Retrofit Project of Guangzhou White Swan Hotel

by / 2018-06-13 15:54:44 / China / 9512 / CN

Primary energy need :

120.79 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 : Hotel, boarding house
Construction Year : 2012
Delivery year : 2015
Address 1 - street : 1 510130 ,
Climate zone :

Net Floor Area : 82 000 m²

Construction/refurbishment cost : 891 ¥
Cost/m2 : 0.01 ¥/ m ^{2}

Certifications :

General information

Guangzhou White Swan Hotel, located on the north bank of Pearl River, is a five-star platinum hotel, the first large-scale modern hotel designed, constructed and managed in mainland China, and a representative and famous building of China's Reform and Opening-Up. It was opened in 1983, and closed in 2012 for renovation of building function layout, interior design, mechanical and electrical systems. The retrofit project mainly includes four parts: structure reinforcement, interior renovation, outdoor amenity and mechanical and electrical equipment. The total energy consumption of the original building was at the middle level compared to other five-star hotels in the same area. The goal is ambitious: to retrofit the hotel in a conservative way as well as to achieve a level of energy consumption reduction of more than 30%.

Building conservation: because the original building is a remarkable project of great importance, representing Chinas Reform and Opening-Up, the retrofit project is based on effective conservation of the existing overall appearance and typical spaces. The architectural modification mainly relates to the functional requirements, which includes improvement of fire-protection performance, adjustment of guest room areas to meet the operational needs, etc. Meanwhile, the original components are retained to the maximum extent during the retrofit process.

Structure reinforcement: to reinforce the building structure and improve the reliability of the structure, the new partition wall adopts the lightweight partition wall, and adopts the reinforcement measures such as sticking steel plate and sticking fiber composite material.

Energy and water conservation: target at building total energy reduction and focus on the three major categories to lower overall energy consumption (e.g. HVAC System, steam boiler plant and domestic hot wat system)

HVAC energy system: high chilled water temperature difference (7/15°C), super high efficiency chiller plant system, radiative water curtain air-con system, highly efficient AC

terminals, automatic monitor and control system, measured annually average EER of chiller plant ≥5.91;

Domestic hot water system: a new large temperature difference high hot water temperature water-water heat pump system has been invented with own intellectual property based on the principle of energy cascade utilization. The total EER of heat pump is 8.52 (Cold side 3.86, hot side 4.66), cold side temp 7/15℃, hot side temp 15/60℃ (product energy efficiency much better than similar products)

Boiler plant system: in view of the large fluctuation of heat load in hotels, a system of several efficient boilers with heat recovery has been designed for array control. Measured boiler plant system efficiency is over 90%.

Other measures: passive design based on simulation tools, rooftop greenery, water-saving appliances, rainwater and condensate recycling, separate metering and energy consumption monitoring system, energy-saving lighting, etc.

Comparing the one-year operation data before and after the retrofit, the building energy consumption after the retrofit is far lower than the national guided value of the "*Energy Consumption Standard for Civil Buildings*"; the total building energy consumption is reduced by 40.4%, water saving percentage is 49.9%; and the annual energy cost is reduced by 18.46 million RMB compared with that before the retrofit. It has won awards including **The Best Practice of Energy Efficient in Building Industry** by the National Development and Reform Commission of the People's Republic of China (2018), **China Tall Building Legacy Award Winner** by CITAB-CTBUH (Council on Tall Buildings and Urban Habitat, 2016), etc.

Green retrofit helps the project improve service level and user satisfaction, reduce energy consumption, and produce economy benefits.

Data reliability

3rd part certified

Stakeholders

Contractor

Name :

Construction Manager

Name :

Stakeholders

Function : Designer

hehengzhao@qq.com

http://www.gzdi.com/

GZDI undertook the initial design of the project in the late 1970s; also undertook the design and energy-saving technical services of the renovation project which began in 2011. It formulated the energy-saving technical objectives and routes of the projec

Contracting method

General Contractor

Owner approach of sustainability

The design goal of the retrofit is to create a more pleasant indoor environment, lower energy consumption and a green and environment-friendly platinum-five-star hotel. The project has applied high-efficiency boiler plant system, high-efficiency high-temperature water heat pump domestic hot water system, high-efficiency fans and air conditioning units, radiative cooling water curtain, and taken the lead in putting forward the concept of “super-high-efficiency chiller plant system”(which is suitable for similar climate zones and achieves more than 40% energy saving).

