



联合国工业发展组织中国建筑业企业社会责任项目  
UNIDO CHINA CONSTRUCTION INDUSTRY CSR PROJECT

# China Construction Industry Enterprise Social Responsibility

## Excellent Cases

(2022)



China Construction Corporate Social Responsibility Project Office

二〇二二年

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# FUNDAMENTAL<sup>®</sup> RESPONSIBILITY

Fundamental responsibility is the responsibility that construction industry enterprises must abide by for normal operation and sustainable development, and it is the foundation of enterprise life and livelihood. It mainly includes issues such as project quality, safe production, legal compliance, corporate reputation, innovation and development.



# Create Distinguished Project with Craftsmanship in Mind: Description of CMEC's Project of Revamping Line Belgrano in Argentina

◇ China Machinery Engineering Corporation

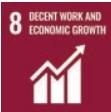
## // Introduction

In revamping Argentine rail network (1st Period), China Machinery Engineering Corporation (CMEC) emphasized quality management, technology innovation, and equipment manufacturing supervision and quality inspection. With carefulness, craftsmanship and conscientiousness, the company has created a distinguished project. The new rail network has significantly promoted transportation and people's well-being, and increased grain exportation and employment. All these efforts advanced local economic growth and social development.





## SDGs

 Goal No. 8	<p>The project of revamping Argentine rail network (1st Period) has created 65,000 jobs for Argentina, improved transportation and grain exportation, and significantly advanced economic growth and social development.</p>	 Goal No. 9	<p>CMEC developed a new railway single- and double-sided rapid unloading ore hopper car technology. It also performed innovative studies in the entire train structure, the mechanism of unloading, and manufacture technology. The company sought to improve quality with advanced technologies.</p>
 Goal No. 11	<p>The renovation of the rail network not only improved transportation in seven provinces along, decreasing the cost of logistics and the price of grain; but also formed a bigger rail network with that in Chile and Brazil, covering the whole Southern America, facilitating transporting and exporting agricultural and mineral products.</p>	 Goal No. 17	<p>CMEC cooperated with other Chinese equipment manufacturing enterprises to develop the new railway single - and double - sided rapid unloading ore hopper car technology. It hired professional and independent third party organization to participant in quality inspection. The success in completing a distinguished projects was a result of mutual efforts.</p>



## CSR

 Fair Operation Practices	<p>CMEC implemented stronger quality management, with close supervision of equipment manufacturing and quality inspecting, wholeheartedly focusing on high quality. It also held on to technology innovation and developed a new railway single- and double-sided rapid unloading ore hopper car technology. Moreover, it performed innovative studies in the entire train structure, the mechanism of unloading, and manufacture technology. The company sought to improve quality with advanced technologies.</p>	 Community Participation and Development	<p>CMEC arranged technical personnel to carry out multi-phase, multi-site and long-term mobile technical training for local engineers of the multi-section railways in Argentina, helping enhance skills and promote employment.</p>
 Fundamental Responsibility	<p>CMEC reinforced the management of partners along the supply chain, including designers, equipment factories, and subcontractors in the project's quality assurance system. In this way, special department was founded to perform strict quality inspection.</p>	 Labor Practices	<p>CMEC emphasized the localized management. It not only provided numerous jobs and proper skill training for local people, but also insisted on increasing local sourcing ratio. The project has successfully improved transportation, employment and grain exportation in Argentina and has advanced the development of overseas community.</p>





## 1. Case Overview

CMEC's first phase of revamping Line Belgrano in Argentina (hereinafter referred to as the Project), with a contract value of \$2.47 billion, was a cooperation between China and Argentina in transportation and was China's first mega railway project brought up in Argentina. During construction, CMEC provided competitive service and equipment to Argentine railway. As a result of that, Argentine people were benefited and Argentine economy grew.

## 2. Case Background

China Machinery Engineering Corporation (CMEC), established in 1978, is the core subsidiary of SINOMACH, a Fortune 500 company. After more than 40 years of development, CMEC has become a large-scale international comprehensive enterprise group with engineering contracting and industrial development business as the core, integrating trade, design, survey, logistics, research and development and other full industrial chain support. It is able to perform regional comprehensive developing and to provide "one-stop" customized solutions for various engineering projects, including pre-planning, design, investment, financing, construction, operation and maintenance. Over the years, focusing on energy engineering, CMEC has adhered to the principle of "based on its own advantages, meeting market needs, and pursuing win-win cooperation", and has been involved in vital civil industries such as environmental protection, infrastructure, industry, water affairs, agricultural cooperation, transportation and communications at home and abroad. Hundreds of high-quality projects have been created.

The Belgrano Railway is one of the largest railway networks in Argentina, with a total length of 7,410 kilometers, spanning 13 provinces. Its regional economy accounts for 45% of GDP and 78% of exports. However, the railway has been in disre-

pair for a long time, and most of the sections are no longer usable. In view of CMEC's rich foreign engineering experience and good international reputation, the company was entrusted to renovate the Belgrano cargo railway.

## 3. Responsibility Actions

### (1) Quality management: build the quality system with carefulness

Ever since CMEC's Project commenced, all staff have conscientiously bore in mind the principle of "rigorous and efficient management, orderly organization and coordination, sincere and thoughtful service, exquisite and innovative business". They have also followed the company's instructions about projects' quality management system and obeyed relevant management regulations in all aspects. In other words, they have carried out every work in strict accordance with the quality management requirements, and well managed schedule, quality, cost and safety issues of the project. At the same time, in terms of sourcing, they have covered the whole process from product design to test delivery in quality management, and have formulated differentiated quality control plans for different goods.

The project department has established a quality management organization headed by project managers, as well as a quality assurance and inspection system consisted of project consultants and specialists. Specifically, the project manager was the first responsible person for the quality, and the project consultants and specialists played the role of supervisor and controller of the quality management.

The project department devised schemes to control and plan key steps in the process of design, procurement and construction. As the basis for quality control, those schemes should be approved by the project manager before being implemented.

The on-site project department was responsible for the implementation and inspection of on-site quality management. Specialized quality management personnel strictly supervised the progress and quality of on-site subcontracted civil engineering operations to ensure that the quality of civil engineering could meet the contract requirements and that the project could be delivered on time with high quality.

The project department of the Project also incorporated the quality assurance system of design, equipment manufacturers and subcontractors into the overall project quality assurance system. Moreover, it established a technical procurement department to conduct strict supply quality inspections for design institutes and equipment suppliers, so as to ensure that the technical indicators of all equipment meet the contract requirements, and free of claim on quality.

## (2) Technology innovation: improve business quality with craftsmanship

As a well-known international comprehensive service provider of engineering contracting, CMEC attaches great importance to the role of technological innovation in project management. To this end, the company has joined hands with Chinese equipment manufacturing enterprises to unprecedentedly develop a new type of railway single- and double-sided rapid unloading ore hopper car technology that was first applied to Argentina's 25t axle load wide-gauge ore hopper car.

Through innovative research on the overall structure of the train, unloading mechanism and manufacturing technology, CMEC gained many achievements and solved the technical update and upgrade of Argentine ore hopper trucks according to local conditions. CMEC's research subjects included the X-shaped section structure for unloading goods on one side, the first-level transmission unloading system, the plate support end wall and side plate, the embossing device. The train met

needs of users, expanded the structure and scope of application of the hopper car, and increased the load, volume and unloading efficiency using numbers of new achievements and new technologies. These brought the overall technical and economic indicators to the international leading level. Moreover, the promotion and application in the design and manufacture of railway vehicles in China and other developed countries is conducive to advancing the improvement of the product quality and technical performance of traditional hopper cars, and hence driving the development of the industry.

After more than 3 years of actual operation tests on the Belgrano Freight Railway in Argentina, the vehicle now can not only be easily operated, but also greatly reduce labor intensity, effectively improving the efficiency of single- or double-side unloading. In addition, as the load capacity of a single vehicle has increased by 30.1%, from 57.7 tons to 75 tons, the vehicle better adapts to the pit landform and completely solves the problem that former Argentine one-sided unloading vehicles used to have large amount of residual. This has practically upgraded railway vehicles in Argentina and has been highly recognized by the Argentine.



Training Spot

In order to better use and maintain the vehicles, CMEC arranged technical personnel to carry out multi-phase, multi-site and long-term mobile technical training for local engineers of the multi-section railways in Argentina. After receiving locomotive theories combined with practical knowledge, trainees at all levels had a comprehen-



sive understanding of the locomotives supplied by China. This significantly reduced and almost eliminated the incidence rate of faults caused by misoperation. Meanwhile, users had a comprehensive knowledge of the repair and maintenance the locomotive.

### (3) Equipment manufacturing supervision and quality inspection: create project of quality with conscientiousness

The CMEC project department established a technical procurement team to ensure the quality of the project, considering the great diversity and large quantity of equipment required by the Project. The team was responsible for coordinated planning, managing and controlling the manufacturing supervision plan and process (including but not limited to supervising equipment quality and production progress). Then, supervision personnel were arranged according to different goods and manufacturers, covering every supplier of key goods by combining on-site factory supervision and patrolling inspection. In addition, the equipment supervisor inspected all parts related to relevant equipment, such as material preparation, production, processing, testing, inspection, assembly to delivery conditions, port installation supervision, and etc. The supervisor also regularly provided manufacturing supervision reports and real-time early warning, so that the project department could learn the equipment manufacturing status in time. As the technical procurement team was also in charge of supervisory inspections, the equipment supervisor directly worked with the team. According to the supervision work procedures, the supervisor should regularly prepare and submit the supervision documents, including the supervision log, the weekly and monthly reports, the summary of the supervision work, and records of inspection, testing, examining, acceptance, etc.

At the same time, CMEC has hired a professional and independent third-party organization to par-

ticipate in the quality inspection process. Quality inspection involved 1) the overall quality, specifications, performance, 2) the main components, construction materials, heavy machinery, spare parts and 3) inspection items specially proposed by the owner, and their conformity with the technical specifications. The project department focused on the management of subcontractors and their leaders. The department also ensured the quality of products in each link through self-inspection, in-process inspection, special inspection, pre-delivery inspection, arrival acceptance, trial operation and acceptance, etc.

Furthermore, CMEC employed project specialists. Under the leadership of the project manager, all specialists (locomotive specialists, vehicle specialists, rail specialists, and rail sleeper specialists) carried out technical coordination and product quality supervision of equipment or materials (locomotives, vehicles, rails, sleepers) in an orderly manner. They supervised, inspected and managed the entire process of project implementation. Their other responsibilities were providing guidance to various technical activities conducted by the technical procurement department and the on-site project department, and cooperating with the technical procurement department to supervise and check equipment of the suppliers in accordance with quality management requirement, so as to ensure the smooth implementation of the project quality scheme.

Ever since the commencement of the Project, the completion ratio of locomotives, vehicles and other equipment and materials provided by CMEC has reached 99%, with 3,500 railway freight cars and 107 diesel locomotives have been checked and accepted by the owners. Being commended for both quality and technology by the operating company and drivers, they took on important freight tasks on the Belgrano freight railway line in Argentina: by December 2016, they have completed minor civil works of no less than 321 kilometers, with a

cumulative completion of nearly 500 kilometers; overhaul of civil works totaled 1,511 kilometers, nearly 900 kilometers have been completed.

#### 4. Effect of Responsibility Fulfillment

##### (1) One pioneer project bringing two countries closer

The Belgrano Freight Railway Reconstruction Project was highly appraised by all walks of life in Argentina. China Central Television (CCTV) and Argentina mainstream media reported on the project many times. The then-president of Argentina, Macri, also visited the Belgrano Railway many times to inspect the locomotive and railway construction and highly appreciated CMEC's performance. The then-president Macri himself participated in the Project's opening ceremony of 500 kilometers, and regarded the Project as one of the cores of the Belgrano railway which was expected to revitalize the entire northern region of Argentina.

##### (2) One cost-effective project bringing better development

At present, the Project has had social and political effects in Argentina. It became a model of China-Argentina economic and trade cooperation, since it has brought better traffic, grain exportation and employment to seven provinces from the Santa Fe province (where Teminal Puerto Rosario is located), to the Salta province on the northwestern border. The Project has laid a strong foundation for Argentina's "Railway Revitalization Plan", further promoted China-Argentina strategic cooperation, and made outstanding contributions to deepening the comprehensive strategic partnership between China and Argentina.

According to the latest statistics from the Argentine Freight Railway Company, the line operator, by March 2021, the traffic volume of the Argentine Railway line has increased by 4 times compared

with the same period in 2015. The time it takes for grain to travel from Salta to the Teminal Puerto Rosario has been shortened by 10 days. After the completion of the Project, the railway company's transportation volume is expected to increase by at least 5 times compared with 2015, and the transportation volume of the Line Belgrano is expected to increase by 8 times.

According to the research data of Argentina's Rosario Trading Center, after the revamping of the Belgrano Railway with the locomotives and carriages provided by CMEC, freight railways in Argentina started to play an important role in Argentina's national transportation system, fundamentally changing Argentina's transportation structure and rail transport's share. Taking the actual experience of a local grain merchant as an example. Although Tucuman is 830 kilometers away from the port, after choosing the Belgrano freight railway for grain transportation, about 20 US dollars' cost is saved per ton. This cost saving has reduced the prices of local corn, soybeans and wheat by 17%, 9% and 19% respectively, significantly improving the international competitiveness of Argentina's grains.

After the completion of the railway reconstruction, the Belgrano railway line in Argentina will form a railway network connecting the South American continent with the railways of Chile, Brazil and other countries, promoting the import and export among South American countries. Besides, the network will also drive the agricultural products and mineral products along the railway line, facilitating the exportation of Latin American products.

Key Indicators	Pre-renovation	Post-renovation
Speed (km/h)	28-30	60-80
Annual Load (mt/y)	<100	600-800
Transportation Structure	Most on road, railway accounted for 8%	Most on railway

##### (3) One win-win project bringing China higher reputation



CMEC has been committed to promoting the localized construction of the Project. Included in the contract that China should be in charge of equipment supply and civil works, CMEC respected the owner's wishes and not only subcontracted the civil works to a local company designated by the owner, but employed local employees in strict accordance with the Argentine labor law, greatly promoting local employment. CMEC adhered to the procurement principle of "all equipment that can be purchased locally in Argentina should be purchased locally", expanded the share of local procurement. The employment rate was further increased as CMEC subcontracted 50% of the cargo transportation to local companies in Argentina, maintaining Argentina's economic and social stability. It is estimated that the Project has created 56,000 jobs in domestic Argentina, including about 13,000 direct and 52,000 indirect jobs, and has sent nearly 1,000 technical managers overseas.

This Project contracted by CMEC has earned China a better reputation in the world. It is the first large-scale railway infrastructure construction project in Latin America financed by China, and the first to successfully apply our country's mode of Export Buyer's Credit to a large-scale project of infrastructure construction which cost more than 1 billion US dollars. The Project has driven the production capacity and cooperation of many domestic heavy industrial enterprises from more than a dozen locomotive and rolling stock factories under CRRC (China Railway Rolling Stock Corporation), to Wuhan Iron and Steel Co., Ltd., Panzhihua Iron and Steel Co., Ltd., and Shandong Hi-Speed Group Co., Ltd. Establishing a brand image in Argentina that China's quality is excellent, after-sales service is timely and thoughtful, and prices are moderate, CMEC has gathered valuable experience for domestic enterprises to produce export products in the future, and has also shown impressive skills of our country in railway locomotives and freight trains. Benefiting both sides, the Project has truly achieved a win-win result.

As the Project is large in scale and covers a wide variety of rail equipment, all domestic participating units have been improved in the project. The equipment provided for the project has won various provincial and ministerial science and technology awards for many times, and technical staff have won various engineer awards such as Mao Yisheng Since and Technology Award and Tien-yow Jeme Civil Engineering Prize. CMEC also provided Argentina with the world's first rail detection and measurement car in response to the owner's request. The Project has prepared talent teams for China's railway equipment industry to go global, bringing China both economic and social benefits.

The successful construction of the Project not only brought China's technical standards, project management experience and financing model to Argentina, but also helped Argentina to cultivate a large number of railway technical and construction talents, which greatly improved Argentine railway transportation capacity and international competitiveness of grain prices. The Project has fulfilled President Xi Jinping's ardent expectations for the Argentine Railway Project: *"I hope that the 'Argentina Railway Project' will not only achieve good economic benefits, but also achieve good social benefits, opening more to the Argentine."*

## 5. Future Outlook

Based on the fact that the Project has created well economic and social effects, the Argentina government hopes to further upload the railway, enlarging the number of locomotives and examining equipment, adding new subjects such as modifying some parts of the railway lines and revamping bridges and signal systems along the railway lines. On May 18th, 2017, witnessed by China's President Xi Jinping and Argentina's President Macri, CMEC signed the mending agreement to the Project with the Argentine Ministry of Transportation in the People's Hall. The agreement value was 1.6

billion dollars, including 800 million dollars for the former Project. This was a symbol of Argentina's trust in CMEC's performance in the Project and showed their strong wish to maintain cooper-

ation with CMEC. In the future, CMEC will keep making distinguished project with craftsmanship in mind.

