

# TADI Office Complex – Building B

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**Building Type** : High office tower > 28m  
**Construction Year** : 2014  
**Delivery year** : 2015  
**Address 1 - street** : 95 300074 ,  
**Climate zone** :

**Net Floor Area** : 20 560 m<sup>2</sup> SHON  
**Construction/refurbishment cost** : 202 000 000 ¥  
**Number of Work station** : 930 Work station  
**Cost/m2** : 9824.9 ¥/ m<sup>2</sup>

## General information

**Tadi won the Health & Comfort Award of the 2019 Green Solutions Awards at the China level and the international Health & Comfort Award.**

### 1. Building Scale and Main Functional Space

TADI Office Complex- Building B, of reinforced concrete frame + damper structure, with a total construction area of 20,560 m<sup>2</sup> and the height of 41.9 m, consists of 10 storeys above ground and 1 below ground, which is an office building, including offices, library, operation and maintenance control center, etc.; and all-steel structure assembly parking garage, supported with parking spaces, car washes, charging piles, etc., with 300 motor parking spaces and 250 non-motor parking spaces. TADI Office Complex- Building B is applied this time.

### 2. Four Featured Health Spaces

In order to improve physical and mental health levels of building users in an all-round way, four featured health spaces have been constructed in this Project:

**Comfortable office space:** In order to provide comfortable and pleased working environment for employees, in the Project, importance has been attached to the construction of indoor air quality and good sound, light, heat and humidity environment, provided with temperature and fresh air regulation terminal, light source, color and temperature control terminal, direct drinking water purification and mineralization system, as well as green planting wall, bonsai and so on.

**Fitness exercise space:** In order to encourage employees to combine work and leisure and take the initiative to exercise, in the Project, a sports and recreation center has been established, with professional basketball and badminton venues, fitness room, yoga room, billiards room, table tennis room and other activity spaces, providing more than 30 sets of fitness equipment in 11 categories, where the Labor Union of the TADI regularly organizes various recreation and sports activities.

**Health management space:** In order to improve the health of employees and reduce the risk of occupational diseases, a health management

center of TADI is established, equipped with medical rescue facilities such as first aid kit, cardiac resuscitation device, oxygen generator, with meditation room, mother - infant room, providing cervical massage and physiotherapy, etc., so as to achieve the effect of physical and psychological relaxation and decompression.

Leisure and entertainment space: In order to promote employees' mental health and communication, rainwater landscape garden is established in TADI to regulate the microclimate of the site, providing a space for employees and neighboring community residents to rest and communicate, and also attracting birds and other animals to inhabit, meanwhile, leisure activity rooms such as Go- room and library are established.

### 3. Integration of 30 Health and Green Technologies

In order to achieve the goal of comfort, health and environment friendliness, in the Project, 30 passive and active technical measures have been adopted according to local conditions: Medium temperature trough-type solar energy, ammonia absorption type air source heat pump, solution humidification fresh air unit, ventilation chamber, external shading, window magnetism, DC brushless fan coil unit, green planting wall, intelligent lighting, energy-saving lighting, light source color and temperature regulation, elevator monitoring, recyclable material utilization, lithium bromide absorption chiller unit, energy dissipation and shock reduction system, intelligent power diagnosis and recovery, intelligent integrated platform, water-saving appliances, floor heating, lighting shaft, water-saving irrigation, infiltrating rainwater pipe, energy management system, ground source heat pump technology, direct drinking water, photovoltaic power generation, flat plate solar energy, vertical greening, charging pile, automobile flushing and circulating water system.

### 4. Project awards

With its excellent performance, this Project has won the Two-star Design Logo of China Healthy Building, the Three-star Design Logo of Green Building, the Three-star Operation Logo of Green Building and the LEED Gold-grade Certification of the United States, meanwhile, has won the First Prize of Tianjin Green Building, the First Prize of Tianjin Building Intelligence, the Second Scientific and Technological Progress Prize of Tianjin BIM and Intelligence and other awards.