As a typical example of existing hotel buildings and high-end hotels, the energy cost after retrofit only accounts for 6% of operating income, which is far lower than the level of 9-15% of five-star hotels. As an existing building, the service level of high energy efficiency, low energy consumption and high indoor environmental quality has been realized, which fully reflects the economic and environmental benefits of green renovation of existing buildings.

In view of the high efficiency air conditioning system, high efficiency hot water system and high efficiency boiler plant system designed and adopted by the hotel, the system runs reliably and has remarkable energy-saving benefits. It has a good application prospect in similar hotel buildings and other types of buildings.

The garden landscape of the site and the interior of the building continue the original architectural design style, inherits and develops the advantages of the traditional Chinese garden. For the water landscape culturing Koi fish beneath the original daylighting roof of the indoor lobby, the water temperature is lowered by using air conditioning chilled water to improve indoor thermal comfort.

In the retrofit project, the original architectural style has been preserved to the maximum extent. Through building retrofit, the service level and performance of the building are improved.

The intelligent building system adopted in the project is advanced compared with newly established hotels, which greatly reduces the workload of operation and maintenance personnel.

Architectural description

(1) Existing historical building conservative renovation: the retrofit project is based on effective conservation of the existing overall appearance and typical spaces. Classic design of façades, including exterior wall with “feather window”, an umbrella-like structure of the canopy of the east entrance, as well as typical Indoor spaces, such as “Hometown Waterfall” atrium, “Jade River” Chinese restaurant, are retained. The renovation project is based on protection in view of conservation, instead of large-scale dismantling and rebuilding.

In terms of functional renovation, even if the original design has won the national gold medal for architectural design and the first prize for national excellent engineering design, it is still necessary to improve the functions of the hotel on the original basis, including the renovation of room types and building functional layout, the improvement of service facilities, the improvement of building fire performance, structural safety performance and so on.

(2) Building energy efficiency: the overall energy efficiency of the building envelop is improved. Measures include adding a 60 mm thick foam glass inner insulation layer to the external wall, replacing the external window with low-Emissivity hollow glass, replacing the roof with green roof or using a 50 mm thick extruded polystyrene board insulation.

Openable windows are designed at both the podium and the tower to achieve natural ventilation; the daylighting level of the tower guest rooms is acceptable; and the indoor background noise is low.

The renovation on “Water from hometown” waterfall and the original skylight above it, includes to change the glass of the skylight to low-Emissivity hollow glass and use the water to culture Koi fish and work as cold radiation air conditioning.

Through renovation, the comfort of users is improved, building energy consumption is reduced, the original architectural features are retained and sustainable development of the hotel is realized.

If you had to do it again?

In the construction process, it has been found that the existing situation cannot coincide with the drawings due to the past transformation during the use of the site, so it is necessary to make timely adjustments to the design and construction plan.
The data of building energy management system was confusing just after use, and some data points could not be read and so on. After meetings, coordination and commissioning of owners, design team and construction team, the energy management system ultimately meets the users’ management needs and works as a tool of energy consumption statistical

analysis.
With the help of on-line HVAC efficiency monitoring system, it has been found that a lot of automatic control systems have not reached the optimum condition, and the problems of inaccurate measuring points and lack of linkage of control valves has been found and solved.

Building users opinion

The building users are satisfied with the environmental quality and the indoor comfort is good. The indoor temperature and humidity are suitable, the air is fresh without peculiar smell, and the noise in the guest rooms is low.

Energy

Energy consumption

Primary energy need : 120,79 kWhpe/m^2.