## 6. Deposition from Stakeholders

*"The 'Railway Revival' plan will increase railway capacity by renewing rolling stocks and tracks, with a view to restoring the country's industrial competitiveness, and the resulting demands such as supply, maintenance, and expansion will also create a large number of job opportunities."*

——Siorhi, Argentine Minister of Industry

*"The trains put into operation by China on the North Belgrano Line and the San Martin Line in Argentina are a model for China-Latin America cooperation. The construction of the 'Belt and Road' accelerates the pace of China-Latin America cooperation, which not only improves the level of infrastructure in Latin America, but also creates local employment opportunities to promote economic growth."*

——Edgardo Manavera, Head of Regional Production for the San Martin Railway Line

*"With the re-opening of the Belize Railway project, land transportation costs in inland provinces will be reduced by 80%. The project will also increase domestic railway capacity and efficiency. therefore, tens of thousands of labor forces living far away from the logistics center cities in central Santa Fe, Chaco, Santiago de Estero, and other provinces will re-integrate into the production system and benefit from it."*

——Randazzo, Minister of the Interior and Transport of Argentina

*"Since Chinese trains were put into use, the transportation cost of the San Martin Line has been reduced by 40%, and the once lost customers have re-chosen railway transportation. Speed is the most intuitive change. The operating speed of the new train can be stabilized at 70 kilometers per hour. There are great improvements in the drive's working environment, with comfortable operating equipment and dual-mode air conditioners are incomparable to old locomotives. Most importantly, due to the introduction of electronic equipment to strengthen communication, monitoring and other functions, the safety of railway transportation is largely guaranteed."*

—— Maximilian Luhan, a freight driver on the San-Martin railway line



September, 2016, CMEC Exported Meter-gage Locomotive to Argentina for the First Time



February, 2017, the first two meter-gage Locomotives arrived in Argentina, becoming the first new locomotive in Belgrano Railway in 39 years.



May 11th, 2017, before Belt and Road Forum for International Cooperation, then-President Macri of Argentina was interviewed by CCTV in his Office in Buenos Aires.



Scan the QR code to watch then-President Macri's remarks on CMEC



July, 2017, the broad-gauge locomotive provided by CMEC in the revamped Belgrano Cargo Railway was put into commercial operation for the first time. It was the first update to Argentine freight locomotive in 44 years, setting a milestone to Argentine freight railway capacity.

## Attachment: Enterprise Related Information



Company Name: China Machinery Engineering Corporation (CMEC)  
Company Location: Fengtai District, Beijing  
Company Website: [www.cmecc.com](http://www.cmecc.com)

### Company Profile

China Machinery Engineering Corporation (CMEC) is a core subsidiary of SINOMACH, one of the world's top 500 companies.

Established in 1978, the company was China's first industrial and trading company. After more than 40 years of development, CMEC has become a large-scale international comprehensive enterprise group with engineering contracting and industrial development business as the core, integrating trade, design, survey, logistics, research and development and other full industrial chain support. It is able to perform regional comprehensive developing and to provide "one-stop" customized solutions for various engineering projects, including pre-planning, design, investment, financing, construction, operation

and maintenance.

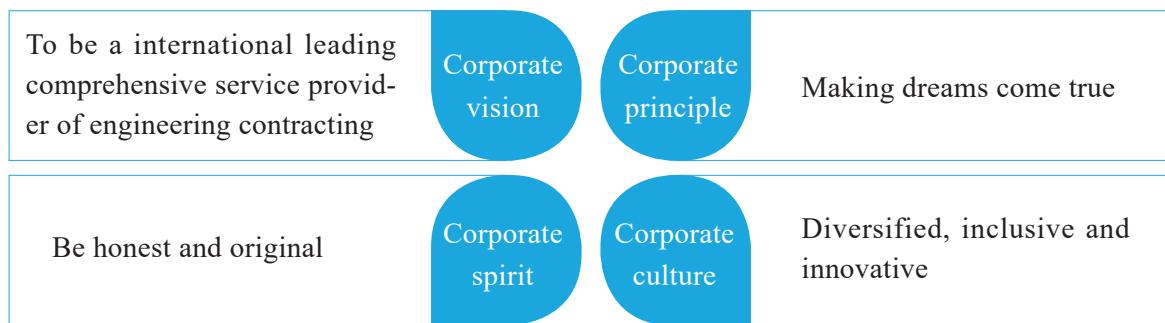
CMEC has constructed projects and provided services in more than 160 countries and areas. The company has created a large number of excellent projects in nearly 60 countries and areas, especially along the "Belt and Road", in the areas of energy, water affairs, environment protection, agriculture cooperation, infrastructure, traffic facilities, industrial engineering, and communication.

On December 28, 2021, CMEC, Sinomachinery International, Sinomachinery Construction, China United, Sinomachinery Sixth Institute and China HNA formed SINOMACH. As the corporate headquarter, CMEC then was endowed with new historical tasks and opportunities for development.





## Corporate Culture



## Major honors in the Past Three Years

Subject	Presenter	Name of the Award	Time
CMEC	International SOS	Runner-up of the Sustainability Award	October, 2021
	Global Corporate Sustainable Competitiveness Summit	2021 Overseas Sustainable Practice Excellence Award	November, 2021
	China International Contractors Association	“2021 annual credit rating evaluation of foreign contracting projects AAA enterprises”	December, 2021
	China Chamber of Commerce for Import and Export of Machinery and Electronic Products	Honorable title of “Enterprise credit evaluation AAA credit enterprises”	December, 2021
	SINOMACH	Market Development Award	December, 2021
Angola SOYOI Combined Cycle Power Plant Construction and Installation Project	China's Ministry of Housing and Urban-Rural Development, China Construction Industry Association	2020 Luban Award of China Construction Engineering (Overseas Project)	April, 2021
Comprehensive Application of BIM Technology in Sri Lanka's Atana Water Plant Project	China Municipal Engineering Association	The Third Category of result Award, construction company group, the third “Municipal Cup” BIM Practicable Skills Competition	December, 2021
Angola SOYOI Combined Cycle Power Plant Project	Ministry of Ecology and Environment of the People's Republic of China	Model of synergizing pollution reduction and carbon emission reduction along the “Belt and Road”	December, 2021
Pakistan Thar Coal Mine Project	China International Contractors Association	China Overseas Engineering Excellent Camp	December, 2021
Information System of National Engineering Construction Conditions along the Belt and Road	China International Contractors Association	The 2021 International Engineering Digitization Best Practice Case	December, 2021
Engineering Inspection Management System	China International Contractors Association	Excellent Application Case of International Engineering Digitization in 2021	December, 2021
Legal and Risk Management Department	China Business Law Journalism (CBLJ)	Excellent Legal Team in Construction and Infrastructure Field	December, 2021
Legal and Risk Management Department	China Business Law Journalism (CBLJ)	Excellent Domestic Legal Team	December, 2021
Industrial application of the new type of railway single- and double-sided rapid unloading ore hopper car technology	SINOMACH	The third prize of the 2021 “Science and Technology Award of China National Machinery Industry Corporation”	December, 2021
A comprehensive compaction method of land filling in loess hilly and gully region	SINOMACH	The second prize of “Excellent Patent Award of China National Machinery Industry Corporation” in 2021	December, 2021

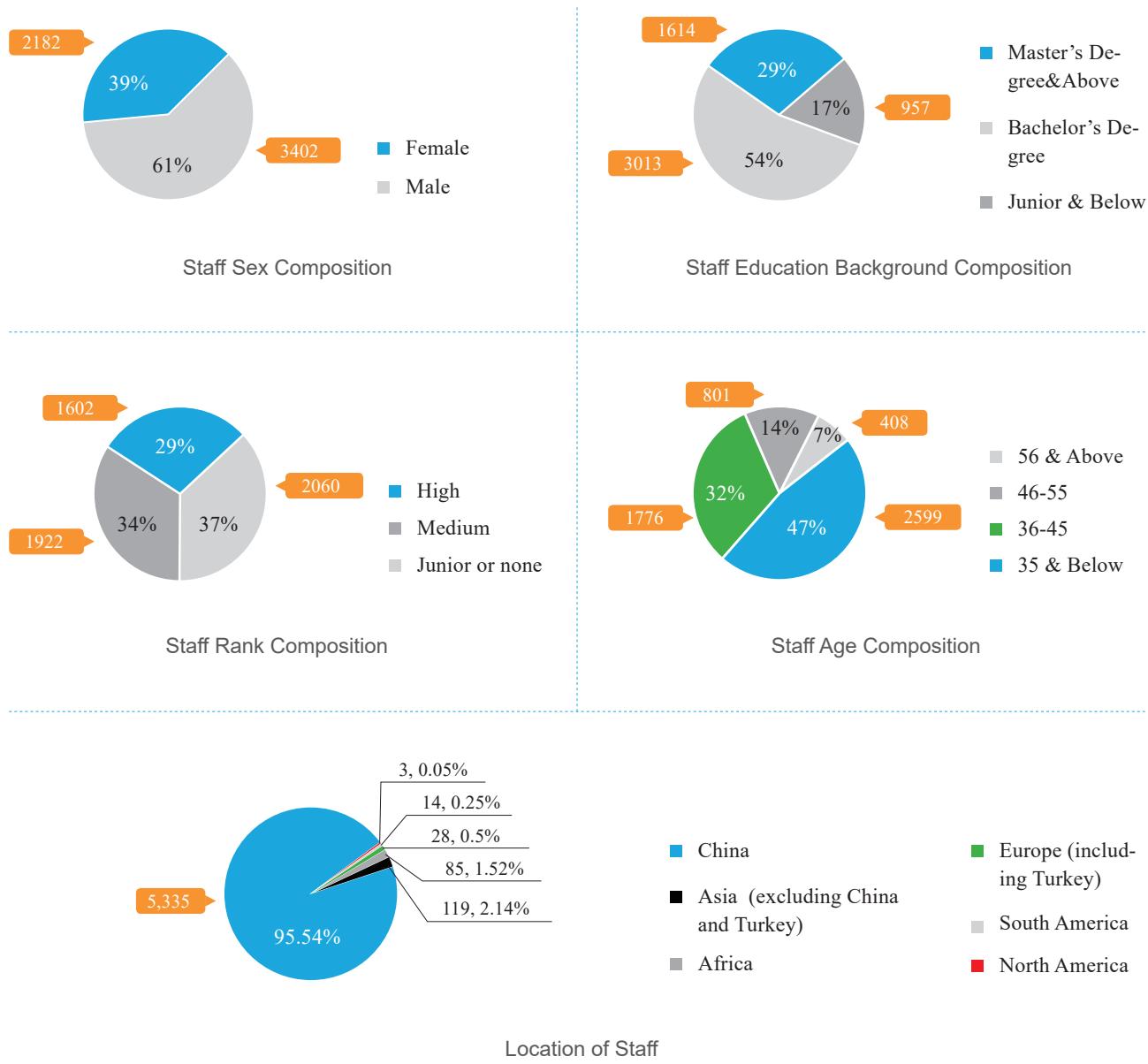
Subject	Presenter	Name of the Award	Time
CMEC	China Chamber of Commerce for Import and Export of Machinery and Electronic Products	“Enterprise credit evaluation AAA credit enterprise” honorary title	August, 2020
	Global Corporate Sustainable Competitiveness Summit	2020 Overseas Sustainable Practice Enterprise Excellence Award	November, 2020
	China International Contractors Association	“2020 Annual Credit Rating Evaluation of Foreign Contracting Projects AAA Enterprise”	December, 2020
	Hong Kong Ta Kung Wen Wei Media Group Business Development Limited, The Hong Kong Chinese Enterprises Association, The Listed Companies Association of Beijing, Chinese Financial Association of Hong Kong, Chinese Securities Association of Hong Kong, Hong Kong Securities and Investment Institute, The Hong Kong Institute of Charted Secretaries, China Mergers and Acquisitions Association in Hong Kong	The 10th China Securities Golden Bauhinia Award -- the most socially responsible listed company	December, 2020
Angola SOYOI Combined Cycle Power Plant Project	China Electric Power Construction Association	“2020 China Quality Power Project”	June, 2020
Laos 230 KV Nansar Power Transmission and Transformation Project	Lao Ministry of Energy and Mineral Industry	“Quality Project of Laos Ministry of Energy and Mineral Industry 2019”	July, 2020

Subject	Presenter	Name of the Award	Time
CMEC	Organizing Committee of International Infrastructure Investment and Construction Forum	“Outstanding Contribution Unit” Award	July, 2019
	Organizing Committee of the 9th China Securities Golden Bauhinia Award	“Best Investor Relations Team” Award	November, 2019
	2019 “Belt and Road” Global Forum	Economic Development Contribution Enterprise Award	December, 2020
	Global Corporate Sustainable Competitiveness Summit	2019 Overseas Sustainable Practice Enterprise Excellence Award	December, 2019



## Employee Data

By the end of 2021, CMEC had a total number of 5,584 employees on the spot, with 328 ethnic minorities. There were also 1,712 former and retired employees. The company signed employment contract with every one of the staff, and neither the company nor subcontractors has ever hired any minor or forced any labour.



## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	billion yuan	54.00	51.19	53.839
Operating Income	billion yuan	28.348	19.120	23.029

# Strengthen Welding Quality Management & Create High-Quality Welding Projects

◇ Beijing Yanhua Construction & Engineering Co., Ltd. (BYCE)

## Introduction

By optimizing quality and safety management from multiple perspectives, and taking into account environmental benefits and employee growth, Beijing Yanhua Engineering & Construction Co., Ltd. won good customer reviews and first prize of Excellent Welding Project awarded by China Engineering Construction Association in promoting the high-quality welding project of the 1 million tons/year ethylene and refining PO/SM units of Sinochem Quanzhou.





## SDGs



Goal  
No.13

Adopt internationally advanced technology to reduce public works and material consumption, realize cascade matching of process stream energy through optimized heat exchange network, maximize the existing energy utilization, reduce external energy input through internal energy circulation of the device, and reduce energy consumption.

## CSR



Fundamental  
Responsibility

Set quality goals, take multiple measures to promote the optimization of quality and safety management, ensure the quality and safety of the project, and won the first prize of Excellent Welding Project awarded by China Engineering Construction Association.



Labor Practices

Formulate training plans, carry out training and assessment project, conduct on-site inspection and guidance by project welding engineers and welding technicians, and conduct practical and theoretical explanations on different steel grades, different wall thicknesses, and different welding positions to improve practical skills and promote development for workers.



Environment

Adopt internationally advanced technology to reduce public works and material consumption, realize cascade matching of process stream energy through optimized heat exchange network, maximize the existing energy utilization, reduce external energy input through internal energy circulation of the device, and reduce energy consumption.

## 1. Case Overview

The propylene oxide/styrene (PO/SM) plant in Sinochem Quanzhou 1 million tons/year ethylene and refining expansion project is located in Quanhui Petrochemical Industrial Zone, Huian County, Quanzhou City, Fujian Province. The 12 million tons/year oil refining project uses the basic chemical products benzene, ethylene and propylene produced in the industrial zone as raw materials, and then produces propylene oxide and styrene monomer through co-oxidation method. The products are widely used in fine chemicals, polymer materials and other fields. The PO/SM device is affiliated to Sinochem Quanzhou Petrochemical Co., Ltd. and was constructed by Beijing Yanhua Engineering & Construction Co., Ltd. The supervision unit is Beijing Huaxia Supervision Co., Ltd. The project implements the “E+P+C” management mode, adopts the international advanced technology to reduce the consumption of public works and materials, and at the same time realizes the energy cascade matching of the process stream through the optimized heat exchange network, so as to maximize the effective energy utilization. Through using the internal energy circulation, external energy input can be reduced to achieve the purpose of lowering energy consumption.

The welding work of this project started on March 20, 2020, and basically ended on August 10, 2020. The construction period is short, and the pipeline welding volume reaches 660,000 inches in diameter. The work is heavy, the peak period is concentrated, and the invested manpower and equipment resources are relatively high. Also, there are many on-site construction spaces, which overall increases the difficulty of management. Nearly 330 people participate in the welding project of PO/SM device, including 1 project manager, 1 project chief engineer, 1 quality assurance engineer, 2 welding engineers, and 2 welding quality inspectors, 2 secondary warehouse keepers, and 1 document clerk. At the peak of the welding operation, the total

number of personnel reached 310.

Quality objectives of the project:

The construction quality should conform to the current national or industrial construction quality acceptance standards, and the technical data should be complete and correct.

If counted by the welded joints number, the one-time pass qualified rate of the inspected welded joints should be  $\geq 92\%$ .

If counted by piece, the one-time pass qualified rate of the inspected welded joints should be  $\geq 97\%$ .

The pipeline pressure and tightness should pass the test for the first attempt, and no leakage be found.

100% pass rate for special operation is required, and mistakes in distribution and use of welding materials should be eliminated.

Ensure that the project is completed and put into use successfully for the first attempt.

Keep the record of zero major quality accident and create more high-quality projects.

The PO/SM device completed the construction of the project two months ahead. No safety and quality accidents that affected the project implementation process occurred. The device produced qualified products on March 25, 2021. The device adopts a standardized management mode during the welding operation. With strict control, safe construction, and no quality accidents, conditions were created for the early delivery. And the project won the first prize awarded by the China Engineering Construction Welding Association.

## 2. Case Background

This project is initiated from the need of the “Belt and Road Initiative”, petrochemical industry up-

grading, and strategic measures for economic take-off on the west coast of the Taiwan Strait, as well as the realization of Sinochem Quanzhou Petrochemical's "refining and chemical integration", and the need to improve Sinochem Group's energy sector industrial chain, rise industrial status and raise the level of economic development of Fujian Province. Relying on the 12 million tons/year oil refining project, 19 sets of refining and chemical plants, including the newly-built and expanded 3 million tons/year atmospheric pressure units, 2.6 million tons/year continuous reforming units, 800,000 tons/year paraxylene units, 2.2 million tons/year Hydrocracking unit, 1 million tons/year ethylene unit, 100,000 tons/year EVA unit, 20/500,000 tons/year EO/EG unit, 350,000 tons/year PP unit, 20/450,000 tons/year PO/SM unit and etc., as well as the supporting public utilities, storage and transportation facilities, were built to achieve goal of "refining and chemical integration". Among the facilities mentioned above, the POSM plant adopts the co-production of styrene with propylene oxide by co-oxidation, which is transferred by Spain's REPSOL Company for the first time. It produced 200,000 tons propylene oxide and 450,000 tons of styrene per year. The commissioning of Quanzhou Petrochemical's PO/SM plant is also the first time that the patented technology of Spain's REPSOL co-oxidation method has been successfully put into operation in China. For Sinochem Quanzhou Petrochemical Co., Ltd., the plant is conducive to optimizing resource allocation, increasing product added value, improving corporate profitability and anti-risk capabilities. After completion, the main products are: National VI standard gasoline, diesel and aviation oil, polyethylene, polypropylene, ethylene oxide, ethylene glycol, propylene oxide, styrene, p-xylene, and other chemical products. For our company, the 20/450,000 tons/year PO/SM plant especially is one of the key plants of this project. It is a production plant for propylene oxide and styrene products, and the undertaken of this plant reflects our

company's superb management level and precise positioning in welding technology management.