## Data reliability

3rd part certified

## Stakeholders

### Contractor

Name :

Contact : 15802233893 cyarchi@163.com

<http://www.tadi.net.cn/>

### Construction Manager

Name :

### Owner approach of sustainability

Following the principle of "passive design takes priority, and active design makes optimization", various green building technical measures were tailored to local condition in this project, such as BIM and low-impact-development, and sustainable design was combined with engineering design to achieve the goal of "healthy, low carbon, and environmentally friendly". The operation energy consumption of this project is around 53.67 Kwh/m<sup>2</sup>/year, which has an energy-saving rate of 65%, comparing with ordinary office building in cold climate zone of China.

**Passive design takes priority:** building spaces, wind environment, light environment, and thermal environment were optimized through software simulation, for instance, the basement get natural daylighting through light wells and light tubes, while the wall inlets were applied to strengthen natural ventilation; rainwater garden, permeable pavement, and water storage module were adopted for low-impact-development's rainwater management; energy dissipation structure system saved concrete consumption of 1350m<sup>3</sup>, which reduced about 49 tons of carbon emission; and recycling material utilization rate was 10.3%; moreover, the reasonable overall plan layout provided suitable site for ground source heat pump's pipe burying, while protecting more than 50 existing trees on site.

**Active design makes optimization:** The project minimizes fossil energy consumption through multi renewable energy complementary application, major system includes ground source heat pump, parabolic solar collector, lithium bromide absorption type cold water unit, ammonia absorption air source heat pump, solution conditioning humidifier, DC brushless fan coil. In terms of electric and intelligent design, the building intelligent platform integrated all MEP systems such as intelligent lighting, elevator control, intelligent power diagnosis and recovery, and photovoltaic power generation. Furthermore, various measures were taken to improve indoor environment, such as the fresh air system that responses to CO<sub>2</sub> sensors, and intelligent shading control system which has flexible sunshade opening and angle control under different sunshine conditions.

## Architectural description

### 1. Fusion of healthy and green building technology

As a typical office building for a design institution, major users are professional architects and engineers. The users' daily work is characterized by high work intensity, which usually causes cervical spondylosis, stress, irritability, less communication and other health problems. For designers who are engaged in creative brain work, the office environment is more demanding for health and comfort. From the perspective of "user-oriented", our solution is to build four special healthy spaces: comfortable office space, fitness space, health management space, and recreational space. Firstly, adopted a variety of healthy green technical measures such as intelligent exterior shading, vertical planting, direct drinking water purification mineralization system, solution conditioning humidifier fresh air system, ground source heat pump system, etc. to create high-performance green office Space. At the same time, we set up a complete sports and fitness, health management, leisure and entertainment space, such as gymnasium, diagnostic room, yoga room, etc., and optimize the operation management system, regularly organize sports activities, and carry out group activities such as calligraphy, chorus, photography, etc. By delivering healthy knowledge and

encouraging building users to join various activities, TADI efficiently promotes the overall health of employees at the physiological, psychological and social levels.

## 2. Environmental friendly, low carbon emission

The overall color and architectural style of the project is coordinated with the existing administrative office building which was built in 1995 on the west side. At the beginning of project planning, the building was laid out from the perspective of site ecological protection. While retaining more than 50 tall trees, it also inherited the 67 years of historical memory and emotional linkage of TADI's current employee. The landscape design of the new building focuses on ecology and humanity. The beautiful garden space not only provides designers with a comfortable and relaxing space for recreation, but also provides habitat for birds and small animals, which balance a harmonious coexistence between man and nature.

While improving the physical and mental health of building users in all aspects, the project also focuses on green and low carbon technologies. Based on local climate and site conditions, ground source heat pump coupled with solar heating and cooling system is adopted to maximize usage of renewable energy, while cooperated with other green building technical measures to reduce operating energy consumption to 53.67Kwh/m<sup>2</sup>/year, and created a healthy and green office building.

