4.5%

### Envelope performance

Envelope U-Value : 1,60 W.m<sup>-2</sup>.K<sup>-1</sup>

More information :

Roof 60 mm thick extruded polystyrene EPS board insulation

Outside wall Partly aerated concrete, partly reinforced concrete

Window outside window ordinary aluminum frame + low-E insulating glass interior window Ordinary aluminum frame + ordinary insulating glass

Building Compactness Coefficient : 0,27

Indicator : GB/T 7106-2008

### Real final energy consumption

Real final energy consumption/m<sup>2</sup> : 38,01 kWhfe/m<sup>2</sup>.

Year of the real energy consumption : 2 013

### Systems

#### Heating system :

- Heat pump

#### Hot water system :

- No domestic hot water system

#### Cooling system :

- Water chiller
- Fan coil

#### Ventilation system :

- Double flow heat exchanger

#### Renewable systems :

- Heat pump

#### Renewable energy production : 46,11

A. Building control system: the project intelligence system includes the following sub-systems:

1. Information facilities system: communication network system, Premise distribution system, computer network system, cable television system, public \ emergency broadcast system, conference system, public information system
2. Equipment management system: building automation system, energy management system
3. Security technology prevention system: Intrusion alarm system, video security monitoring system, access control system, intelligent card system, parking administrative system, handicapped emergency assistance system.

#### B. Air quality monitoring system

each office building has no less than 2 fresh air handling units, and CO2 detectors are set up in the central exhaust duct of each floor, the number of operating fresh air units is controlled according to the collected data. The underground parking with sunken courtyard can be natural ventilated, but the distance between courtyards is relatively far, the project still has mechanical exhaust system, and using CO detectors to control the exhaust fan start and stop.

#### C. Metering device

The project sets up an energy management system that collects and analyzes data on electricity, cooling, and water. According to the requirements of power supply sector, a separate metering cabinet is set up for the mid-voltage power, based on the requirement of green building, low-voltage power is sub-metered by sort of air conditioning, power, lighting and office equipment.

#### Solutions enhancing nature free gains :

Optimization of building orientation, shading optimization, passive technology to strengthen the indoor lighting, ventilation.

### Smart Building

#### BMS :

Building intelligent control system is running well, the users are very satisfied with the operation of control system

**Users' opinion on the Smart Building functions :** Building intelligent control system is running well, the user is very satisfied with the operation of the control system.

## Environment

### Urban environment

The construction site of the project is located in the administrative island in Dongguan ecological park. There is no large industrial pollution source nearby, and the site has a good natural and sound environment in the surrounding.

The public transport of the site surrounding is designed in accordance with the detailed planning of the regional traffic network of the administrative island in Dongguan ecological park. The traffic network in the region is crisscrossed, except for the pedestrian, the traffic consists of three major systems: light rail, automobile, bicycle and cruise ship. Centering on the light rail station, the surrounding area has bus stations, social parking lots, and a green island site as centralized transfer area, public site area covers the whole island by setting sites with an accessible radius of 500 meters.

### Land plot area

Land plot area : 36 925,60 m<sup>2</sup>

### Green space

Green space : 11 088,00

### Parking spaces

Project sets up 19 parking spaces above ground and 297 underground, totally 316 parking spaces. The actual number of users is 300, each user occupies 1.05 parking space averagely.

The project has intelligent parking management system, which can manage vehicle traffic intelligently.

## Products

### Product

Magnetic suspension oil-free centrifugal compressor high temperature chiller

268

<http://www.mcquay.com.cn/>

Product category :

Magnetic suspension high temperature chillers using magnetic levitation technology, due to mechanical movement without contact, the mechanical loss can reduce to zero. Compressor operates without lubricating oil, the entire refrigeration system without lubricants, the heat transfer performance of heat exchanger heat can improve to 10%. Equipment maintenance is also without the need to replace the oil.

Magnetic suspension centrifugal high temperature chillers, chilled water inlet / outlet water has a temperature of 19/14 °C. As a result of the use of high temperature chillers, the COP in standard operating conditions is up to 6.99, IPLV value of 7.70. The cooling water system of the magnetic suspension centrifugal medium-high temperature chiller does not use the conventional cooling tower, instead of that this project has adopted the lake water source cooling water system. Not only the cooling tower is omitted, it can also save the building space, and prevent the influence on the local micro-climate caused by heat dissipation, and saves the cooling water consumption.