The PO/SM unit includes an ethylbenzene unit and a POSM unit. The ethylbenzene unit adopts the liquid phase molecular sieve technology of the Academy of Stone Science, and the PO/SM unit adopts the Repsol ethylbenzene co-oxidation technology. The investment cost of the PO/SM co-production unit is 25% lower than that of the HPPO method propylene oxide unit and styrene unit alone, and the operating cost is reduced by more than 50%. The Repsol PO/SM co-production process has been implemented in Repsol's self-owned factory for more than 20 years continuously, which shows it's mature and reliable. Therefore, this method is shown to have more competitive advantages than the traditional chloroethanol method, HPPO method to produce propylene oxide and ethylbenzene dehydrogenation method to produce styrene.

### 3. Responsibility Actions

Beijing Yanhua Engineering & Construction Co., Ltd. is an engineering construction industry enterprise integrating general contracting of petrochemical projects, design and manufacture of pressure vessels (non-standard equipment), operation, maintenance and repair of petrochemical plants, engineering project management, engineering technology development and services. It is one of the senior large-scale petrochemical engineering construction industry enterprises in China. The company has been serving Sinopec, PetroChina, CNOOC Sinochem Group, Shenmu Group, Yanchang Group and other major petrochemical companies across the country. Relying on its own management and operational strength, the company has undertaken the construction of core oil refining and chemical plants represented by large atmospheric and vacuum units, delayed coking units, hydrogenation units, polypropylene units, and large storage tanks of 100,000 cubic meters, and provided equipment inspection, repair, and

maintenance services.

Sinochem Quanzhou 1 million tons/year ethylene and refining expansion project PO/SM unit (including EB) is a key construction project of the company. In the early stage of construction, an organization that meets the requirements and a quality system has been established. From personnel to equipment, machinery, etc., one by one, the key and difficult points of construction are analyzed. The device has seven production units [ethylbenzene unit (block 11), ethylbenzene oxidation unit (block 12), propylene alkoxylation unit (block 13), propylene oxide refining unit (block 14), ethylbenzene recovery unit (zone 15), methyl benzyl alcohol dehydration unit (zone 16) and benzyl alcohol hydrogenation unit (zone 17)] and eight auxiliary facilities [intermediate tank area (zone 18), loading and unloading station (zone 19), freezing station and heat exchange station (area 21), device outer pipe (area 71), cabinet room (area 90), foam station (area 91), initial rainwater pool (area 92), and transformer room (area 95)]. The unit has a road of 2,450 meters, a vertical area of 80,000 square meters, a reinforced concrete soil of 48,000 cubic meters, a steel structure of 8,700 tons, 746 sets of equipment, 650,000-inch diameter pipes with the length of 192 kilometers, 3,149 sets of electrical equipment and electrical bridges for 12 kilometers, 382 kilometers of electrical cables, 6386 sets of instrumentation equipment, 30 kilometers of instrument bridges, and 115 kilometers of instrument cables.

The materials involved in this project include 20 (GB/T8163), 20 (GB9948, GB8163), 20 (GB3087), 20+Zn (GB8163), L245 (GB/T9711), 20G (GB5310), 304 (ASTM A312/A312M), 304L (GB/T14976) 316L (ASTM A312/A312M), 316 (ASTM A312/A312M), Gr.6 (ASTM A333/A333M), P11 (ASTM A335/A335M), P91 (ASTM A312/A312M) A335/A335M), S31803 (ASTM A790/A790M) and S32750 (ASTM A790/A790M), with the maximum diameter of DN1700

and the minimum diameter DN15. The total length of the pipeline is 192 kilometers, the total inch diameter is 660,000 DB, the steel structure is 8600 tons, and the field group has 27 welding storage tank equipment.

Therefore, it can be seen that welding engineering has the following features:

- ① There were many types with various materials. The pipeline construction area was concentrated. And there were many construction personnel, which increased the difficulty of the traceability of pipeline materials and welding materials.
- ② The welding work started on March 20, 2020, and basically ended on August 10, 2020. The welding construction period was short, the pipeline welding volume reached 660,000 inches, the welding work was large, the peak period was concentrated, and the input of manpower and equipment resources was high. It made the on-site construction space narrow, which increased the difficulty of welding management.
- ③ The welding of chromium-molybdenum alloy steel P11 and P91 pipelines requires pre-weld pre-heating, post-weld heat treatment, 100% non-destructive testing and hardness testing. Especially for the welding of P91, because it puts forward higher requirements for the selection of welding materials, preheating temperature, interpass temperature, and post-weld heat treatment, which increases the difficulty of the welding process.
- ④ Stainless steel pipes 304, 304L, 316, 316L not only have many specifications, but also have many large-diameter and thin-walled pipes, which increases the difficulty of welding joint alignment.
- ⑤ The strict requirements for ferrite content of dual-phase steel S31803 and S32750 increase the difficulty of incoming inspection of pipeline materials and welding materials and control of welding process.



⑥ The device layout is compact, the construction period is tight, and the cross-construction operation is serious. There are many high-altitude counterparts and welding operations, the construction area and the effective construction area is small. It increases the difficulty of on-site welding work management.

In view of the above, we have intensified management efforts, adopted active measures, and achieved high personnel efficiency, high material efficiency, and reduced the construction cost through dividing key project areas and managing construction personnel's application for review and inspection. The project optimizes the management level in terms of specific personnel optimization, material cost control, progress management, and welding quality. The specific measures are as follows: by optimizing the prefabrication scheme, secondary design of the pipeline and in-depth prefabrication, the construction period was shortened by 45 days and the on-site labor is reduced by 11,250 men per day and saved costs of 5.65 million yuan. Through the modular construction of steel structures, the cost of crane machinery was saved by about 3.55 million yuan. And the cost of scaffolding and dismantling was reduced by 2.6 million yuan. The device was put into operation two months ahead of schedule, creating a direct economic benefit of 180 million yuan.

#### (1) Strict control of welders entering the site

The pipeline prefabrication work started in March 2020, entered the peak installation period in mid-May 2020, and basically completed the installation work by mid-November 2020. In order to ensure the quality of the pipeline prefabrication work, the project team strictly controlled the qualifications of welding engineers, conducted inspection and review of the qualification certificates of welding operators, and conducted post-employment assessments for those who have not obtained qualifications. The project was divided into theory and

practical operation. Only after approval could they enter the construction site to carry out corresponding professional welding operations. 457 welders have participated in 46 batches of entrance examination. 368 welders passed the test, and the passing rate was 80.5%. Welding engineers conducted qualification examination of welders, identified them through the database of Chinese special equipment operators, and submitted the welder's ID card and qualified project to the supervision department for examination. After passing the supervisory examination, the workers could go to the welding examination center of the construction unit to take the examination. After passing the examination, they could get the job certificate. Welders without employment certificates were not allowed to engage in welding work. The work permit must also be carried with them.

Established the dynamic management information of welders, implemented the first inspection system for welders entering the site, promptly notified welders who have a pass rate less than 96% in a week, and analyzed the reasons. Welders who had a pass rate of less than 96% for a cumulative two weeks would be suspended from work and cleared out of site.

Through the welder examination, assessment, and follow-up inspection, the welding qualification rate of the construction site has been greatly improved.

#### (2) Strengthen the management of the secondary warehouse of welding materials

According to the project quantity and schedule requirements, sufficient secondary warehouses for welding consumables were set in the prefabrication field and work site, and special personnel were assigned to be trained. Their job duty included sorting, placing, drying, distributing, and recycling materials. And the welding material receiving strip system was carried out. Receiving strips were confirmed by pipeline technicians, welding engineers,

welders, and secondary warehouse administrators to ensure the traceability of welding material distribution, which ensured control of the source of welding materials.



### (3) Strengthen the management of raw material color or label transplantation and material distribution

Carried out verification inspection of materials according to the requirements of the specification, checked the product qualification certificate, and applied for review according to requirements. Establish and implement a material distribution and requisition system. Pipes and pipe fittings were stored in specific zones. Mixed storage of stainless-steel pipes, chrome-molybdenum steel pipes, and carbon steel pipes was prohibited. Bolts, gaskets, and other small pipe fittings must be put into the warehouse for storage, and signs were needed for unqualified materials in the warehouse. Concentrate the materials that need anti-corrosion, commissioned them strictly according to the requirements, and confirmed before and after anti-corrosion to ensure that the materials, anti-corrosion forms and color bands were correct. Tracked the use of materials after entering the site and conducted verification inspections for materials with unclear color labels and disputes to ensure that the materials were used correctly.

### (4) Do well in the disclosure of welding process and welding plan, and improve the theoretical and practical level of welders

According to the information of materials, components and accessories provided in the design documents, the existing welding process qualifications were sorted out, and the “Process Pipeline Instal-

lation and Construction Plan”, “Pipeline Welding and Heat Treatment Plan”, and “Alloy Steel P91 Welding and Heat Treatment Special Construction Plan” and other construction technology plans were compiled. 4 new welding procedure qualifications were formulated, 26 procedure qualifications were reported, and 42 welding operation instructions were prepared.

The quality managers of the project conducted on-site inspections every day, attaching great importance to the direct operation, and the project welding engineers, and welding technicians took charge of on-site inspection and guidance, and conducted operation and theoretical explanations for different steel grades, different wall thicknesses, and different welding positions. They also needed to analyze the reasons for the welding defects, and propose improvement measures from factors of worker, machine, material, method, and environment, which improved the practical level of welders and strengthened their concept of quality. Through the dynamic statistical analysis of welders' work, abnormal state could be found in time, and cause of defect could be found as well, so as to ensure the qualified rate of first-time welding.

### (5) Strengthen welding process management

The following zero-tolerance principles were implemented: ① Welders who do not have the “Welder Employment Certificate” shall not carry out on-site welding operations; ② Welding qualification rate of less than 85% within one week is considered unqualified; ③ Welding process discipline is violated three times in total or wrong welding is used; ④ Welders who do not clean up the welding seam splash and coating and after work.

The welding process inspection was also strengthened: ① The counterpart inspection of stainless steel 304, 304L, 316, 316L thin-walled pipes shall be confirmed by the welding quality inspector of the project department before welding; ② The pre-heating temperature, interpass temperature, and

post-weld heat treatment of chrome-molybdenum steel P91 should be inspected and confirmed by the welding quality inspector of the project department, and by the supervising engineer; The inspection of opening and welding of the branch pipe, the socket welding and the fillet welding will be upgraded to point B control point, and the professional engineer and supervision of the project department should jointly confirm them; For 316, 316L, P11, P91 pipeline components and welds, 100% verification inspection shall be carried out after installation to ensure the correct use of high-risk materials.

(6)Optimize the construction process and improve the welding quality



PMI, PT inspection of components and welds after pipeline installation



Excellent Welder Award

The depth of pipeline prefabrication was increased, and large-diameter pipelines were pre-assembled to prevent on-site assembly difficulties or rework. Transportation and hoisting issues were reasonably considered, and steel structure were installed in sheets or modules as much as possible to reduce the workload of on-site installations, high-altitude welding, assembly and hoisting, which better ensured the welding quality of the project from the construction process.

(7)Develop a reward and punishment system to ensure the quality of the project

The project department would review the quality status of last week at the weekly project meeting,



PT inspection of chrome-molybdenum steel P91 groove



Welding Technology Seminar

announce the assessment results, arrange the quality work for this week, hold quality problem analysis meetings from time to time, participate in the joint quality inspection of the project party, rectify, and solve quality problem in time. The “Quality Rewards and Punishments Management Measures” were established, and a special quality reward fund was set up. The assessment standards were formulated for the welders, and the assessment was carried out according to the three data -- appearance quality of the welding joint, the number of shots and the pass rate of one shot. If the standards were met, reward would be given. Through this system of rewards and penalties, the enthusiasm of welders for meticulous construction was stimulated, and the first-time pass rate of welding and quality of welding were improved.

#### **4. Effect of Responsibility Fulfillment**

Sinochem Quanzhou 1 million tons/year ethylene and refining expansion project with 200,000 tons and 450,000 tons/year PO/SM units (including EB) were constructed by Beijing Yanhua Engineering & Construction Co., Ltd. According to the characteristics of the project and the expectations of the owner, combined with the actual construction situation on site, a set of quality assurance system suitable for the project requirements has been established, including planning the prefabrication yard, formulating personnel training plans, coordinating the material management system, etc., optimizing the project from many aspects. Also, company's mature and advanced construction technology, advanced machinery and equipment were selected. High-level welders were mobilized and selected. Principles of being scientific, rational, economical, reliable, and feasible were adhered to when formulating measures and plans. And at the same time clarified the responsibilities, work content, work process, methods and coordination with owners, supervisors, and other units, therefore implemented a modern, scientific and standardized project

quality management model. They also completed the quality assurance data during the construction process, applied for inspection in a timely manner, and completed the project in cooperation with all parties involved. According to statistics, the number of welding joints in the RT inspection of the process pipeline is 24,308, and 22,608 are qualified the first time, with a pass rate of 93%. There are 5760 pieces of welding equipment (tank installation) RT test, 5622 pieces of which passed the first time, with a one pass rate of 97.6%. 1399 meters of steel structure are constructed in the welding UT test, 1389 meters pass, and the pass rate is 99.3%. The device produced the first batch of qualified products on March 25, 2021, creating economic benefits for the construction unit in advance.

The project implemented the model engineering work according to the profession, standardized the process operation, and implements the first-piece inspection system to ensure the quality of the project. The welding project successfully applied for the excellent welding project and won the first prize granted by China Engineering Construction Association.

#### **5. Future Outlook**

Sinochem Quanzhou 1 million tons/year ethylene and refining expansion project with 200,000 tons and 450,000 tons/year PO/SM units (including EB) were constructed by Beijing Yanhua Engineering & Construction Co., Ltd. The construction was carried out according to the design documents and standards. Various problems in the construction were corrected in time, various difficulties were overcome, and the construction was completed two months ahead of schedule. Throughout the welding management process, various management systems were strictly implemented, and responsibilities were clear. During the project implementation process, the “three inspections” system in the construction process was strength-



ened, and the “low, old and bad” faults in on-site welding work were constantly corrected and eliminated. The welding quality was guaranteed. There were no accidents of safety or quality that had any



Customer Satisfaction  
Evaluation



Welding Quality Evaluation

impact during the implementation. And the device has been producing qualified products on March 25, 2021, creating economic benefits for the construction unit in advance.



Excellent Welding Engineering -- First Prize

## 6. Deposition from Stakeholders

*“The construction unit has established the concept of ‘quality is criterion, loyalty, and responsibility’. According to the actual situation of project, a quality management system has been established. According to the actual conditions of site, an efficient material and equipment management system has been established to strictly control the entry of raw materials and their usage. Welding quality, process piping design changes and construction, pipeline system pressure testing, and joint calibration of control instruments have also been controlled. In every key construction link, there was no accident due to poor quality during the construction of the project, which laid foundation for the successful start-up of the device.”*

——Chemical Project Division of Ethylene Project Department of Sinochem Quanzhou Petrochemical Co., Ltd.

## Attachment: Enterprise Related Information



Company name: Beijing Yanhua Construction & Engineering Co., Ltd. (BYCE)  
Company address: Fangshan District, Beijing  
Company website: <http://www.byce.cn/>

### Company Profile

Beijing Yanhua Construction & Engineering Co., Ltd. (abbreviated as Beijing Yanhua) was established in 1969 with a registered capital of 134 million yuan, and fixed assets of 758 million yuan. It is a large-scale engineering construction company that integrates general contracting of petrochemical construction, design and manufacture of pressure vessels (non-standard equipment), petrochemical plant operation and maintenance, engineering

project management, engineering technology development and services.

Beijing Yanhua was formerly known as Beijing Yanhua Construction and Installation Engineering Company (First Construction Company of Sinopec Group). In November 2005, it changed its name to Beijing Yanhua Construction and Installation Engineering Co., Ltd. and became the largest and oldest construction industry enterprise under Sinopec Group. In May 2011, in order to adapt to





changes in the economic situation and better expand its business, it was renamed as Beijing Yanhua Construction & Engineering Co., Ltd.

Established in 1969, Beijing Yanhua Construction and Installation Engineering Company (the predecessor of Beijing Yanhua Construction & Engineering Co., Ltd.) provides stable energy guarantee for national construction and military facilities. It has repeatedly set the record in China's petrochemical industry: China's first 100,000-ton/year cracking furnace; China's first 2 million-ton/year heavy oil catalytic cracking unit; China's first set of 200,000 tons with the largest single-line production capacity/year polypropylene plant; China's first industrial production of 30,000 tons/year butyl rubber plant; China's first 80,000-ton/year cresol plant, etc. In 1994, the first domestic reconstruction and expansion project of 450,000-ton/year ethylene plant was successfully started and won the "Luban Award", the highest award in the construction industry of the People's Republic of China. In 2009, the project was elected as one of the "One Hundred Excellent Projects" by the China Construction Industry Association for the 60th Anniversary of the Founding of PRC.