## If you had to do it again?

In the stage of independent research and development of intelligent system, this project encountered the problem, interfaces were unable to be developed in some of the system, and of own system data were unable to be provided to the integrated platform, such as elevator monitoring system and air conditioning automatic control system. By writing specific interfaces requirements into the bidding documents, clearly requiring that specific interface types shall be provided in systems and the interface test shall be carried out before the bidding, only the product passed the test can be used for the bidding. By conducting the Project coordination meeting regularly to solve problems in the debugging stage, the R&D team had successfully solved the problem, ensuring normal operation of the intelligent system.

## Building users opinion

The building users' satisfaction survey was taken during the operation stage, and the result is as follows:

Thermal comfort: PMV is  $\pm 0.23$ , PPD is 6.1%, and the satisfaction rate is 86%;

Indoor air quality: the satisfaction rate is 93%;

Lighting environment: all office spaces meet requirements for illuminance level, glare control, lighting uniformity, and color rendering index of lamps, the satisfaction rate is 100%;

Sound environment: the office indoor noise level is 38.1dB during worktime, and the satisfaction rate is 83%;

## Energy

### Energy consumption

Primary energy need : 72,00 kWhpe/m<sup>2</sup>.

Primary energy need for standard building : 105,94 kWhpe/m<sup>2</sup>.

Calculation method : Other

Final Energy : 74,34 kWhfe/m<sup>2</sup>.

Breakdown for energy consumption :

HVAC 38.99Kwh/m<sup>2</sup>/year

Lighting 15.42Kwh/m<sup>2</sup>/year

Motor Facilities 2.98Kwh/m<sup>2</sup>/year

Others 2.98Kwh/m<sup>2</sup>/year

### Envelope performance

Envelope U-Value : 0,52 W.m<sup>-2</sup>.K<sup>-1</sup>

More information :

Terracotta panels were chosen as the exterior material, which are recyclable and self-cleaning. And the project strictly controls the window to wall ratio on each orientation of the building as follows: south facade 0.28 east facade 0.24 west facade 0.33 north facade 0.28

Building Compactness Coefficient : 0,21

Air Tightness Value : 7,00

### Real final energy consumption

Real final energy consumption/m<sup>2</sup> : 1 390 680,00 kWhfe/m<sup>2</sup>.

Real final energy consumption/functional unit : 67,64 kWhfe/m<sup>2</sup>.

Year of the real energy consumption : 2 018

## Renewables & systems

### Systems

Heating system :

- Heat pump
- Solar thermal

Hot water system :

- Heat pump
- Solar Thermal

Cooling system :

- Others

Ventilation system :

- Single flow

Renewable systems :

- Solar Thermal
- Heat pump (geothermal)

Located in eastern China, Tianjin has a continental climate similar to its neighbor Beijing, which is hot in summer while cold and dry in winter. The demand for cooling and heating is large. After comprehensive analysis, the region has good solar and geothermal energy utilization conditions, thus the project adopted ground source heat pump coupled with solar cooling and heating system.

Solutions enhancing nature free gains :

Optimization of building orientation, shape coefficient, window-to-wall ratio; Optimization of natural ventilation and daylighting; Intelligent shading system; Vertical planting;

## Smart Building

BMS :

1 Intelligent operation and maintenance management: In order to comprehensively manage multi subsystems used in the building and improve the efficiency of building operation and management, this Project makes full use of BIM operation and maintenance management platform in the operation and maintenance stage. Major functions of the platform include: Real-time monitoring, centralized control, alarm management, operation log, maintenance management, etc. Through centralized monitoring and control of intelligent system data, data interaction among subsystems, global event management, etc., periodically outputting the report of operation status, the interoperability, rapid response and linkage control among related systems have been realized, so as to maintain the best working condition of each system in the building.