Chillers operating in good performance, and basically operate in the setting condition, so far there is no major problem. Its COP in standard operating conditions is up to 6.99, IPLV value of 7.70, in the actual operating condition two chillers have been tested as samples, their COP is basically between 5.5-5.8, although the COP doesn't achieve the design value of standard operating conditions, comparing to ordinary chillers, it shows a relative high energy efficiency.



Lake water source screw heat pump

318

<http://www.daikin-china.com.cn/>

Product category :

The lake water source screw heat pump takes the lake water as heat source, water passes through the automatic swirling sand removing device, purified by the vertical automatic backwashing filter, the lake water further conducts heat exchange with the heat pump, the pump effectively takes use of lake water as heat source, it has a heating capacity of 320kw, and a heating cop of 4.6, operating in good performance.

With less control device, simple waterway configuration and short design cycle, the equipment installation and maintenance of the lake water source screw heat pump is simple and convenient.



Dual temperature fresh air handling unit with full heat recovery

B 2805

<http://12905177.czvv.com/>

Product category :

This project use dual temperature fresh air handling unit with full heat recovery, in addition to the use of concentrated cold (hot) source to provide cold (hot) water, the unit comes with cold source for auxiliary dehumidification. In summer, fresh air is pre-cooled by full heat recovery device, passes further through two groups of coils to be cooling dehumidified, the front coil is cold (hot) water coil, using the lake water source to provide high temperature water refrigerant, the rear coil is direct evaporative coil, used for fresh air auxiliary dehumidification. In winter, lake water source is used as a heat source, by use of the screw heat pump unit to provide hot water to front coil, so as to heat the fresh air.

The fresh air unit is a stand-alone system with its own cold source. In the transitional season, due to the small temperature difference between the fresh and exhaust air, it can reach a higher operation efficiency, the comprehensive energy efficiency could be 20% higher than that of the conventional chiller + water pump + cooling tower system. It can run separately and bear less indoor heat load, reduce time and cost of chiller performance.



In the actual operation, the fresh air handling unit operates within the design range, the unit total air volume and power consumption per unit wind volume have been tested, and both can meet the design as well as the limit requirements, means that the equipment system performs in good condition.

## Costs

### Construction and exploitation costs

Total cost of the building : 200 287 700 ¥

### Energy bill

Forecasted energy bill/year : 3 240 000,00 ¥

Real energy cost/m<sup>2</sup> : 86.02

Real energy cost/Work station : 10800

## Building Environmental Quality

### Building Environmental Quality

- consultation - cooperation
- acoustics
- water management
- energy efficiency
- renewable energies
- maintenance
- building end of life management
- integration in the land

## Health and comfort

### Water management

Consumption from water network : 13 629,00 m<sup>3</sup>

Consumption of grey water : 11 986,00 m<sup>3</sup>

Water Self Sufficiency Index : 0.47

Water Consumption/m<sup>2</sup> : 0.36

Water Consumption/Work station : 45.43

## Carbon

### GHG emissions

GHG in use : 34,01 KgCO<sub>2</sub>/m<sup>2</sup>/

Methodology used :

1 kWh = 0.9183 kg CO<sub>2</sub>, the reference standard for the "building carbon emission calculation standards" for the draft of the Southern regional power grid carbon emission factor

GHG before use : 912,96 KgCO<sub>2</sub> /m<sup>2</sup>

Building lifetime : 50,00

, ie xx in use years : 26.84

GHG Cradle to Grave : 2 613,50 KgCO<sub>2</sub> /m<sup>2</sup>

The total carbon emission in the building material production phase is 18.14 kg CO<sub>2</sub> / m<sup>2</sup> / a, and the total carbon emission in the transportation phase is 0.12 kg CO<sub>2</sub> / m<sup>2</sup> / a. in the operation phase the total carbon emissions per unit area is 34.01 kgCO<sub>2</sub>

## Contest

Building candidate in the category