Beijing Yanhua has the QHSE management system certification, first-level qualification of petrochemical construction general contracting, a number of professional contracting qualifications, and the GA1-level, GB1-level, GC1-level, GD1-level pressure pipeline installation licenses and other special equipment license qualifications. It also holds the "U" and "U2" authorization certificates of American Society of Mechanical Engineers (ASME). There are 1820 employees, more than 800 technical and project management employees, including 102 first-level construction engineers, 106 PMP certified personnel, and more than 1,200 senior and intermediate skilled workers. There are more than 2,000 sets of construction equipment, including 88 sets of hoisting and transportation equipment, 398 sets of welding equipment, and more than 1,500

sets of other processing and inspection equipment. The annual project contracting capacity reaches 1.5 billion yuan, and the annual manufacturing capacity for various types of containers reaches 16,000 tons.

In the past 50 years, Beijing Yanhua has undertaken projects of oil refining, chemical, rubber, coal chemical, storage and transportation, long-distance pipelines, demolition of old equipment and other sectors, and construction of more than 150 sets of main equipment, more than 200 sets of public works and supporting facilities, 100 crude large-scale oil storage tanks and more than 1,000 kilometers of long-distance pipelines, involving more than 20 provinces, cities and autonomous regions, including Beijing Yanshan, Gansu Lanzhou, Inner Mongolia Zhongtian Hechuang, Liaoning Yingkou, Tianjin Petrochemical, and Fujian Quanzhou.

As a high-tech enterprise and a Beijing patent pilot company, Beijing Yanhua constantly seeks excellency in management, technological and product innovation. The independent research and development center has dedicated infrastructure, professional team and equipment. It obtained the Beijing Technology R&D Center Certificate in 2017 and passed the recheck in 2021.

Up to now, Beijing Yanhua has 37 patents authorized by China National Intellectual Property Administration, including 2 invention patents, 21 industry standards involving welding special materials, installing and commissioning of large-scale units, hoisting operations, and safety and quality management have been formed. In response to the national requirements for energy conservation, emission reduction and environmental protection, the company independently developed "membrane separation hydrogen equipment", "reformation steam generator" and "waste heat power generation system", which have been successfully applied. The "membrane separation hydrogen equipment" technology even won Beijing New

Technology and New Product Certificate.

In the process of promoting localized high-end equipment, Beijing Yanhua has also achieved gratifying results. Butyl rubber polymerization kettle, ABS reactor, vinyl acetate reactor, high-pressure thread locking ring heat exchanger, 100 square meters dewaxing drum vacuum filter and a series of products are at a leading position in China and have been praised by Sinopec Group and major engineering companies. The localization of core equipment has not only changed the situation that the domestic petrochemical industry is controlled by foreign companies in terms of core equipment, but also shortened the order cycle and lowered product prices.

At the same time, Beijing Yanhua strengthens co-operation with external parties, constantly seeks new models and develops new markets. The company cooperates with construction units such as Sinochem Quanzhou Petrochemical Co., Ltd., Zhejiang Petrochemical Co., Ltd., Jiangsu Sierbang Petrochemical Co., Ltd., CNOOC Refinery Co., Ltd., Shaanxi Yanchang Petroleum Group Co., Ltd., and undertakes the management and construction tasks of EPC, PC, PMC, etc. The company also cooperates with well-known domestic engineering companies to undertake project management, design, procurement, and construction general contracting business. The company also cooperates with domestic and foreign sci-

tific research institutions to carry out research and cooperates with colleges and universities. The co-operation with Tsinghua University, University of Chemical Technology, Hebei University of Technology and other universities provides theoretical support for the research and development of enterprises and achieves a win-win situation for the three parties of production, education and research.

From its establishment to now, Beijing Yanhua has never forgotten its original motivation. It has undertaken many government-aided construction projects launched in underdeveloped areas, including national crude oil reserve base, Ningxia 7500-ton/year plastic shed film, mulch film, drip irrigation belt construction, etc. During the epidemic from February to March 2020, the company organized elite employees to benchmark the construction speed of Huoshenshan and Leishenshan hospitals. They worked 24 hours a day and finished building the meltblown nonwoven production line for Yanshan Petrochemical in only 12 days.

Beijing Yanhua will be rooted in the fertile soil of petrochemical equipment technology, vigorously develop new fields and new markets, carry out scientific and technological research in the direction of “supporting clean production and promoting transformation of traditional manufacturing”, strengthen international cooperation, and strive to build a well-known technological, R&D-based, and innovative enterprise.



# Fine Benchmark Projects to Help High-Quality Development

◇ China Shanxi Sijian Group Co., Ltd



## Introduction

During the construction of the Shennong Health City project in Gaoping City, Shanxi Sijian Group Co., Ltd. took the “Luban Award” as the quality target, adhered to the spiritual concept of achieving excellence at one time, strengthened pre-planning, insisted on leading with science and technology, strengthened process control and implemented green construction, and won the “Luban Award” project of the China Construction Industry Association.



## SDGs

	<p>Strengthen construction technology management and deepen the application of BIM technology to effectively improve the efficiency and quality of project management and construction.</p>		<p>The project has been hailed as a “model of green construction” and won the Green Construction Model Project Award.</p>
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## CSR

	<p>Strengthen quality management, prepare corresponding management methods and adopt effective measures to create high-quality projects; strengthen technological innovation and deepen the application of BIM technology to enhance efficiency and quality.</p>		<p>Organize all staff to learn the content and essence of the PPP model, etc., and provide training for staff to enhance their professional skills.</p>
	<p>The project is regarded as a “model of green construction” and has won the Green Construction Model Project Award.</p>		



## 1. Case Overview

Gaoping Shennong Health City project is a modern green Grade IIA comprehensive hospital integrating centralized medicine, maternal and child health care and rehabilitation center, and is a key livelihood project in Jincheng City, Shanxi Province. The project was constructed by Shanxi Sijian Group.

The design concept of the project is “inheriting historical culture and integrating regional characteristics”, and the building shape is “simple and natural, regular and atmospheric”, which reflects the practicality, culture and modernity of the building.

The project is located in Gaoping City, Shanxi Province. It consists of a comprehensive building, a liquid oxygen station and a sewage treatment station, with a total construction area of 71,305 square meters and a total investment of 324 million CNY. In November 2021, the project was awarded the “Luban Award” by the China Construction Industry Association.

## 2. Case Background

At present, in order to implement the spirit of the Third Plenary Session of the 18th CPC Central Committee “regarding the participation of social capital in urban infrastructure investment and operation through franchising and other means”, expand the financing channels for urbanization construction, promote the accelerated transformation of government functions, improve financial input and management methods, and form an institutional system conducive to promoting the development of the government and social capital cooperation model as soon as possible. This is the direction for the development of PPP projects. As a long-term partnership established in the field of infrastructure and public services, promoting the use of the government and social capital cooperation model is one of the new urbanization development strat-

egies being implemented in China, and is also an important grasp of stabilizing growth, promoting reform, adjusting structure and benefiting people's livelihood, as well as a change in the institutional mechanism to enhance national governance capacity. By regulating the development planning, market supervision and public service functions of the government and social capital cooperation model and combining the management efficiency and technological innovation dynamics of social capital, the government's excessive involvement in micro affairs will be reduced and the efficiency and quality of public services will be improved. It also aims at promoting the strategic restructuring of the national economy, strengthening the construction of weak links, promoting sustainable and healthy economic development, and enabling the market to play a decisive role in the allocation of resources and better play the role of the government.

The Gaoping Shennong Health City project is a new public healthcare (elderly) project using the PPP model to improve the level of public healthcare services in Gaoping. The project is based on the demolition and relocation of the former Municipal Chinese Hospital and Municipal Maternal and Child Health Hospital. It includes two health institutions, the City Chinese Hospital and the City Maternal and Child Health Center and adds special medical functions such as elderly rehabilitation.

The project is designed, invested, financed, constructed and operated by Beijing Baoxin Longma Hospital Management Co Ltd, Shanxi Sijian Group Co., Ltd. and Gaoping Zhongxing Investment Co Ltd, which together form the project company (spv).

Faced with a brand-new project operation mode, all the management personnel of Gaoping Shennong Health City project did not slacken off in the slightest. Under the guidance and organisation of the group company, the whole team studied the content and essence of the PPP model, as well as

the key points to focus on in future project management.

At the beginning of the project, the group company and the project department set the quality target of the “Luban Award”, and insisted on the company’s spirit of sound system, advanced planning, technology leading, green construction, process control and once-over excellence, and prepared the preliminary planning scientifically and effectively.

### 3. Responsibility Actions

Shanxi Sijian Group Co., Ltd. is a large state-owned construction industry enterprise in Shanxi Province. It was founded in November 1995. With a registered capital of RMB 1 billion and an annual turnover of over RMB 12 billion, the Group’s projects are located in 25 provinces (municipalities directly under the Central Government) and 10 countries in 3 continents, including Asia, Africa and South America, and is the first unit in the field of engineering construction to be awarded the “Fengshui Cup”, “Shanxi Quality Award”, “Luban Award” by the Government of Shanxi Province.

The project of Gaoping Shennong Health City was identified as a “Luban Award” project by Shanxi Sijian Group Co., Ltd. The company organized the entire staff to prepare corresponding measures in terms of technology and quality before the start of the work.



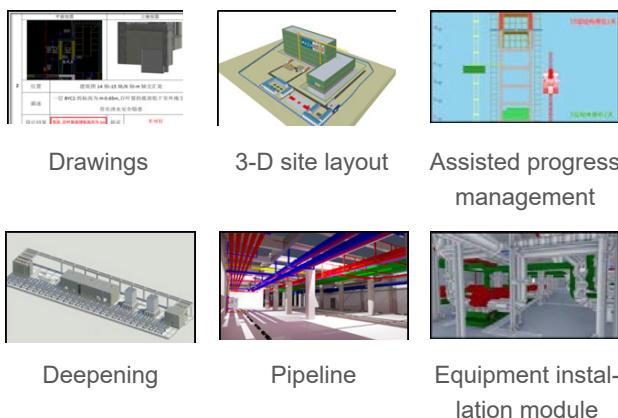
Gaoping Traditional Chinese Medicine Hospital

#### (1) Strengthen the technical management of construction

Focus on the front management of planning work. Optimize the site layout and process system in advance, adopt the four new technologies with stable performance and economic applicability, and strictly implement the quality management responsibility system to provide guarantee for project excellence.

Strictly implement the work concept of “plan first”. Prepare practical “Construction Organisation Design” and “Special Construction Program”, amend them in time during construction, and conduct detailed handouts for sub-projects to ensure accurate communication of construction technology.

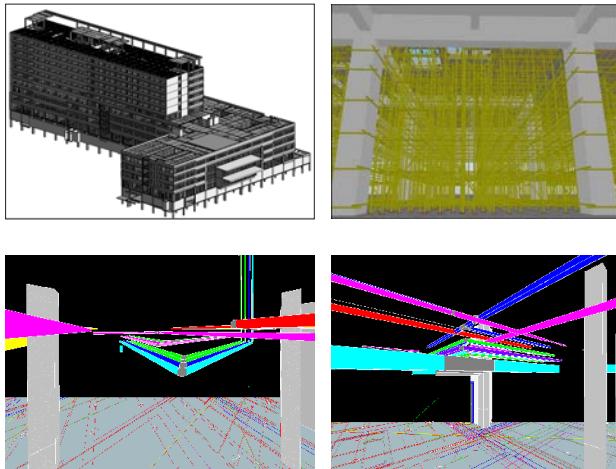
Actively promote the scope of application of virtual simulation technology. Establish BIM information models of various professions to provide participants with a fast, convenient and novel way to read and review drawings and to achieve prior control of technical management.



#### (2) Deepening the application of BIM technology

The project has a large volume, involves many professions, has intertwined pipelines, several subcontracting units, and a scattered work surface. These characteristics bring certain difficulties to construction technology and management and put forward higher requirements for the management of the project, making it difficult to guarantee construction quality. As the general contractor of the

Shennong Health City project in Gaoping City, we proposed to apply BIM technology to model establishment, secondary deepening, visualization, prefabrication, precision and informationization to achieve higher speed of information transfer, better collaboration of all parties and improved project management efficiency.



### (3) Strengthening construction quality management

Establish a three-tier quality management system with the participation of all staff and linkage between the top and bottom. Clarify the responsibilities of quality management, actively carry out comprehensive quality management activities, and tackle key technologies and construction difficulties.

Implement professional modular management. The corresponding division of work for each profession is reasonably defined, and the professional foreman is responsible for each work area, so as to create an atmosphere of “creating excellence” and mobilize the subjective initiative of all parties to create excellence in multiple directions.

Strictly implement the “three inspection system”, “sample guiding system” and “sign-raising acceptance system”. After the sample of the sub-project has been approved by all parties, it will be used as the quality standard for large area construction.

The project has been praised as “a model of med-



ical technology sharing, intelligent medical care, special services and green building”. The project has won 34 awards, such as Excellent Design and Fenshui Cup, etc. Ever since it has been in use, the structure has been safe and reliable, the system has operated normally, the average daily attendance is 2000, the economic and social benefits are very significant, and the community is very satisfied!

## 4. Effect of Responsibility Fulfillment

In August 2020, Shennong Health City in Gaoping City, built by the general contract of Shanxi Sijian Group Co., Ltd., was officially put into use. It has won 35 awards, such as Shanxi Excellent Design, 2-star Green Building Design Mark, Shanxi New Technology Application Demonstration Project, Green Construction Demonstration Project, Fenshui Cup and Luban Award.



The hospital has an ideal and comfortable environment, which has greatly improved the local medical and healthcare conditions and has received an average of 2,000 consultations daily, alleviating the current situation that people in the old revolutionary base areas of southeastern Shanxi have difficulty in accessing medical care. The economic and social benefits are very significant and have been well received by the people and patients.

The project has been hailed as “a model of medical technology sharing, intelligent medical care, special services and green building”.

## 5. Future Outlook

The “Luban Award” is the highest quality award in the domestic construction field, which is a quality recognition for the complete construction cycle of the project and also recognition for the development of the enterprise.

On the road of future development, the company will, as always, adhere to the enterprise motto of “Creating credibility with high quality and speed, occupying the market with excellent construction products”, devote itself to “creating a first-class

enterprise group in the domestic engineering construction field”, focus on “becoming an excellent provider of services for the whole life cycle of construction”, and strictly adhere to the principle of “becoming a first-class enterprise group in the domestic engineering construction field”. To be “the best service provider in the whole life cycle of construction”, we will build a solid foundation and compete with each other to serve the society with the best schedule and the best quality. We insist on building every project with the spirit of “craftsmanship” to give back to the society.

## 6. Deposition from Stakeholders

*“The engineering design concept of the Shennong Health City project in Gaoping City ‘inherits historical culture and integrates regional characteristics’, and the architectural shape is ‘simple and natural, regular and atmospheric’, reflecting the practicality, culture, and modernity of the building. The project has been hailed as a ‘model of medical technology sharing, intelligent medical care and characteristic services’.*

*The project has a solid foundation, safe main structure, reliable waterproofing works, excellent decoration, smooth system operation, balanced overall quality and exquisite details.*

*Since the project was delivered for use, the structure is safe and reliable, the system is running normally, the average daily number of consultations is 2,000, the economic and social benefits are very significant, and the community is very satisfied.”*

——Gaoping Shennong Health City Project Construction Unit



## Attachment: Enterprise Related Information



Company name: Shanxi Sijian Group Co., Ltd.  
Company Address: Taiyuan, Shanxi Province  
Company website: <http://www.sxsjjt.com.cn/>

### Company Profile

Long history: Shanxi Sijian Group Co., Ltd. is a large state-owned construction industry enterprise in Shanxi Province, established in October 1950, once known as "Jianba Si" (Ministry of Construction and Industry, eight bureau four companies) in Shanxi. And in November 1995, it was restructured into Shanxi Sijian Group Co., Ltd. (hereinafter referred to as the Group). With a registered capital of RMB 1 billion and an annual turnover of over RMB 12 billion, the Group's projects are located in 25 provinces (municipalities directly under the Central Government) and 10 countries

in 3 continents, including Asia, Africa and South America. It is also the first unit in the field of engineering construction to be awarded "Luban Award", National Excellence Award, "Fengshui Cup" and the "Shanxi Quality Award" by the Government of Shanxi Province.

Complete qualification: After more than 70 years of continuous development, the Group now has the special grade qualification of general contracting for municipal public works and construction engineering ("double special grade" enterprise), grade A engineering design qualification ("double grade A") for municipal industry and construction



industry (construction engineering, human defense engineering), grade B engineering design qualification for environmental engineering, one grade qualification for general contracting for highway engineering, electromechanical engineering and metallurgical engineering, and five grade A engineering design qualifications for mining engineering, water conservancy and hydropower engineering, petrochemical engineering, electric power engineering and communication engineering. unit) and Class B Engineering Design Qualification for Environmental Engineering. There are also three Grade 1 qualifications for general contracting in highway engineering, electromechanical engineering and metallurgical engineering, and five Grade 2 qualifications for general contracting in mining engineering, water conservancy and hydropower engineering, petrochemical engineering, electric power engineering and communication engineering. The company has 13 qualifications of general contracting for railway engineering; 13 qualifications of professional contracting for road pavement engineering, steel structure, building electromechanical installation, foundation, electronics and intelligence, fire protection facilities, building decoration, building curtain wall, ancient building engineering, lifting equipment installation, environmental protection engineering, waterproofing, anti-corrosion and insulation, city and road lighting engineering. It also has the professional grade C qualification in highway industry (road) and other professional qualifications of various kinds, totaling 112 items. The Group also has the qualification of general contracting enterprise for foreign aid projects, the right to operate international expatriate labor services and the right to contract international projects. With obvious advantages in its main business, complete professional categories and superior market access, the Group is a national excellent construction industry enterprise and an excellent backbone construction enterprise in Shanxi Province (Top 10 backbone construction industry enterprises in Shanxi Province).