Primary energy need for standard building : 220,00 kWhpe/m^2.

Calculation method : Other

CEEB : 0.1113

Final Energy : 120,79 kWhfe/m^2.

Breakdown for energy consumption :
HVAC 52.24 Kwh/m2/year
Lighting and plug load 41.81 Kwh/m2/year
Power equipment 6.05 Kwh/m2/year
Others 20.69 Kwh/m2/year

Initial consumption : 227,00 kWhpe/m^2.

Envelope performance

Envelope U-Value : 1,55 $W.m^{-2}.K^{-1}$

More information :
The overall energy efficiency of the building envelop is improved. Measures include adding a 60 mm thick foam glass inner insulation layer to the external wall, replacing the external window with low-Emissivity hollow glass, replacing the roof with green roof or using a 50 mm thick extruded polystyrene board insulation.
Openable windows are designed at both the podium and the tower to achieve natural ventilation; the daylighting level of the tower guest rooms is acceptable; and the indoor background noise is low.

Building Compactness Coefficient : 0,14

Indicator : GB/T 7106-2008

Air Tightness Value : 6,00

Real final energy consumption

Real final energy consumption/m2 : 120,79 kWhfe/m^2.

Year of the real energy consumption : 2 016

Renewables & systems

Systems

Heating system :

- Gas boiler

Hot water system :

- Gas boiler
- Heat pump

Cooling system :

- Water chiller

Ventilation system :

- Natural ventilation
- Double flow

Renewable systems :

- No renewable energy systems

Solutions enhancing nature free gains :

The project is oriented towards the north and the south, and combines the shape and facade design to form an effective external shadings.

Smart Building

BMS :

Integrated wiring system, computer network system (hotel guest network system, office network system), satellite and cable television system, security system (closed-circuit television system, burglar alarm system, entrance guard management system, electronic patrol system, video intercom system, security integrated system), audio and video system (conference room amplification system, video display system, remote video terminal system,

background music system, information diffusion system), guest room control system (integrated room security equipment, air conditioning equipment, lighting equipment, electric curtains, guest rooms and other data), energy management system, equipment monitoring system.

Smartgrid :
Electric distribution and transformation system, lighting control system, electromechanical equipment distribution and control system, power metering and energy management system, air conditioning energy efficiency monitoring system, boiler plant energy efficiency monitoring system.

Users' opinion on the Smart Building functions :

The system is advanced and reliable.

Environment

Urban environment

The project is located on the south side of the 0.3 square kilometers Shameen island and the north shore of the Pearl River. Shameen is the first batch of historical and cultural conservation zones in Guangzhou and a national cultural relic reserve. Shameen was once the concession of Britain and France in the history and there are more than 100 European style buildings on the island nowadays. The environment of the island is quiet and the trees are towering. Now it is a tourist area and a leisure resort.

There is no public transport on the island. People tend to walk or take bikes. The project is about 400 meters away from the nearest bus stop, the Municipal Hospital of Traditional Chinese Medicine, which has about 20 bus lines; 500 meters away from Huangsha Metro Station and 800 meters away from Huangsha Water Bus Station.

There are parks, churches, convenience stores, restaurants, culture and tourism sites, offices and other functions near the project. The dense road network on the island is suitable for walking.

Land plot area

Land plot area : 34 100,00 m^2

Green space

Green space : 8 650,00

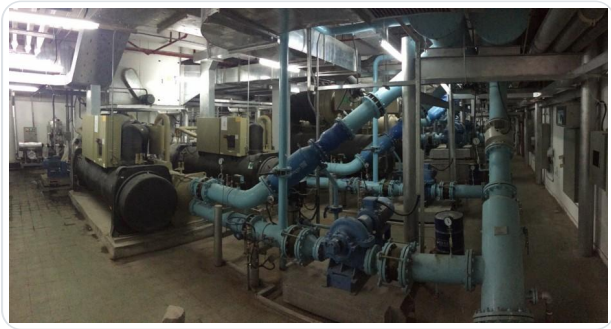
Parking spaces

There is an outdoor parking lot outside the east entrance of the building, which has 60 parking spaces and intelligent parking management system is set up. There are 35 parking spaces for non motorized vehicles as well.