For example, the intelligent lighting control system can adopt specific control modes for different functional zones; Intelligent curtain control system can automatically control the curtain state according to the outdoor irradiance and wind speed, and select various control modes according to the demand of light and heat in different seasons, which greatly reduces the energy consumption of lighting and air conditioning; A main control module and three sub-control modules are set in the air-conditioning automatic control system. The main control module can formulate the overall operation strategy according to the predicted cooling and heating loads and the measured solar radiation intensity, based on the principle of minimizing energy costs; The sub-control modules are trough-type solar collector cooling and heating system module, plate-type solar collector cooling and heating system module, vertically buried tube ground source heat pump module, which implement the program operation requirements of the main control module and run safely the input, dynamic adjustment and exit of the "governed" cooling and heating subsystems.

2 Platform of energy management: In order to acquire, analyze, display and manage the information of energy consumption and improve the level of building comprehensive energy management, an energy management platform is designed and developed for the Project. Major functions include: Energy consumption monitoring, energy consumption statistics and reports, energy efficiency analysis, energy consumption benchmarking and alarms, etc. Through above functions, operation and maintenance managerial personnel can query the power consumption of the Project from the whole to the part accurately to the hour, and the load power of the equipment to the second level; In order to reduce the overall energy consumption and carbon emission of the building, improve economic efficiency and management level, operation and maintenance managerial personnel regularly collate and analyze energy consumption data, and timely maintain and adjust the operation scheme for the equipment with any problem.

Users' opinion on the Smart Building functions :

The users satisfaction rate for control system is 86.5%.

## Environment

### Urban environment

The Project is located in an area with well-equipped supporting service facilities and prominent advantage in cultural landscape. Within the range of 500m walking distance to surrounding areas, there are 4 bus stops at which 22 different bus routes pass by. It is 880m walking distance from Wujiayao Metro Station of Metro Line 3. The Project is connected to bus stops and metro station with convenient walkways. A New Life Plaza is located 170m north of the Project, inside of which are social amenities such as supermarket, catering facilities, shopping facilities, and cinemas. There are 10 banks and 2 parks within 500m walking distance to surrounding areas.

### Land plot area

Land plot area : 13 200,00 m<sup>2</sup>

### Green space

Green space : 3 450,00

### Parking spaces

The newly built ancillary complex building to the north of the Project is a parking garage which provides convenient parking condition for employees who drive. The parking garage is connected to the office building with a closed corridor to prevent danger when walking on a rainy day. The total construction area of the garage is 10,590 m<sup>2</sup>, with 5 storeys (8,325 m<sup>2</sup>) above ground and 1 storey (2,265 m<sup>2</sup>) underground, and the basal area of the building is 2,150 m<sup>2</sup>. The basement is used as a garage in peacetime; in the event of war, it will be used as air defense material warehouse against nuclear weapon and Grade 5 conventional weapons. The garage is equipped with 300 parking spaces for motor vehicles and 250 parking spaces for non-motor vehicle, including 16 parking spaces with charging piles, to meet the needs of employees. Besides, the residential buildings in the yard provide staggered parking spaces: The main users of the parking spaces are employees in the daytime of work days, and residents of the residential building in the yard in the nighttime of work days and on the weekends. Photovoltaic power generating units are installed on the roof of the ancillary complex building, which not only make full use of renewable energy source but

also provide shade for the parking area on the roof.

## Products

### Product

Heat pump type solution conditioning humidifier fresh air unit

1 1 B B1219

<http://www.sinorefine.com.cn/lxwm>

Product category :

Air volume m<sup>3</sup>/h 10000; Air supply residual pressure Pa 300;  
Cooling capacity kW 163; Heating capacity kW 120;  
Dehumidification kg/h 155; Humidification kg/h 75;  
Cooling power consumption kW 32; Heating power consumption kW 24;  
Voltage V 380.