**Scientific structure:** The Group adheres to the strategy of transformation and development, constantly optimizes its industrial structure and continues to lay out new businesses. It has formed a comprehensive industry chain, life-cycle and group operation model with the main business of construction (housing and municipal construction), consulting (survey, design, consultation and testing), investment (real estate and infrastructure investment), procurement (labor, equipment, materials, steel structure, climbing frame and assembly-type mechanical and electrical) and operation and maintenance (property, security and PPP operation). The Group is the first company in Shanxi Province to have passed the quality, safety and reliability standards, and is the first company to have passed the quality, safety and reliability standards. It is also the first company in Shanxi Province to be certified for quality, environmental and occupational health and safety management systems, and for the integration of information technology and industrialization management systems, and is a pilot unit of the national construction industry for quality management system excellence, and to obtain the AAA-grade quality management system certification and the alliance mark of high quality certification in the field of engineering construction, and is one of the “Top 100 Growing Enterprises in China’s Construction Industry” and “Top 200 Competitive Enterprises in China’s Construction Industry”.

**Abundant talents:** The Group implements the strategy of strengthening the enterprise with talents. Among the existing 3,300 employees, there are 122 doctors and masters; 1,712 managers with intermediate titles and above; 1,358 national registered architects; 135 international and national outstanding project managers, making it the preferred enterprise in Shanxi Province for the employment and training of talents from construction colleges.

**Consistency of excellence:** By March 2022, the Group had created 592 national, ministerial, pro-



vincial and municipal excellent projects: 2 of which won the “Ministry of Construction Quality Model Project”; and 20 of which won the “China Construction Engineering Luban Award” (of which 12 consecutive years from 2010 to 2021). 10 projects won the “National Quality Engineering Award” (including one gold award); 11 projects won the “China Installation Engineering Quality Award (China Installation Star)”. 14 projects won the “China Construction Engineering Decoration Award”; 2 projects won the “China Steel Structure Golden Award”; and 97 projects won the “Fenshui Cup Award for Construction Projects in Shanxi Province”. Among highway projects, 1 project won the “Luban Award of China Construction Engineering” and 18 projects won the Provincial Excellent Project; among municipal projects, 3 projects won the “Fenshui Cup Award of Shanxi Construction Engineering”, and 44 projects won the “Shanxi Province Municipal Golden Cup Model Project”. The total number of “Luban Awards” won by the Group ranks first in Shanxi, and the Group is a national advanced enterprise in engineering quality management and a special honorary enterprise in creating Luban Award projects, and one of the 33 national outstanding contribution units in creating Luban Award projects.

**Leading in Science and Technology:** The Group was recognized as a national intellectual property advantage enterprise, a high-tech enterprise, the first batch of assembly building industry bases in Shanxi Province, awarded the “Enterprise Technology Innovation Award” by the Shanxi Provincial People’s Government, the only construction industry enterprise among 9 enterprises in various industries in the province, recognized by the Shanxi Provincial Science and Technology Department as “Shanxi Province Science and Technology Achievement Transformation Demonstration Enterprise”. It is the only construction-type enterprise among 33 enterprises in various industries in the province, with provincial-level technology center and engineering innovation center. Two

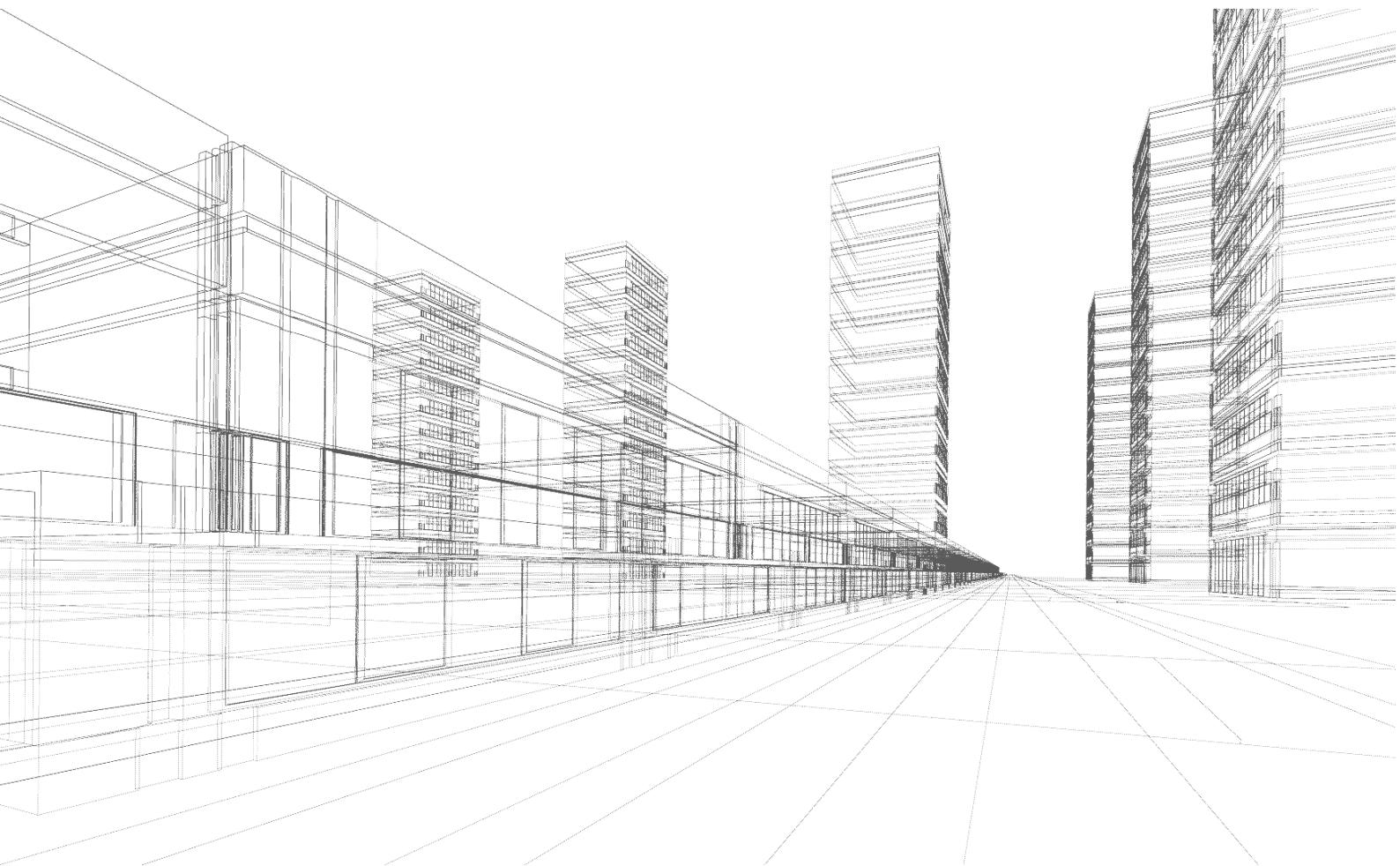
projects, including the main stadium project of Shanxi Sports Center and Chongqing West Station (station building and related works of Chongqing West Station of Chongqing-Guiyang Railway Expansion and Renovation Project), won the “Zhan Tianyou” Civil Engineering Award, and the old city renovation project of Jinsong Road No. 2 and Jin Runyuan project won the “Zhan Tianyou” Award. “Award for Outstanding Residential Area”, and Vanke Langrun Garden Project won the “Zhan Tianyou” Award for Residential Area; Jinsong Road No. 2 Old City Renovation Project, Taiyuan Red Star Macalline Furniture Life Plaza Project, Guangxin-Jinyang Jiayuan Project and Dingxiang County “Six Halls and One Hospital”. The project was awarded the “Green Construction Technology Demonstration Project” by the Ministry of Housing and Construction. The Group has won 19 national science and technology awards, 3 Huaxia Construction Science and Technology Achievement Awards in the field of science in the national construction industry, 9 Shanxi Science and Technology Awards and 45 registrations of construction science and technology achievements in Shanxi Province. The Group has 1012 national authorized patents, including 38 invention patents, 18 design patents and 955 utility model patents; 5 national work methods, 298 provincial and ministerial work methods; 53 standards, including 1 national standard, 1 group standard and 8 local standards, and 43 national standards, industry standards, group standards and local standards. For nine consecutive years, the company was awarded the Science and Technology Award for Advanced Enterprise in Technological Innovation.

**Courageous mission:** The Group is brave enough to assume social responsibility and has completed hundreds of national and provincial key projects such as Taiyuan Jinji Group, Taiyuan Heavy Machinery Group and Fenjiu Factory, making great contributions to national industrialization and modernization. In recent years, the number of workers employed annually has remained at around 30,000.

It has solved a large number of employment problems and created social value. The company has fully implemented the real-name system and shift system for the employment of workers in projects and has done its best for society in ensuring people's livelihood and promoting growth. While the enterprise has achieved significant development, the Group attaches full importance to the growth of its employees and constantly enhances their happiness and sense of achievement. The average income of employees is always at the leading level of local construction industry enterprises in Shanxi, and the overall satisfaction of employees with the enterprise is 98.3%. The Group has been awarded the National Civilized Unit, the National May Day Labor Certificate, the Shanxi Province

Model Unit and the “AAA” Enterprise in Social Credit Evaluation for Engineering and Construction Industry Enterprises.

We will, as always, adhere to the corporate purpose of “creating credibility with high quality and speed, and occupying the market with high-quality construction products”, devote ourselves to “creating a first-class enterprise group in the field of domestic engineering construction”, and strive to become “an excellent provider of services for the whole life cycle of construction”, build a solid foundation, and compete for the top, willing to serve the society wholeheartedly with the best schedule and the best quality.





## Corporate Culture

### Corporate Vision

To build a first-class enterprise group in the field of engineering and construction in China, and to become an outstanding provider of services for the whole life cycle of construction.

### Corporate Mission

To build with heart, to achieve the future.

### Corporate Style

Honesty, truthfulness, unity, and hard work.

### Corporate philosophy

one standard, two representatives, three spirits, four personalities, five consensus and “twenty words policy”.

One standard

all the projects of Shanxi Sijian are implementing the same standard (strict implementation of the “Shanxi Sijian Group Enterprise Management Manual”).

Two representatives

the highest level of project management of Shanxi Sijian should represent the highest level of the construction market in the construction area where the project is located; the lowest level of project management of Shanxi Sijian should represent the advanced level of the construction market in the construction area where the project is located.

Three spirits

the spirit of dedication, innovation and team spirit should be reflected in the four-construction people.

Four Construction Personalities

integrity, courage, passion, and excellence.

Five points of consensus

1. To establish oneself with sincerity and to seek business with faith

Be sincere and honest and be consistent in word and deed; keep your promises and be true to your word; prohibit the use of empty cheques that cannot be cashed to cope with partners and overdraw personal and corporate credibility.

Put an end to false data; with falsification comes new falsification, and the more one tries to cover up problems the more they are exposed.

Five points of  
consensus



Insist on problem orientation and criticism of reporting good news but not bad; what Four Construction needs is people who dare to face problems head-on and solve them, not people who just talk without doing.

Selling the interests of the company is selling your soul; the interests of the company and your soul are always packed together.

2. Truthfulness and open communication

Do not evaluate what you do not understand and do not disseminate unverified words.

Communicate directly with the person concerned or report to a superior if you have an opinion or suggestion

If you feel that a superior is wrong, tell the person directly.

Be genuinely grateful to a colleague who communicates openly with you when you hear a word of advice.

3. Boldly take charge and act diligently

In the face of difficulties dare to rise to the occasion, in the face of crisis dare to come forward, in the face of mistakes dare to take responsibility, with action to inspire enthusiasm, with performance to return the enterprise.

Only leave more money, debts and better influence and reputation of the unit to the successor, and never leave the difficult, potential loss and weak organization to the successor.

The blue is out of the blue, slow progress is backward, to exceed the performance of the predecessor as a matter of pride, to consume the accumulation of the predecessor as a matter of shame.

Never shift conflicts upwards, let alone push difficulties to the grassroots.

4. Dedication and diligence, eliminating slackness

Eliminate the philosophical, fear of offending people.

Be cautious and respectful of the end, do things in a closed loop; everything has to be done, everything has a reply; eliminate people who shirk their responsibilities and do not look for their own reasons when they encounter problems.

### Five points of consensus

-----> Eliminate people who only complain about the process has problems, do not start from me to improve the process.

Eliminate people who do not think about learning and progress, do not dare to accept new challenges, are not willing to leave their comfort zone, do not take the initiative to improve business capabilities.

### 5. Customer first, performance speaks for itself

Putting the customer first and winning the trust and respect of the customer is the greatest job performance.

Getting the job done is the best way to gain recognition from leaders. A minute of customer service is better than ten minutes of fawning over leaders.

If your voice is not being heard, look back at your performance and contribution.

Working hard and creating results is the best way for individuals to gain opportunities

### Four guidelines

-----> strong awareness of rules, strict system implementation; low cost to create excellence, high quality development.

## Employee Data

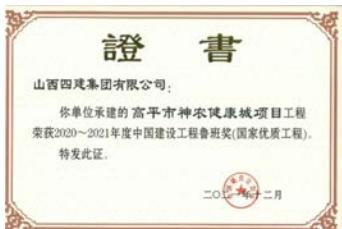
By the end of May 2022, Shanxi Sijian Group Co., Ltd. had 3,082 registered employees on duty, including 2,205 male employees, 877 female employees. The number of female employees in middle and senior management was 32.



## Major honors in the Past Three Years



2021 December China Shanxi Sijian Group Jinzhong City Museum (Archives), Library, Science and Technology Museum Construction Project - Museum (Archives). The project won the Luban Award for China Construction Engineering 2020-2021 (National Quality Project)



In December 2021, Shanxi Sijian Group's Shennong Health City Project in Gaoping City won the Luban Award for China Construction Engineering 2020-2021 (China Quality Project)



In December 2021, Shanxi Sijian Group won the National Quality Engineering Award for 2020-2021 for the Business Building B of Shanxi International Financial Center



In December 2021, the 6# Business Building in Block C of Shanxi International Financial Center constructed by Shanxi Sijian Group won the National Quality Engineering Award for 2020-2021



In December 2019, China Shanxi Sijian Group's Chongqing West Station project won the 17th China Civil Engineering Zhan Tianyou Award



In November 2021, Shanxi Sijian Group's Jin Runyuan project won the Gold Award of the 2021 China Civil Engineering Zhan Tianyou Award for Outstanding Residential Community

# Play a Good Safety Production “Foundation Bottom”, and Strictly Guard the “Lifeline” of Engineering Projects

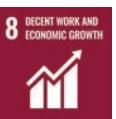
◇ China Nonferrous Metal Industry's Foreign Engineering and Construction Co., Ltd

## // Introduction

During the construction of the Aktogai Project, a world-class copper ore processing plant, China Nonferrous Metal Industry's Foreign Engineering and Construction Co., Ltd. has set a clear production safety target of “zero injury and zero accident”, adhered to the management method of “clear standards and strict implementation”, adopted the assessment method of “strict assessment and grasp the key”, and strengthened the control measures of “prevention in advance and timely response” to effectively ensure the safe operation of the project. Meanwhile, it has actively fulfilled its overseas social responsibility by providing a large number of jobs, driving local employment, stimulating local economic and social development and promoting the improvement of people's livelihood.



## SDGs

 Goal No. 5	<p>Great importance is attached to the protection of female workers, and the ratio of men to women on site has reached about 5:1. About 600 female workers are provided with on-site management, translation and logistic support.</p>	 Goal No. 8	<p>Provide a large number of employment opportunities and a safe working environment to stimulate local economic and social development.</p>
 Goal No. 17	<p>Work with the world's top safety consulting company, SNC-Lavalin, to provide special safety training to all project staff and achieve safety goals together.</p>		

## CSR

 Fundamental Responsibility	<p>Adhering to the goal of “zero injury and accident”, we vigorously carry out safety education and training, strengthen safety management, pay close attention to safety performance, enhance risk control and take multiple measures to ensure safe production.</p>	 Human Rights	<p>Adhering to the safety management guideline of “respect for life and safety”, we protect employees’ right of life.</p>
 Labor Practices	<p>Provide equal employment opportunities and labor protection for women; strengthen safety training and management and guarantee occupational health and safety.</p>	 Community Participation and Development	<p>Actively participate in the construction of overseas communities, provide employment opportunities, absorb labor force employment and drive local economic and social development and livelihood improvement.</p>

## 1. Case Overview

The Aktogai Project is a world-class copper processing plant construction project located in the south of East Kazakhstan Oblast, approximately 500 kilometers southeast of the capital Astana. The project comprises a 25 million ton per annum sulfide ore processing plant and a 12 million ton per annum oxide ore processing plant, with a total construction investment of US\$2.1 billion and a mine life of over 50 years. It is also equipped with some of the world's best large-scale ore processing equipment, including a gyratory crusher (capacity 4186t/h), a gearless semi-autogenous mill (capacity 3412t/h) and a gearless ball mill (capacity 1706t/h).

The owner of the project, Kazakhstan Copper Group, is an international mining company listed on the London and Hong Kong stock exchanges, and the largest copper producer in Kazakhstan. It is mainly engaged in the business of mining, processing, smelting, refining and sales of copper products, and owns a number of mines and copper smelters in Kazakhstan.