Products

Product

High energy efficiency chiller (Trane)



33 2104

http://www.china.trane.com

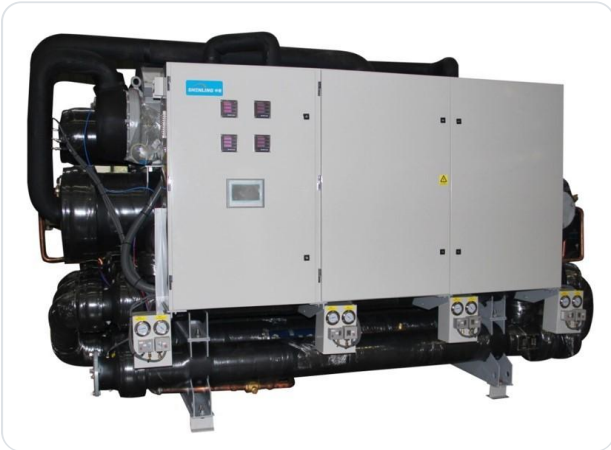
Product category :

For chillers with large temperature difference of chilled water, the supply and return water temperature of chilled water is 7/15℃ (37.5% less energy consumption than the conventional 5℃ chilled water temperature difference). The EER is 6.79, much higher than national energy efficiency level 1 (6.1). In addition, the water resistance of evaporator and condenser of the selected chiller is low. Compared with the conventional chiller, the water resistance is reduced by 40-60 kPa, which can greatly reduce the pump head and the energy consumption of water pumps.

The chiller units run well. There has been no major failure so far, and the energy efficiency ratio and actual water resistance of the units have reached the design targets.

---

high efficiency and high temperature water-water heat pump unit (Shenling)



8

http://www.shenling.com

High-efficiency and high-temperature water-water heat pump units are products under GZDI's independent intellectual property rights, which have been patented by the country. The unit is efficient and energy-saving. It can directly obtain 60℃ high temperature domestic hot water which meets the daily needs as well as 7℃ chilled water

which is used for air conditioning. It does not need other heat sources to assist water heating. The comprehensive energy efficiency ratio of cooling and heating can reach more than 8.3. Compared with other conventional water-water heat pump units, such comprehensive energy efficiency ratio is about 60% higher.

The heat pump unit run well. There has been no major failure so far. The energy efficiency ratio of the unit and the actual outlet water temperature all reach the design targets. In most of the year, the project does not need the boilers to provide domestic hot water, so energy consumption of the heat source is largely saved.

Costs

Construction and exploitation costs

Cost of studies : 8 000 000 ¥

Total cost of the building : 891 672 000 ¥

Subsidies : 2 000 000 ¥

Energy bill

Forecasted energy bill/year : 16 045 000,00 ¥

Real energy cost/m2 : 195.67

Real energy cost/Bedroom : 8913.89

Building Environnemental Quality

Building Environmental Quality

- indoor air quality and health
- energy efficiency
- integration in the land

Health and comfort

Life Cycle Analysis

Eco-design material :

The interior materials of the guestroom use a lot of diatom ooze. Ready-mixed concrete and ready-mixed mortar are used.

Water management

Consumption from water network : 132 592,00 m^3

Water Consumption/m2 : 1.62

Water Consumption/Bedroom : 73.66

Carbon

GHG emissions

GHG in use : 97,57 $KgCO_2/m^2$/

Methodology used :

National Standard "Standard for Building Carbon Emission Calculation" Exposure Draft

GHG before use : 42,00 $KgCO_2$ /m^2

Building lifetime : 50,00

, ie xx in use years : 0.43

GHG Cradle to Grave : 4 878,50 $KgCO_2$ /m^2

Contest

Reasons for participating in the competition(s)

2014 2018

Building candidate in the category

Date Export : 20230321000209