The product performance of the solution dehumidifying fresh air handling unit driven by heat pump and the screw type water-source heat pump unit meets the design requirements of the designing entity, which facilitates construction and maintenance. After they are put into use, the designing, constructing, developing, and operating entities believe in general that the two equipment are operating steadily with high energy efficiency ratio, and are able to meet the needs of the user.



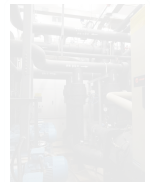
Water source heat pump

<http://teling.d17.cc/>

Product category :

Under 100% load:  
Cooling capacity kW 1166.33

The water-source heat pump unit meets the design requirements of the designing entity, which facilitates construction and maintenance. After they are put into use, the designing, constructing, developing, and operating entities believe in general that the two equipment are operating steadily with high energy efficiency ratio, and are able to meet the needs of the user.



Parabolic solar collector

<http://11269824.czvv.com/>

Product category :

Concentrating area>96% Visible light reflectance >90%



Shear type soft steel energy dissipator

8 12 (B )507

<http://www.11467.com/beijing/co/107445.htm>

Product category :

Yield strength 380KN Yield displacement 1.5mm Ultimate displacement 45mm



CO sensor

SenseAir

Stationsgatan 12, 82471 Delsbo, Sweden

<https://www.senseair.com/>

Product category :

Measurement range 0~250ppm Response time <20s Deviation <3%



CO sensor

Honeywell

555

<https://www.honeywell.com.cn/>

Product category :  
Measurement range 0~250ppm Response time <20s Deviation <3%



Soil humidity sensor

Hunter

B1618, Huibin Office Bldg. No.8, Beichen Dong Street Beijing 100101 China

<https://www.hunterindustries.com/product-line/Sensors>

Product category :

Farthest distance between the sensor and the control module 1000 ft



Direct drinking water system

28

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

Product category :

Capacity 1m<sup>3</sup>/hour Maximum daily water supply 2.4m<sup>3</sup>

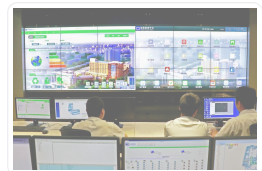


Building Intelligent System

95

<http://www.tadi.net.cn/>

Product category :



## Costs

### Construction and exploitation costs

Renewable energy systems cost :3 500 000,00 ¥

Cost of studies : 11 250 000 ¥

Total cost of the building :202 000 000 ¥

Subsidies : 5 750 000 ¥

### Energy bill

Forecasted energy bill/year :971 000,00 ¥

Real energy cost/m<sup>2</sup> : 47.23

Real energy cost/Work station : 1044.09

## Building Environmental Quality

### Building Environmental Quality

- indoor air quality and health
- acoustics
- water management
- energy efficiency
- integration in the land
- mobility
- products and materials

## Health and comfort

## Water management

Consumption from water network :3 703,00 m<sup>3</sup>

Consumption of grey water :3 421,00 m<sup>3</sup>

Consumption of harvested rainwater :92,00 m<sup>3</sup>

Water Self Sufficiency Index : 0.49

Water Consumption/m<sup>2</sup> : 0.18

Water Consumption/Work station : 3.98

1 Quality of domestic drinking water: Employees of TADI spend most of the day in the building, in order to provide more safe, high-quality and healthy drinking water for employees, in the Project, a direct drinking water purification and mineralization system has been provided, which can provide employees the treated water with direct drinking water pipes or barrel; in order to avoid secondary pollution during long-term use, drinking water tanks and water dispensers are regularly disinfected.

The water treatment process of direct drinking water system is as follows: Municipal tap water - raw water tank - booster pump - pretreatment device (sand filtration, activated carbon filtration, softening, precision filtration) - reverse osmosis - mineralization - pure water tank - disinfection - water supply system (pipeline system / barreled water). The water quality of all direct drinking water supply (including barreled water and all direct drinking water pipelines) meets the requirements of CJ94 of China Water Quality Standards for Fine Drinking Water which ensures that the water quality, meanwhile, it is activated small molecule water and contains minerals beneficial to human body.