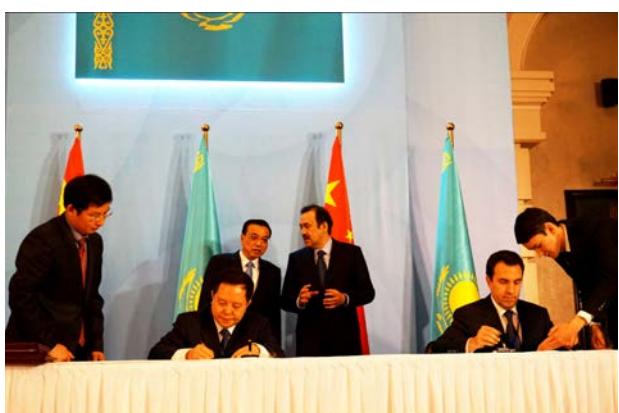
On December 14th, 2014, the Aktogai project was officially launched under the joint meeting and signing of Premier Li Keqiang and the then Prime Minister of Kazakhstan, Mr. Masimov. On March 3rd, 2017, the commissioning ceremony of the Aktogai project was held, marking the official completion of the Aktogai integrated mining and processing project and its commercial operation.



Panoramic view of the Aktogai copper ore processing plant

## 2. Case Background

In 2013, China put forward the cooperation initiative of building the “New Silk Road Economic Belt” and “21st Century Maritime Silk Road” to promote the development of Chinese enterprises in the world economic arena. As the earliest enterprise to go global, NFC insists on practicing social responsibility, not only bringing domestic advanced equipment and technology out of China, but also directly providing thousands of employment opportunities, at the same time, boosting the development of local economy, effectively solving the surplus local labor force and improving the living conditions of local residents. The Aktogai project is one of the landmark projects under the framework of China-Kazakhstan capacity cooperation, and is a demonstration project for the docking of China's “Belt and Road” initiative and Kazakhstan's “Bright Road” new economic policy. The Aktogai Copper Project has been hailed as a model project for China-Kazakhstan capacity cooperation. It now ranks first in Kazakhstan and seventh in the world in terms of ore processing capacity after its commissioning. The project has adopted a large number of advanced technologies, including artificial intelligence, and employs over 3,000 people, playing an important role in driving local economic and social development. President



In the presence of Premier Li Keqiang and Kazakhstan Prime Minister Masimov, NFC signed an engineering contract with Kazakh Copper for the 25 million ton per annum copper processing plant in Aktogai

Tokaev described the project as a valuable gift to Kazakhstan's 30th anniversary of independence, in line with the country's industrialization route development goals. The Aktogai project brings China's surplus production capacity into Kazakhstan, truly achieving "mutual benefit and win-win" and "production capacity cooperation". The project is a practical response to and a serious practice of the "Belt and Road" concept.

### 3. Responsibility Actions

#### (1) Clarify safety goals

"Zero injury, zero accident" has always been the goal of safety management of NFC. The Aktogai Project Department insists on adopting the European standardized management model. In order to further enhance the awareness and skills of safety management, SNC-LAVALIN, the world's top safety consulting company, was hired at the beginning of the project department to conduct 32 sessions of special safety training for 1,797 persons /times, covering 17 subjects such as responsibilities and norms, safety protection and behavioral norms, construction site risk identification, crane work, fire work, limited space work, work at height, use of work apparatus, PPE use norms, etc. During the training, the trainer combined theory and practice, and carried out practical operations on site for crane work and fire work, correcting the non-conforming operations and pointing out the hazards of wrong operations in a timely manner. The Aktogay Project Department strictly abides by the provisions of occupational health and safety in Kazakhstan, and specifically recruits local lawyers to identify the laws, rules, regulations and standards related to labor safety in the country, and to formulate detailed and highly operational occupational health and safety management regulations in conjunction with the specific reality of the construction site and living area, so that all acts of the project can be followed by rules and violations can be investigated.

"Respecting life and safety" is the guideline of safety management of NFC. The Aktogai Project Department has carried out regular safety education and training, providing 5,000 person's safety training to project management staff, general work personnel and special work personnel, including foreign affairs knowledge, general knowledge of Kazakhstan, general and special professional safety knowledge, and site regulations.



Lectures by SNC-LAVALIN

#### (2) Enhanced safety management

"Clear standards and strict enforcement" is an important tool in the management of safety at NFC. In order to eliminate the occurrence of dangerous situations such as accidents, injuries and illnesses, and to help protect the environment, the Aktogay Project Department requires that every task must be carried out in accordance with the provisions of the Total Safety Task Instructions (TSTI). No task may commence without a TSTI and operations must be halted when a situation arises that is not covered by the TSTI. The project department conducts a JHA analysis of all operations. Before construction, the project organizes a JHA analysis of the construction project by professional engineers, area managers, construction team leaders and HSE department engineers, formulates detailed safety measures, and provides training and briefing to safety operators before construction. All responsible persons have the right to stop and punish any irregularities found during site inspections. The project department hopes to maximize the safety

awareness of all staff through teamwork. In terms of management methods, the company has given more specific safety management responsibilities and powers to different roles such as the construction manager, HSE manager, safety management specialist and task implementation staff, so as to truly achieve full participation and responsibility of all staff.



Vertical crushers installed with strict precision

#### (3) Focus on safety performance

“Strict assessment and grasp the key” is an important way to verify the safety performance of NFC. The project department insists on adopting the KPI (Key Performance Indicator) method to manage the HSE work every month. The project department conducts assessment and requirements for several key indicators, from the frequency of entry of project department heads and department managers, training, fluke incidents, hidden danger rectification, analysis of “three violations”, pre-shift physical examination and other key indicators, and strictly grasps the key indicators. The key indicators are strictly controlled. Operators go to the infirmary for a medical check-up before each shift, and attend the pre-shift meeting for safety warning education and briefing after their physical condition meets the conditions for starting work before they are allowed to work; each operation must have a safe work permit (PTW) beforehand, and the application is submitted by each regional

foreman according to the construction arrangement on the basis of a full assessment of the operational risks and safety measures to be taken, and the professional engineer of the project department and the owner’s engineer on The HSE Department is responsible for filing the work permits, inspecting the work permits according to their contents during site inspections, stopping work immediately for rectification if inconsistent with the work permits or violating the requirements, and punishing the regional foremen and responsible persons, so that the HSE management of the project site is always under control. Implementing toolbox meeting management, the daily pre-shift team leader organized a toolbox meeting and conducted a total of over 6,000 toolbox meetings to explain safety precautions to construction personnel while laying out construction tasks.



Precise positioning of pre-embedded bolts



Ball mill inspection for radial runout

#### (4) Strengthen risk management

“Prevention in advance and timely response” is an important part of the safety management of NFC. The project department dynamically identifies

risks, analyses and evaluates possible hazardous events and formulates countermeasures. The necessary safety working groups are set up according to the internal/external environment of the site to deal with future hazards. An Incident Management Team (IMT) is set up to respond to public emergencies; an On-Site Response Team (ORT) is set up to respond to safety incidents on site; an Incident Command Center (ICC) is set up to provide unified command of safety incidents by radio; and a medical support team is set up, including trained medical staff and ambulances.

#### **4. Effect of Responsibility Fulfillment4. Effect of Responsibility Fulfillment**

The Aktogay Project is the third largest copper beneficiation project in the world and the first in Asia contracted by NFC under the EPC model. With an annual processing capacity of 25 to 30 million tons of ore, the sulfide ore processing plant of the Aktogay project is a world-class project and is currently one of the largest mining projects in Kazakhstan. The equipment level of the project is world advanced. All three mills in the grinding plant adopt ABB's advanced gearless mill drive system, which is the largest semi-autogenous mill and ball mill in the world. The construction is difficult and highly accurate, and the construction procedures are complex.

The Aktogay project is a very large industrial building construction type, the project site is highly intensive, with Chinese and Kazakh operators working interspersed, with high level work throughout, up to over 50 meters, and mostly steel structure installation. In order to effectively reduce or eliminate high-risk accidents, the project department and each construction manager signed a special safety responsibility letter, and all workers are implemented at the construction site safety technical briefing: including high altitude life ropes, five-point safety belts, fall arresters,

scaffolding, suspension frames, aerial lift trucks, hanging baskets of intensive training and education, so that they can master the use of these safety and protective equipment. All safety and protective equipment is checked and labelled weekly by the HSE Department before use. Daily morning shift meetings are held to focus on pronouncing and warning about the tendency to violate rules and regulations at work. The whole site is inspected and violations are immediately dealt with and publicized. By the end of the project, the number of safe working hours for the completion of the workforce withdrawal reached 12,745,895, setting a record for both corporations.

The number of construction workers on site during the peak construction period of the Aktogay project reached 5,000, which set the record of construction workers for a single project in Kazakhstan. It also accumulated valuable experience for organizing the construction organization of large and complex projects in Kazakhstan, created 2,000 local jobs, effectively relieved the employment pressure in East Kazakhstan and Almaty Oblast, drove more than 50 local enterprises from upstream and downstream to participate in the construction, and brought tangible economic benefits to Kazakh enterprises. The project department also attaches great importance to the protection of female workers, and the ratio of men to women on site has reached about 5:1, providing site management, translation and logistical support for about 600 female workers.

After 2 years of intense construction, the Aktogay project successfully passed the Kazakhstan state acceptance and was officially put into production. The then former President of Kazakhstan, Nazarbayev, attended the commissioning ceremony by video link, and the Chinese Consul General in Almaty, the President of Kazakhstan Copper Company, the owner of the Aktogay copper processing plant project, the General Manager of the general contractor of the project, NFC, and the



government officers of East Kazakhstan Oblast attended the completion ceremony.

## 5. Future Outlook

The accelerated industrial development in Kazakhstan has brought unlimited opportunities to the enterprises going abroad under China's "Belt and Road" initiative. In recent years, with advanced technology, first-class quality, amazing speed and excellent service, NFC has successfully completed a number of projects, including the Kazakh electrolytic aluminum plant, the Bashaku copper processing plant project, the petroleum coke project of the third petrochemical plant in Kazakhstan, the delayed coking project, the sulfide project, the VCM shaft project, the semi-coke project and a large number of far-reaching engineering contracting projects. It has won the praise of the owners and the industry, established long-term strategic partnership with famous enterprises such as HALCO, HACCP, HOCCO and Eurasian Resources, and played a positive role in promoting the development of projects in Kazakhstan and the

surrounding areas in Central Asia. The company has always paid close attention to the changes in the international market and kept pace with its strategic partners. With the steady development of the company and closer cooperation with various parties, the company will be involved in the development and implementation of more projects in the future.

NFC has also successively passed the "ISO45001" occupational health and safety management system certification and carried out the HSE two-party audit certification, and has repeatedly achieved the best performance in safety. The company will always adhere to the principle of "people-oriented, life first", insist on placing equal importance on safe production and providing quality services, continuously improve the safety management system, strengthen the level of on-site safety management, create a corporate safety culture, enhance the safety quality of all staff, and provide a solid guarantee for the company to continuously provide better project quality.

## 6. Deposition from Stakeholders

*"The cooperation with the Chinese partner has proved to be successful and fruitful, and for this I thank the general contractor of the project, NFC."*

——Novachuk, Chairman of Kazakhstan Copper Company, owner of the Aktogay copper processing plant project

*"This is one of the largest investment projects implemented in Kazakhstan in recent years and a landmark project in the framework of China-Kazakhstan capacity cooperation. Its completion and commissioning will give a great boost to Kazakhstan's industrial process and economic development and is a demonstration project of the successful docking of the 'Belt and Road' initiative with Kazakhstan's 'Bright Road' new economic policy, and another manifestation of the success of mutually beneficial cooperation."*

——Zhang Wei, Chinese Consul General in Almaty

*"The Aktogay project is in line with the development goals of the country's industrialization route and is a valuable gift to the 30th anniversary of Kazakhstan's independence."*

——President of Kazakhstan Tokaev

## Attachment: Enterprise Related Information



Company Name: China Nonferrous Metal Industry's Foreign Engineering and Construction Co., Ltd.

Company Address: Chaoyang District, Beijing

Company website: <http://www.nfc.com.cn/>

### Company Profile

China Nonferrous Metal Industry's Foreign Engineering and Construction Co., Ltd. (abbreviated as NFC) was established in 1983 with the approval of the State Council and was listed on the Shenzhen Stock Exchange (stock code: 000758) on April 16, 1997, after a restructuring of its assets to divest high-quality assets. It is owned by its controlling parent company, China Nonferrous Mining Group Limited, a large central Chinese enterprise.

As one of the earliest enterprises to go global in China, it is mainly engaged in international engineering contracting and non-ferrous metal mining resources development, and its business scope covers non-ferrous metal mineral resources exploration, development, smelting and investment, international engineering contracting, non-ferrous metal industry design and R&D, metallurgical industry equipment manufacturing, non-ferrous metal trade and other fields. It covers the whole

process of non-ferrous metal industry. Its business covers more than 20 countries and regions, with 30 holding (participating) enterprises and nearly 20,000 employees worldwide.

In recent years, it has seized the strategic opportunity of the national “Belt and Road” initiative and international production capacity cooperation to actively promote overseas engineering contracting, resource development and non-ferrous metal technical and economic cooperation business, covering more than 50 countries and investing or constructing projects in more than 20 countries and regions along the “Belt and Road”. It has invested in or constructed a number of internationally influential non-ferrous metal industrial projects in more than 20 countries and regions along the “Belt and Road”. “NFC” has become a well-known brand in the international non-ferrous metal industry with high reputation.





## Corporate Culture

### Corporate vision

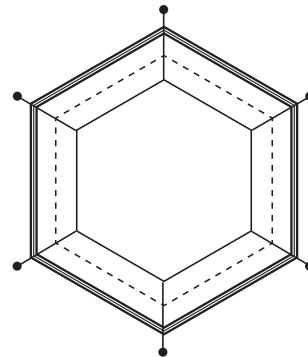
To become an internationally influential engineering contractor and a renowned mining company in the international non-ferrous metals industry

### Core values

Quality-oriented, customer first; rewarding hard work, self-improvement; people make the best use of their talents, happy work

### Enterprise development philosophy

sincere cooperation, honesty and trustworthiness; mutual understanding and trust; mutual benefit and win-win cooperation.



### Social responsibility concept

sustainable development, environmental protection, and social harmony

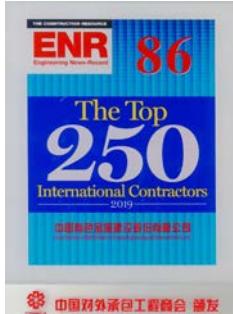
### Quality philosophy

lifelong responsibility for the project, let the owner always satisfied

### Safety and environmental protection concept

prevent pollution, save energy and reduce consumption, eliminate hidden dangers and care for life

## Major honors in the Past Three Years



One of the world's top 250 international engineering contractors for 2019



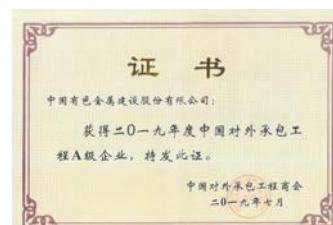
Outstanding Contribution to International Infrastructure Investment and Construction



Safe and advanced mines in Mongolia



First Prize of Science and Technology of China Demolition Industry Association



2019 China Foreign Contracting Engineering Grade A Enterprise



Advanced Safety Enterprise in Sukhbaatar Province

## Employee Data

There are 489 employees in NFC, of whom 361 are male and 128 are female, with a male to female ratio of 2.8:1. There is a total of 122 middle and senior management staff, 23 of whom are female, accounting for 18.85% of the middle and senior management staff.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets (RMB)	Billion	25.298	22.096	18.993
Gearing Ratio	%	65.85	59.30	55.48



# Innovation-Driven Development, Safety Production Data First

◇ China Huashi Enterprises Co., Ltd.

## Introduction

China Huashi Enterprise Co., Ltd. upholds the concept of “People First, Life First”, adheres to the innovation drive, gives full play to the role of the leading goose and the spirit of pioneering, and actively promotes the transformation of safety production to digital intelligence to escort the safety production.



## SDGs



Goal  
No. 9

Actively promote the transformation of safety production into “digital intelligence”, continuously improve the safety management system, innovate safety management means, and use innovation to escort safety production.

## CSR



Fundamental  
Responsibility

Attach importance to safety production, adhere to innovative development, and use innovative means to empower safety production; establish enterprise intelligent construction-related technology and data standards, actively participate in industry-related standards, and help industry safety production “digital intelligence” transformation.



Human Rights

Always adhere to the concept of people first and life first to protect the lives of employees.

## 1. Case Overview

The construction industry is a supporting industry for the national economy and a high-risk industry with frequent safety accidents. Safety production in construction industry enterprises is related to the lives of the masses, the reputation of enterprises and social stability, and is the social responsibility that construction industry enterprises must undertake. It is also the core indicator for measuring the long-term development of enterprises. In order to conscientiously implement Xi Jinping's key statements and instructions on production safety, and always adhere to the concept of people first and life first, China Huashi, as an important enterprise in the reform of state-owned enterprises in Sichuan, has actively changed its development ideology, played the role of the leading goose and the spirit of pioneering, actively explored the integration mode of information technology and engineering construction management, independently developed and built China Huashi intelligent construction management system, and innovated a feasible path to transform the safety production of construction industry enterprises into digital intelligence.

## 2. Case Background

Since the 19th CPC National Congress, the supporting role of the construction industry in the national economy has been further strengthened, with the total construction output value increasing from RMB 21.4 trillion to RMB 29.3 trillion and the value added of the construction industry increasing from 6.7% to 7.2% of GDP. The total construction output value in Sichuan increased from RMB 1.19 trillion to RMB 1.73 trillion, and the value added of the construction industry increased from 7.6 to 8.7% of GDP. Along with the rapid development of the construction industry, industry safety issues have also become more and more prominent. Statistics on the number of production safety accidents and fatalities in housing and municipal

projects nationwide in recent years show that (as shown below), the frequency of safety accidents tends to oscillate upwards, with the number of fatalities in production safety accidents exceeding 700 each year, which has a huge adverse impact on the safety of people's lives and property and the development of construction industry enterprises.



National Statistics on Production Safety Accidents and Fatalities in Housing and Municipal Construction

Constrained by objective circumstances such as the high complexity of engineering projects, long construction cycles, the number of units and people involved, and the dependence and influence on the environment, it is difficult to keep project safety in a stable and constant state. Safety management cannot be achieved once and for all by system construction alone but should focus on continuous improvement of safety management systems and innovative safety management tools, combining safety concepts with systems, enhancing the safety awareness and skills of all staff and improving the essential safety management level of enterprises.

In the context of the industry's old sloppy management and business expansion, the Central Party Committee, the State Council, and industry regulators are paying more and more attention to safety production, and the requirements for safety management of construction industry enterprises are becoming more and more refined. In particular, the requirements for the safety of individual practitioners are becoming higher and higher, which resonates with the current problems of "labor

shortage” and “labor difficulties” of construction workers, so there is an urgent need to address the common industrial issues of innovative development ideas and concepts.

### 3. Responsibility Actions

Refined safety process control requires a large amount of information resources. In order to achieve the collection, identification and sharing of production safety information, to strengthen the safety warning and emergency response mechanism, and to ensure that information resources are authentic, reliable, timely and effective, it is necessary to innovate the development concept and optimize the means of control. Huashi has developed “three clouds” (Huashi Good Construction Cloud, Tianfu Sunshine Cloud and Sichuan Construction Cloud) and “two knives” (supply chain platform and smart site platform) to focus on the whole life cycle of construction, targeting “human, machine, material, law and environment”, in order to realize the “Digital twin” and the new generation of information such as Internet, Internet of Things, cloud computing, artificial intelligence and BIM, etc. to empower the whole process of construction safety management.

Through the integration and application of various information technologies, and working together under a unified organizational framework, standard system and platform, each construction project can achieve closed-loop management of the whole construction process through comprehensive perception, intelligent analysis, accurate prediction, real-time warning and in-depth feedback, improve the safety efficiency of supervision at four levels: headquarters, secondary units, branch (sub) companies and projects, and promote the flow of key construction safety information. It also promotes the efficient flow of key construction safety information and enhances the efficient and intelligent application of multi-source data information.

(1) Innovative construction concepts and information tech-

nology to optimize the control system

The core of the safety control system is to ensure that “people, material, environment and management” safety is always under control. Therefore, project management needs should always be taken as the core, and information technology should be used as a tool, to avoid imposing safety management responsibilities on tools, or to seek new and detached from reality. To ensure the effective application of information technology in safety production, Huashi has carried out the transformation and upgrading of digital intelligence in four steps according to the development of information technology. The first step is to select mature IOT collection means through full research; the second is to combine the enterprise’s own safety control needs and structure the control indicators; the third is to develop supporting software products independently according to the safety management needs at different levels; the fourth is to make information technology tools become the basic production materials for employees through software operation training and supporting management system.



Using information technology to raise awareness of safety and quality among all staff

(2) Innovative technology integration, multi-source fusion to sense the state of the field

Building construction safety management is complex and information-intensive. Stakeholders, the

building itself, technology, the natural environment, the state of the elements, knowledge management and other factors all affect the effectiveness of management. Under the overall planning and deployment of the top management, each construction project uses various types of IOT sensor devices and automatic data collection terminals on site, supplemented by a small amount of management information filling, to achieve a digital simulation of multiple elements including “people, machines, materials, methods and environment”. It forms a multi-faceted fusion data platform to describe the safety situation on site, meets the data base needs of safety management for overall safety situational awareness and risk control.

For hardware equipment such as face recognition, surveillance cameras, gates, sensors, and black boxes, Huashi has independently compiled the “Hardware Equipment and Installation Requirements” and “Hardware Equipment Access Operation Guide” for smart construction sites, unifying the requirements for equipment selection, layout, installation and dismantling, operation and maintenance, and establishing a pool of quality smart construction hardware suppliers. They have independently developed or optimized dozens of sensors such as electronic tags, sensors, cameras, infrared sensors, etc., making the transmission of safety management data more timely and providing reliable hardware support for the construction of intelligent construction IOT system.

### (3) Ensure safety through innovation and actively explore intelligent management models

The China Huashi Smart Site Management System incorporates safety management functions such as real-time site monitoring, real-name personnel management, environmental risk monitoring, intelligent remote inspection, crane safety monitoring, safety education and training, dangerous and large project management, and emergency command and dispatch. It also covers the intelligent safety

management mode of prognosis, design, monitoring, analysis, evaluation, and emergency disposal. The system can also better assist frontline production managers and improve the efficiency of enterprise safety management.

The smart helmet monitors the location and video information of personnel in high-risk work areas to reduce unsafe human behavior; the personnel real name module enables early warning of problems such as personal information and employment records to reduce employment risks. Using intelligent AI inspection, construction sites can carry out construction site safety monitoring, risk event identification and alarming, and regulate safety behavior. Through regular aerial inspection by drones, scenes that are difficult and dangerous to inspect manually can also be better inspected for safety. By installing edge computing cameras with built-in algorithms in front of the tower crane jib, the occurrence of safety accidents in tower crane operations is reduced.



Management of personnel by name



Management AI Safety Patrol of personnel by name



Drone safety checks



Drone safety checks

Smart Site System Safety Management Function Display

### (4) Innovative regulatory models and shared safety control data

As the informationization of engineering construction has gradually stepped into the stage of standardization, diversification, integration and nor-

malization, government supervisory departments need to rely on the construction site IOT system to collect and master the site dynamics, forming a closed-loop supervisory process of “dynamic supervision, real-time warning, online disposal and credit evaluation”. Huashi takes the initiative to collect and upload the data information required for safety supervision and unifies the planning to open the interconnection channel of project data, avoiding the problem of cross-level data compatibility and cross-business data silos, maximizing the use of information resources, realizing the linkage between government and enterprises, and promoting substantial improvement in construction safety management.

#### 4. Effect of Responsibility Fulfillment

The “14th Five-Year Plan” period is a critical period for China to move forward from the completion of a well-off society to the basic realization of socialist modernization. Under the current situation, safety innovation in the construction industry is inevitably required to introduce digitalization and intelligence. Through real-time management, remote management, intelligent management and other refinement management means, Huashi has carried out digital and intelligent transformation of safety management and management mode innovation to further raise awareness of safety production, firmly establish the concept of safety development, broaden the scope of management, and effectively reduce costs and increase efficiency.

Through the self-developed Smart Construction Site System, construction workers' self-safety management and corporate safety management are integrated, and a data center to meet the multi-level safety management needs of construction industry enterprises is established. The Smart Construction Management System went live at the end of 2021 and has completed access to safety supervision information for over 400 projects

under construction, integrating over 3,000 units of various sensor devices at construction sites and over 88,000 people under supervision, realizing multi-dimensional safety data sharing for enterprise internal control, government supervision and public disclosure.

Huashi has also successfully opened up the interconnection channel of data from government and enterprise platforms, fostering a new type of data-driven enterprise capability. Through the application of the digital platform, digital technology tools are better used to link the whole process data of construction projects, unify the safety and quality supervision system of construction projects and form standardized construction business processes. In the Sichuan Province 2021 “Production Safety Month” event hosted by Huashi, they demonstrated the practical application of various information technologies in production safety management; and established enterprise smart construction-related technology and data standards, actively participating in the preparation of the “Sichuan Province Smart Site Data Sharing Standard”. The industry standard such as the “Smart Site Data Sharing Standard in Sichuan Province” and “Smart Site Construction Technical Standard in Sichuan Province”, forming a model system that can be replicated and promoted. Through industry exchanges and technology disclosure, we have endeavored to help



2021 Sichuan Province “production safety month” building construction emergency drill and safety and quality standardization observation meeting



the whole industry to carry out the transformation of safety production digital intelligence. The achievement has been selected as one of the “List of Replicable Experiences and Practices for Collaborative Development of Smart Construction and New Construction Industrialization (First Batch)” by the Ministry of Housing and Construction, fully demonstrating China Huashi’s commitment and role in fulfilling its social responsibility.

## 5. Future Outlook

The completion of China Huashi’s intelligent construction management system has enabled the interconnection of project site management and enterprise management, thus achieving innovation in the site construction safety management model.

In the future, Huashi will continue to strengthen its investment in the industrialization, digitalization

and intelligent transformation and upgrading of the enterprise. Through deep learning algorithms, we will strengthen the safety management tools on site and improve the efficiency of supervision. Through continuous optimization of the safety management system, the cost of construction management will be reduced and the scope of management widened. Using increasingly rich information technology tools to make safety production more transparent, efficient and controllable. At the same time, we will continue to drive development with innovation, promote the brand power of Huashi to a new level, seize the high point of future development of construction, establish the construction industry trendsetter, bravely take up the sacred mission of leading the construction of a “strong construction country”, and contribute to Huashi’s strength for the governance of Sichuan to a new level!

## 6. Deposition from Stakeholders

*“In recent years, Huashi has adhered to the concept of ‘life first and safety first’ and has continued to consolidate its basic management. With the official implementation of the new Production Safety Law, higher standards and requirements have been put forward for the production safety work of construction industry enterprises. The use of new information technology to assist in production safety management has not only raised the safety awareness of all staff, but also improved the control efficiency and compacted the safety management responsibility, ensuring the overall stability of the production safety situation and eliminating the occurrence of large and above production safety accidents. This is worthy of continuous promotion and application with continuous iteration and optimization.”*

—— Sichuan Institute of Building Research

## Attachment: Enterprise Related Information



Company name: China Huashi Enterprises Co., Ltd.  
Company Address: Chengdu, Sichuan Province  
Company website: [www.chinahuashi.cn](http://www.chinahuashi.cn)

### Company Profile

China Haushi Enterprise Co., Ltd. was established in December 2008, inheriting 72 years of development history of Haushi Group and all the qualifications and resources. It is a platform for the development of Haushi Group's main industry of engineering contracting and a carrier for the listing of its main industry, and a large state-owned construction industry enterprise with significant influence in the country and even abroad.

The company has 4 special grade qualification enterprises for general contracting of housing construction, with markets in more than 30 administrative regions in China and more than 20 countries and regions overseas. The company has been awarded "National May Day Labor Certificate", "National Advanced Construction Industry Enterprise", "National Contract Observation and Credit Enterprise" and "National Civilized Unit". The company has been awarded many honorary titles such as "National May Day Labor Certificate", "National Advanced Construction Industry Enterprise" and "National Civilized Unit". It has been awarded 41 "Luban Awards" and "Special Honor Award for Creating Luban Projects", the highest award in China's construction field, 7 "China Civil Engineering Zhan





Tianyou Awards” and 40 “National Quality Engineering Awards”. It has also won more than 1,000 engineering quality awards, such as Tianfu Cup, Baiyulan Cup and Golden Bull Award. It is now ranked 306th in the “Top 500 Chinese Enterprises” and 14th in the “Top 80 Chinese Contractors”.

Over the past 72 years, Haushi has grown up with the People's Republic of China and made important contributions to national construction and social development in every historical period. In the early years of the country, it built the Changchun No. 1 Automobile Manufacturing Plant, the China No. 1 Heavy Machinery Plant, the No. 2 Heavy Machinery Plant and the Dongfang Electric Machinery Plant, which made important contributions to stabilizing the economic base and promoting the start of heavy industry at the beginning of the new China. In the 1970s and 1980s, it built the “839” Science City in Mianyang, Sichuan Province and the Xichang Satellite Launch Base, making an important contribution to the country's military industry, national defense and science and technology. It also laid an important foundation for the development of China's industrial and chemical industries with the construction of the Ministry of Aerospace's high-altitude platform exhaust cooling plant, the Sichuan Natural Gas Chemical Plant's large chemical fertilizer project and Hubei Jingmen Oil Refinery. Haushi Group also ventured out of the Sichuan basin, entered the whole country and expanded into overseas markets. In the 1990s, it created the world-renowned “Shenzhen Speed”, which ignited the passion of the nation for development. With its strong technical advantages, Haushi also built the Xi'an TV Tower (245m high), Nanjing TV Tower (310m high) and Sichuan TV Tower (339m high), making it unique in the field of construction of ultra-high structures. Haushi also has an outstanding track record in the

field of airport construction, with obvious advantages and dominant position. In terms of overseas market expansion, Haushi has responded positively to the country's “One Belt, One Road” strategy, carrying out international engineering contracting, real estate development, building materials and trade in East Africa, West Africa, South Africa, Southeast Asia, the South Pacific and the Middle East, and has won a good international reputation for its first-class quality and service.

Haushi also actively undertakes the social responsibility of state-owned enterprises, participating in the whole process of the “5.12” Wenchuan earthquake, “4.14” Yushu earthquake, “4.20” Ya'an Lushan earthquake and It also participated in the earthquake relief and post-disaster reconstruction work of the Kangding earthquake on 11.22 and the Jiuzhaigou earthquake on 8.8. It has undertaken a series of livelihood projects in Ganzi Prefecture, including the removal of the township of Seda Luoruo and the construction of a township, and has promoted the consolidation of the achievements of poverty alleviation and rural revitalization. It donated a total of RMB 6 million worth of epidemic prevention materials and was awarded the “Advanced Group in the National Housing and Construction System to Combat the New Coronary Pneumonia Epidemic”.

Haushi established the “Good Builders” culture system and the corporate spirit of “Follow the Way of Virtue and Build the World Well”. The image of Haushi as a “good builder” has been deeply rooted in people's hearts, and the brand slogan “Good builder - Haushi” has been widely echoed in the whole society. At present, Haushi is striving to achieve the “100 billion Haushi” and to enter the “Top 500 in the world”.

## Corporate Culture

They have established a unique culture system of “Good Construction” and the corporate spirit of “Virtue

and Virtue, Good Construction". The brand slogan "Good builder - Haishi" has been widely recog-

nized by the community.

## Major honors in the Past Three Years



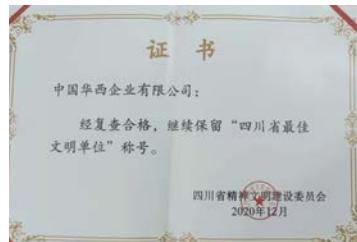
2021 Outstanding Economic Contribution Enterprise in Jinniu District



National Housing and Urban-Rural Development System Advanced Collective in Combating the New Coronary Pneumonia Epidemic



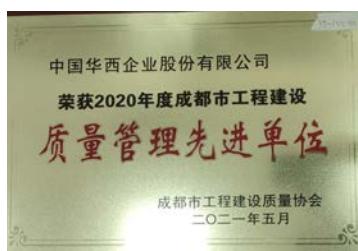
Advanced Enterprise in Construction Industry in Sichuan Province in 2020



Best Civilized Unit in Sichuan Province



Advanced Enterprise of Chengdu Construction Industry in 2020



Advanced Unit of Quality Management in Engineering Construction of Chengdu City in 2019



Advanced Enterprises in the Fight against the New Coronary Pneumonia Epidemic in Chengdu's Construction Industry in 2020



2020 Advanced Enterprise of Chengdu Construction Industry in Poverty Alleviation



Advanced Enterprise in Flood Relief in Chengdu Construction Industry in 2020



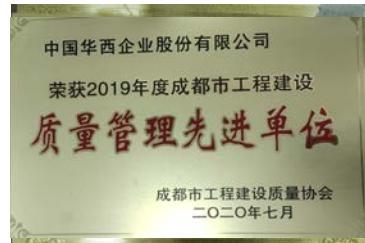
The 5th China Construction Engineering BIM Competition Activity Class II Certificate of Achievement



Outstanding Enterprise Contributing to the 2020 Jinniu District Tax Revenue of RMB 100 Million



2020 Jinniu District's outstanding contribution to tax revenue in the amount of RMB 20 million



Advanced Unit of Quality Management in Engineering Construction of Chengdu City in 2019



2017-2019 Sichuan Province Advanced Construction Industry Enterprise for Foreign Exploitation

## Performance Data for the Past Three Years

Index	Unit (RMB)	2019	2020	2021
Total Assets	billion	61.818	75.536	95.709
Operating Income	billion	64.945	67.507	81.907
Total Profits	billion	1.180	1.314	1.654

# Empower Winter Olympic Venues with Science and Technology, Build the National Sliding Centre with Ingenuity

◇ Shanghai Baoye Group Co., Ltd

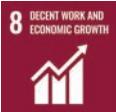
## Introduction

In the process of building the National Sliding Centre of the 2022 Beijing Winter Olympic Games, Shanghai Baoye Group Co., Ltd. overcame difficulties, broke the “technical barriers” with innovation, ingeniously built the ice and snow track with the spirit of excellence, fulfilled the Winter Olympic commitments with “Baoye speed”, realized the ice and snow dream with “Chinese quality”, and contributed wisdom and solutions to presenting a wonderful, extraordinary and excellent ice and snow festival.





## SDGs

 Goal No.8	Open up the first sliding track in China, and create opportunities for the development of new industries with high-quality facilities.	 Goal No.9	Innovate cutting-edge construction technology, overcome “technical barriers”, achieve intelligent, digital and accurate construction, and lead many “initiatives” in China.
 Goal No.11	Create a new look in Yanqing, build an innovative Winter Olympic heritage, and promote the development of suburban areas.		