Major function rooms of the Project adopt centralized pipeline system, and direct drinking water pipeline adopt food grade 304 thin-walled stainless steel pipes. Each department is equipped with a terminal drinking water table, in other offices, water supply is provided by barreled water distribution.

The drinking water tanks adopt ozone disinfection, each with one ozone generator set. Samples of drinking water and direct drinking water are sent to the water quality testing organization quarterly and are tested according to GB 5749 Standard for Drinking Water Quality and CJ 94 Water Quality Standards for Fine Drinking Water.

2 On quality and control of non-traditional water sources: Non-traditional water sources used in the Project include municipal reclaimed water and rainwater. In order to avoid the misuse of non-traditional water sources causing harm to people's health, in the Project, a number of measures have been taken to strengthen water management and water quality control.

For all of water for toilet flushing, greening, landscape and ground flushing, independent reclaimed water system and independent reclaimed water pump house are equipped, and ozone generator is used for the disinfection of water tanks. Rainwater used for greenbelt irrigation and landscape recharge after treatment shall meet the requirement of GB/T 18921 The reuse of urban recycling water - Water quality standard for scenic environment use. The circulating water ground source heat pump unit of heating and air conditioning system is the closed circulating water system, sharing circulating water pumps with the ground source. The solar hot oil lithium bromide unit and solar hot water lithium bromide unit are the open cooling circulating systems. The circulating water pump is equipped with filters at the suction side, and the fungicides, algae killers, corrosion inhibitors, antisludging agent and other agents are added in.

## Indoor Air quality

Testing concentration of indoor CO<sub>2</sub> in the building (mg/m<sup>3</sup>): 550

Test concentration of indoor formaldehyde in the building (mg/m<sup>3</sup>): 0.07~0.08

Testing concentration of indoor TVOC in the building (mg/m<sup>3</sup>): 0.2~0.3

Test concentration of indoor Benzene in the building (mg/m<sup>3</sup>): 0.03~0.04

Testing concentration of indoor PM<sub>2.5</sub> in the building (µg/m<sup>3</sup>): 19.3

1 On outdoor pollutants control: In Tianjin, there are about 200 days of high air quality, 300 days with PM<sub>2.5</sub> meeting the standard, with limited outdoor air quality condition. Therefore, measures shall be taken to avoid outdoor air pollution. Outer windows with air tightness of Grade 7 and glass curtain wall with air tightness of Grade 3 used can effectively control the infiltration of outdoor pollutants. At the same time, it is equipped with air purification treatment device, the solution dehumidification fresh air unit adopted, with PM<sub>2.5</sub> removal efficiency of 32.5%, the PM<sub>10</sub> removal efficiency of 32%; in some areas, the bag air filter is adopted, with PM<sub>2.5</sub> removal efficiency of 51%, the PM<sub>10</sub> removal efficiency of 51%, finally achieving indoor average annual PM<sub>2.5</sub> concentration of 19.3 µg/m<sup>3</sup> and indoor average annual PM<sub>10</sub> concentration of 23.5 µg/m<sup>3</sup> in the Project.

2 On indoor pollution source control: In office spaces, there are more intensive employees, office desks, chairs and decoration materials are major sources of indoor pollutants. In order to avoid the harm of indoor building materials and furniture pollutants to personnel, in the Project, strict controls have been conducted.

In terms of building and decoration materials, in the Project, the quality of main building materials, decorative materials, wood-based panels (plywood, fiberboard, particleboard) and their products, water-borne wall coatings for indoor decoration, solvent-based wood coatings for indoor decoration, water-borne flame retardants for indoor decoration, waterproofing agents, preservatives and other water-borne treatment agents has been restricted, the selected materials are all from regular manufacturers, and some materials products are re-tested. All products meet the requirements of the national standard of China - *Code for Indoor Environmental Pollution Control of Civil Building Engineering*(GB50325-2010).

Most of the furniture products are old ones of TADI, without pollution hazards. A few wooden furniture are customized by block board, mainly including workstations, cabinets, bar counters, etc., of which the safety is retested (the certificate documents attached with their test reports).

3 Air purification measures: In order to provide more fresh and high quality air environment, in the Project, the centralized fresh air system with air purification function is provided, and in small offices, small air purifiers are placed; Meanwhile, outdoor vertical greening is adopted on the west facade of the Subsidiary Complex Building; vertical indoor greening is adopted in the business room lobby and elevator hall of each floor, purifying the indoor environment and creating personalized and beautiful public recreational spaces.

4 Air monitoring system: In this Project, air box testing devices are arranged in open office areas and exhibition halls to test the content of PM<sub>2.5</sub> in densely populated but low relative mobility environments and in the environments with unstable number of personnel but large relative mobility. The air is treated through the linkage fresh air system, based on the concentration change of PM<sub>2.5</sub> checked, the fresh air system is adjusted and a more healthy and energy-saving operation mode is set.

## Comfort

Health & comfort :

Average indoor temperature in January: 21°C      Indoor mean humidity: 30%

Average indoor temperature in July: 26°C      Indoor mean humidity: 60%

1 Optimized ventilation design: In order to improve the indoor ventilation conditions, CFD software was used to simulate the indoor air environment in the scheme design stage of the Project, based on which, the building block model and the positions of ventilation opening were analyzed and adjusted, and the ventilation chamber was set up to optimize the air distribution in the building, thus achieving better natural ventilation effect.

2 Design of indoor and outdoor shading: Considering the demand of heating in winter and shading in summer, as well as the lighting effect of main functional space, this Project optimizes the building shading design from the scheme stage. The self-shading of the wall is enhanced by appropriately deepening the depth of the window. Meanwhile, in the Project, the hidden adjustable shutters to shade are mounted on outside windows in east and west, and irradiance and wind speed sensors are set on the tenth-storey roof to control the curtain status according to the real-time data of small meteorological stations. According to the demand of light and heat in different seasons, automatic control can set up various modes to effectively reduce the energy consumption of lighting and air conditioning. For outside shading, automatic protection device is used, when the outdoor wind speed is  $24 \geq$  m/s (i.e. strong gale), the curtain will be automatically retracted to ensure safety. In the Project, the external shading adjustment terminal and adjustable inner shutter shading are set to facilitate users to adjust indoor lighting and thermal comfort more flexibly.

3 Air conditioning system design: Indoor design parameters of the main function rooms of the Project in the cooling and heating season are as follows: the indoor temperature in the cooling condition is 26°C, relative humidity is 60%, the indoor temperature in the heating condition is 21°C, relative humidity is 60%, fresh air volume in the office is 30 m<sup>3</sup>/h per person, and the fresh air volume in the conference room is 30 m<sup>3</sup>/h per person, which can realize the temperature control in different rooms and meet the comfort requirements of personnel.

Calculated indoor CO<sub>2</sub> concentration :

CO<sub>2</sub> mg/m<sup>3</sup> 550

Calculated thermal comfort :        21°C     30%        26°C     60%

Acoustic comfort :

Noise sources of this Project are mainly equipment noise in the building and motor vehicle noise outside the site. In order to avoid noise interference to employees' work and create a quiet working environment, in the Project, indoor and outdoor noise controls are carried out from following three aspects:

1 Equipment noise control measures: Low noise equipment is adopted in air conditioning and ventilation systems. Meanwhile, noise reduction and vibration reduction measures are adopted to eliminate rigid connection between equipment and foundation, specific requirements are as follows: All refrigeration and heat-supply units shall be installed with shock absorption bases, which shall be provided according to design requirements or supplied by equipment manufacturers; fresh air units and fans shall be equipped with rubber isolation pads, shock absorbers or shock absorber hangers in accordance with design requirements; and circulating water pumps in air-conditioning systems shall be equipped with shock absorption pedestals after the whole system is filled with water, it is necessary to readjust to ensure the level of the shock absorber base; shock absorbing metal soft joints shall be installed at the inlet and outlet water pipes of pumps and other equipment, and connecting hose shall be installed for fans.

2 Vehicle noise control measures: In this Project, the deceleration arches are set up at the entrance and exit of the site and garage to control the speed of vehicles, so as to reduce the traffic noise of vehicles in and out, and ensure the safety of the vehicles at the same time. Slogans are set up in the venue to remind vehicles not to whistle and the vehicles are managed by security personnel.

3 Enclosure structure sound insulation and noise reduction measures: Strengthening the sound insulation design of the enclosure structure of the equipment room; through actual testing, the indoor noise level of typical rooms in the Project is 37.5dB in the day, 33.3dB at night, the sound insulation capacity of inner partition wall is 49dB; the combined effect of the noise of office air conditioning and outdoor noises on the indoor is 38.1dB in the day, and the weighted standardized impact sound pressure level of typical room floor is 63 dB (See supporting documents for the concrete construction of the enclosure structure).

## Carbon

### GHG emissions

GHG in use :34,55 KgCO<sub>2</sub>/m<sup>2</sup>/

Methodology used :

Calculation based on the national standard: Standard for building carbon emission calculation GB/T51366-2019.

GHG before use : 11,68 KgCO<sub>2</sub> /m<sup>2</sup>

Building lifetime : 50,00

, ie xx in use years : 0.34

GHG Cradle to Grave :48,80 KgCO<sub>2</sub> /m<sup>2</sup>

## Contest

### Reasons for participating in the competition(s)

1. In terms of user welfare, the Project upholds the design philosophy of "People oriented", and provides a comfortable, pleasant, and relaxed working environment full of dynamic fashion for employees in consideration of the practical demands of architects, with an aim to improve the health level of the users at the physiological, psychological, and social levels;

2. As to environmental impact, the Project focuses on ecology protection and bio-friendliness: a number of "sponge city" technologies and measures are adopted to utilize and restore the ecological resources on the existing ground; the trees in the surrounding area are bypassed and protected, which not only preserves the existing 50+ tall trees, but also hands down the 67 years of historical memory of and affections for the Tianjin Architecture Design Institute. After the Project is completed, the trees will make a pleasant shade and the water will flow with murmur in the Institute, providing a beautiful and pleasing work environment for the employees with harmonious coexistence of human and



nature; From green construction to green operation, during the whole process of the constructing and use of the Project, focus has been put on energy saving and consumption reduction, and the whole lifecycle carbon emission of the buildings is only about 48.8 kg CO2/m2/year;

3. In terms of economic effectiveness, the Project has reasonable cost, with incremental cost per unit area of CNY 130.5/m2 and energy consumption per unit area in the operation stage of 53.67 Kwh/m2/year, showing significant energy-saving effect. The pay-back period of investment on green building technologies and measures is about 5 years, indicating remarkable economic effectiveness;

4. As for technology application, all the healthy and green technologies and measures planned in the design stage of the Project have been implemented, and the green operation and maintenance platform designed and developed independently by our institute is used for the real-time monitoring of the indoor environment and various equipment, which is carefully maintained and managed by a professional operation and maintenance team, in order to ensure the continuous optimization during the process of technology application and operation and to realize healthy and green operation;

5. In terms of feasibility, this Project is a representative practice of green technology in urban organic renewal and an active exploration in the aspects of ecological environment, spatial environment, cultural environment, and health management, which has reduced 80% of operation cost compared with similar projects and could provide reference for similar projects. During the urban construction process converting from incremental development to stock upgrading in China, the sustainable design philosophy and green and healthy building-integrated technologies of the Project are of great value for popularization.

Building candidate in the category