## CSR

 Fundamental Responsibility	Adhere to innovation driven, strengthen technical breakthrough, and use digital means to forge the national sliding center project. Strengthen quality management, create quality projects, and build good infrastructure for the development of China's ice and snow sports.	 Labor Practices	Establish a growth and development mechanism for highly skilled talents, focus on building four talent teams, and establish and improve multi-level and multi-channel vocational skills development channels.
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## 1. Case Overview

Holding the Beijing Winter Olympics and Paralympic Games successfully is a major event for the party and the country, and it is our solemn commitment to the international community. It is a glorious and significant mission to do well in the preparations for the Beijing Winter Olympics and Winter Paralympic Games. The general secretary Xi Jinping pointed out that we should run the Olympic Games in a green, shared, open and clean manner throughout the whole process of the preparatory work, make every effort to do a good job in all aspects of the preparatory work, and strive to contribute to a wonderful, extraordinary and outstanding Olympic event for the world. Bobsleigh and luge racing is the fastest, most dangerous and highly professional event in the Winter Olympics snow competition, and it has strict requirements on the competition venue. At present, there are only 17 standard bobsleigh and luge venues in the world. The National Sliding Centre is the only bobsleigh and luge track in China, and also the third track in Asia that meets the Olympic competition standards. During the construction of the project, we used the bobsleigh and luge track as the carrier, and used technological innovation to improve the high-quality construction level, creating favorable conditions for the high-quality and efficient completion of the overall construction of the Winter Olympics project, leading a number of “firsts” in China, and conquering “technical barrier” many times. We fulfilled the promise of the Winter Olympics with “Baoye Speed”, realized the dream of ice and snow with “Chinese quality”, and laid a good foundation for the construction of snowmobile sleigh track and other similar ice and snow sports in the future. The birth of National Sliding Centre not only filled the gap of domestic snowmobile sledding tracks, but also planted a seed of hope in the hearts of Chinese lugers.

## 2. Case Background

The 2022 Winter Olympics will be jointly held by Beijing and Zhangjiakou. This is the first time in China's history to host the Winter Olympic Games. Beijing and Zhangjiakou are both host cities. It is also the third Olympic event held by China after the Beijing Olympic Games and the Nanjing Youth Olympic Games. Beijing will become the first city in the Olympic history to host the Summer Olympic Games and the Winter Olympic Games. It is an important opportunity to show the national image, promote national development and inspire the national spirit.

The National Sliding Center, built and operated by Shanghai Baoye, is located in the southwest of Yanqing District of the 2022 Winter Olympics in Beijing. It is the first bobsleigh and luge track in China, the third track in Asia and the 17th track in the world that meets the Olympic standards. The total length of the track is 1975 meters. The maximum design speed is 134.4 kilometers per hour. And the vertical drop is more than 121 meters. The track has a unique 360° roundabout in the world. It is a millimeter precision hyperboloid structure with space distortion. It is one of the new venues with the highest design difficulty, the greatest construction difficulty, and the most complex construction technology in the Winter Olympic Games.

Concealed in the mountains and forests, the venue designed with Chinese temperament is like a dragon flying on the ridge, looming and swimming among the mountains and forests, so it is vividly known as the “Snow Dragon”. This track not only has unique roundabouts in the world, but also has reached the international top level in terms of the number of curves, track length and competition difficulty. Bobsleigh and luge racing is also the fastest event in the Winter Olympic Games. It is known as the “F1 on snow” of the Winter Olympic Games. The maximum design speed is 134.4 km/

h, and the maximum gravity acceleration is 4.7g. With the characteristics of fast speed, great competition difficulty, and strong professionalism, it is one of the most enjoyable events in the Winter Olympic Games.



Panorama of Snow Dragon

### 3. Responsibility Actions

As a well-known enterprise in metallurgical construction, Shanghai Baoye has continuously written new legends in all top comprehensive sports competitions held in China from the 2008 Beijing Olympic Games to the 2022 Beijing Winter Olympic Games, from the World University Games, the National Games to the Youth Olympic Games and the Asian Games. Shanghai Baoye is forging ahead and striving for the major node goals of the National Sliding Center Project, fulfilling its commitment to the Winter Olympics with “Chinese speed”, and constantly polishing the gold lettered signboard of Shanghai Baoye as “the world’s top professional service provider for grand venues”.

In the face of the complex National Sliding Centre, Baoye staff didn’t indulge in fantasy and empty voice. We gave full play to the core competitive advantage of the whole industrial chain, and overcame many construction problems with continuous innovation. After hundreds of experiments, we have successfully developed high-quality special shotcrete materials for the track. We overcame the “technical barrier”, broke the foreign monopoly on the construction technology of bobsleigh and luge track, and led China to “pioneer”. We have

successfully trained our own track ice maker team in China, laying a solid foundation for track maintenance and technical talent reserve. It took Baoye people three years to fulfill their commitment to the Winter Olympics with “Baoye’s ingenuity”, realize the snow and ice dream with “Chinese quality”, and achieve a breakthrough from “0” to “1” in the bobsleigh and luge track in China, which was praised by foreign experts as “the best track ever”.

#### (1) Technical breakthrough to break the track monopoly

① Independent innovation and development of special shotcrete for race track. The track of the National Sliding Center Project is a space twisted hyperbolic shell structure. The surface curvature of the 1975 meter long track is not equal, which cannot be achieved by conventional construction technology. It can only be formed by manual spraying. In order to ensure the safety of high-speed racing on the track, the inner surfaces of different slides on the track must achieve the same compactness and surface space forming accuracy. Shotcrete should not only have a certain strength, density and good impermeability, but also have the technical requirements of high freeze-thaw cycle resistance, good surface decoration, anti sagging, and adjustable setting time. Shanghai Baoye set up a research and development team with the innovative studio of new building materials as the main body. With the support of the powerful scientific research platform of the “national recognized laboratory”, it conducted research and test by optimizing the proportion and adjusting the dosage of accelerator, studied and analyzed every data, every formula, and every process in the process, and formulated improvement measures and methods. Finally, the foreign certified experts highly recognized the mix proportion and performance of shotcrete and unanimously passed the certification. The R&D team of Shanghai Baoye Shotcrete has created new design principles, mastered the core technology of structural concrete quality control, broken the monopoly of foreign countries on the

formulation of high-density and high-strength shotcrete, perfectly realized the autonomy and localization of structural shotcrete, and saved huge technology transfer funds for enterprises.

② The “iron tough man” shaped with many technologies. The racetrack skeleton is composed of nearly 120000 meters of refrigeration pipes. Shanghai Baoye used professional technologies such as pipe finishing, hole forming, special die sinking bending, integral assembly, automatic welding. At the same time, it has developed the form of racing track refrigeration support and high-precision molding technology of slender components. It is the first time to innovate the assembly technology of double curved racetrack refrigeration pipe support under the conditions of multiple curves and high drop. High precision laser cutting, heat treatment, natural cold shrinkage, special bracket fixing and other manufacturing processes are adopted to ensure the machining accuracy of the fixture is within  $\pm 3\text{mm}$ . Meanwhile, a 3D scanning detection process has been developed, which can generate the 3D model of the bracket in real time, compare it with the point cloud model, and directly reflect the information of each deviation point, so as to control the correction of processing error, and ensure the fixture installation accuracy within  $\pm 5\text{mm}$ , ensuring that the “skeleton” installation accuracy and “joint” are perfectly controlled, so that the “steel tough man” finally presents a majestic posture of winding and hovering.

③ Construction technology of sunshade system. The sunshade of the National Sliding Center track, combined with the track shape, natural terrain, “artificial terrain” and sunshade roof, can effectively protect the track from the sun, wind and snow, making it the only track built in the south of the mountain slope in the world. The sunshade adopts the world’s first steel and wood structure, which realizes the perfect combination of traditional wood structure and modern steel structure. Since

there was no similar building construction experience for reference in China, in order to achieve a stable and reliable effect, the road of design and development was arduous, and the structural and technological design took one year. The sunshade system is supported by 279 triangular wooden beams, each of which is composed of more than 50 specifications of materials. The length of unilateral overhang is 7~13m. 279 wooden beams with different specifications should be installed on the track with a vertical drop of 121m, which is extremely difficult and requires high installation accuracy. In order to ensure the smooth implementation of the installation work, the factory’s processing capacity, processing technology, material selection and detailed construction plan were investigated on the spot. A comprehensive analysis and planning was carried out in terms of the project site conditions, crane position and wood beam construction process. From minor component processing and production, wood procurement to steel wood combination, wood beam assembly, and finally hoisting; from the hoisting of the first wooden beam to the completion of the installation of the track wooden beam, and then to the laying of the shingles, Shanghai Baoye overcame many difficulties such as the mountainous transportation of components, the complexity of hoisting and the instability of the mountainous climate. It took 10 months for the golden dragon to emerge

(2) Build with ingenuity to lead innovative Winter Olympics

① Building the snow dragon intelligently. During the construction of the National Sliding Center, Shanghai Baoye adopted the digital method of digital deduction, real scene management and control, and information integration and transmission to make the project quality management information transparent, product quality visible, data accurate, process standardized, and process standardized, so as to achieve the management objectives of data sharing, timely correction, cost reduction and



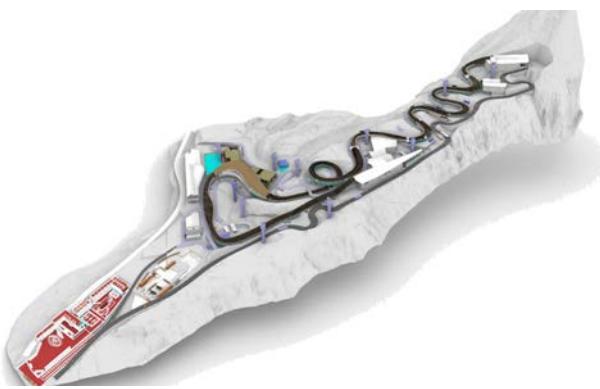
quality improvement. Integrating new technologies such as BIM, Internet of Things and Internet technology, based on BIM model, mechanical analysis model, monitoring data and safety management information, an intelligent construction theory based on digital twins is proposed, which realizes the collaborative management and pre construction simulation of construction site visualization and virtualization. We pioneered a complete set of digital construction and molding technologies such as space curved racetrack refrigeration pipe support, curved surface control system, concrete spraying and finishing of main structure. We formed all element virtual construction technologies such as full professional deepening, site planning, construction scheme optimization, construction simulation, progress comparison, cost calculation, reverse modeling, and solved the problem of scheme optimization, virtual construction and collaboration in the whole process of the project. We overcame the technical difficulties in the construction of long linear spatial hyperboloid millimeter precision racing track under mountainous conditions with multiple curves and high drop. We realized the transparency and integration of construction information during the whole life cycle and the whole process, and effectively controlled the technology, progress, quality, cost and other key factors in the track construction process.

② Building a digital “Snow Dragon”. Shanghai Baoye and China Architectural Design and Research Institute Co., Ltd. jointly developed the algorithm application technology for the generation of three-dimensional curved surface racetrack, established a method for quickly creating and processing three-dimensional curved surface, built a full element three-dimensional model of the space hyperbolic racing track with an accuracy of LOD450, and solved the problem of extracting the coordinates of any spatial point of the space hyperbolic surface and controlling the digital accuracy. A self-developed parametric combination digital analysis program group was put forward to form

the optimal track surface control model and data group. For the first time, the analysis and establishment of all element spatial hyperbolic model of each track system, as well as the extraction and use of coordinates were realized. We completed the design of 1350 groups of pipe supports for the complex space hyperbolic racetrack, more than 1.4 million groups of support space positioning coordinate data, 30,000 groups of type finding system precision feature point data, intelligent optimization and segmentation of 119000 meters of pipe, and the establishment of various curved surfaces in more than 10000 square meters of space. The parametric combined digital analysis and programming technology has been developed. After repeated demonstration, the optimal control parameter of the parametric combined digital analysis program group was the third order curve order. The comparison test showed that the maximum error of the curved surface formed by lofting the curve of order 10 and above was only 0.1mm when compared with the curve of order 3, and the calculation amount was greatly reduced by 90%.

③ Digital mapping of ice and snow dragon. Shanghai Baoye has developed a method for establishing the linear control network of the complex space hyperboloid racetrack, which has solved the problems of precision measurement and positioning, lofting, component installation, detection, deformation monitoring and project operation and maintenance, such as the consistency of the benchmark and reliability of the results. We proposed a method for measuring the processing accuracy of pipe supports based on 3D laser scanning and building information model fusion technology, and a method for completion measurement of complex space hyperboloid racetrack, which realized 3D stereo accurate measurement and rapid detection of complex and irregular engineering components, and improved the installation accuracy of racetrack and the surface flatness of sprayed concrete on space curved surface. A new type of precision measurement and control technology system for

complex space curved surface racing artificial profile track has been established to achieve the organic integration of BIM and GIS, and build a three-dimensional real scene model of indoor and outdoor integrated sliding venues, providing spatial geographic information support for the construction of venues.



Digital Model of National Sliding Centre

### (3) Adhere to quality and build craftsman culture

Shanghai Baoye has made great efforts to create and cultivate the cultural brand of craftsman, established a growth and development mechanism for highly skilled talents. We strove to build four talent teams: a compound excellent management team with both ability and integrity and strong business ability; an excellent “Little Tiger” project management team that can fight and win when called; a professional technical team with excellent professional ability to solve practical problems on site; a team of highly skilled and versatile operators so as to establish and improve multi-level and multi-channel vocational skills development channels. Since the commencement of the project, the enterprising staff of Baoye have vividly interpreted the brand strength by fulfilling the expectations and mission. From the BIM technology innovation team to the first batch of national track concrete spraying iron army, from the domestic first “construction technology of large-scale steel wood structure combination system” to the domestic first ice making and ice repair team, we have integrated

the advantages of the whole industry chain into the whole project construction. Peng Hui, who won the title of “Shanghai Craftsman” in 2021, led the team of racetrack jet shooters to repeatedly train day after day with indomitable will and hardworking spirit, study hard and practice hard and master the skills and techniques of racetrack jet skillfully and accurately. All of them have obtained the qualification certificates of jet shooters issued by international associations, becoming the only team of jet shooters in China. They deeply interpreted the rich connotation of craftsmanship spirit of keeping improving, advocating perfection and pursuing the best with practical actions, and vividly demonstrated the firm belief and unremitting pursuit of Shanghai Baoye in building craftsmanship culture and cultivating skilled talents.

## 4. Effect of Responsibility Fulfillment

Xi Jinping and other national leaders concerned about the preparations for the Beijing Winter Olympic Games, investigated the National Sliding Center in Yanqing District for many times, and learned about the construction of sports venues and the preparation of athletes for competition. In his speech, the General Secretary Xi Jinping highly affirmed the construction achievements of the venues with “very assiduous”, and gave high praise to the construction team, management team, and athletes team with “you are amazing”.

On November 9, 2020, the National Sliding Centre for the 2022 Beijing Winter Olympics, which was constructed by Shanghai Baoye, was successfully certified. On June 30, 2021, the project successfully passed the completion acceptance. Yanqing Sliding Center took the lead in passing the international certification and was highly praised by the President of the GIASF. During the Winter Olympic Games, the International Sliding Centre was highly recognized by international officials, including President Bach of the International Olym-



pic Committee, President Ivo Ferria of the International Federation of Bobsleigh and Tobogganing and so on. It was highly praised by knowledgeable competitors. Foreign certification officers and athletes said this was the best venue and track in the world at present. Of all the certification work they have participated in, this one is the most perfect. It is impeccable and the site conditions are very good. The international mainstream media also competed to report the amazing construction level of this world-class venue and the Winter Olympics event, which fully demonstrated the style of Chinese builders to the world on the international stage.

Then it is the first sliding track in China, with a total length of 1975 meters, a maximum design speed of 134.4 kilometers per hour, and a vertical drop of more than 121 meters. It is known as “Formula F1” in skating and skiing events. During the construction of the project, from the rapid installation of nearly 120000 meters of refrigeration and evaporation pipes to the completion of concrete spraying for the main track, from the hoisting of ammonia tanks to the commissioning results of the refrigeration system, to the successful completion of ice making, Shanghai Baoye has innovated the cutting-edge construction technology, developed the preparation and quality control technology of special spraying materials for the track construction, the processing and molding technology of 10000 meters of hyperboloid refrigeration pipes, and the spraying and finishing molding technology of millimeter-scale hyperboloid track, eight core technologies, such as digital construction technology of space hyperbolic racing track, and led many “initiatives” in China. The project has not only created the first sliding track spraying team and ice making and ice repairing team in China, but also broken the foreign monopoly on sliding track related technologies, and achieved a breakthrough in domestic sliding track acceptance standards and complete set of construction technologies from scratch.

Shanghai Baoye focuses on quality construction and relies on creating excellence and awards to form a distinctive winter Olympic industry. With the requirements of high standards, high levels and high quality, it has ingeniously forged world-class winter Olympic quality benchmarking projects. Up to now, it has completed two sub projects of the key special project of the 2018 key research and development plan of the Ministry of Science and Technology, “Winter Olympics of Science and Technology”, accepted and authorized 123 patents, formed five technical standards and acceptance standards for slide track. It has won many honors, such as the National Luban Award, the Surveying and Mapping Science and Technology Award, the Beijing Structure Great Wall Cup Gold Award, and the China Construction Engineering Steel Structure Gold Award. It has won five national awards and three provincial and ministerial awards in the BIM competition, and has successfully passed the certification of the Beijing ZhongJianXie Certification Center, and has been certified as a “platinum” project.

## 5. Future Outlook

It has been successfully applied in the National Snowmobile Center Project of the Beijing 2022 Winter Olympic Games, breaking the monopoly of foreign patented technologies, forming independent patented technologies and core processes, ensuring the smooth construction of the track for the Beijing 2022 Winter Olympic Games, and has been highly praised by the International Olympic Organizing Committee, GIASF, the Olympic Organizing Committee, owners and other parties.

In the future, on the one hand, the track project of Beijing 2022 Winter Olympics will be taken as an opportunity to develop and master similar key technologies in other fields. On the other hand, the digital intelligent construction mode based on this project will be summarized and refined to form a set of digital management mode and technical

methods that conform to Baoye's enterprise characteristics and run through the whole life cycle of the project construction, so as to promote the digital transformation and upgrading of enterprises. Shanghai Baoye will continue to take scientific and technological innovation as the driving force, brand strategy as the leading force, use the spirit

of ingenuity to create high-quality projects, build a new pattern of high-quality development, write a new chapter of high-quality development, and create a first-class full life cycle engineering service provider with the most competitive advantage in the industrial chain.

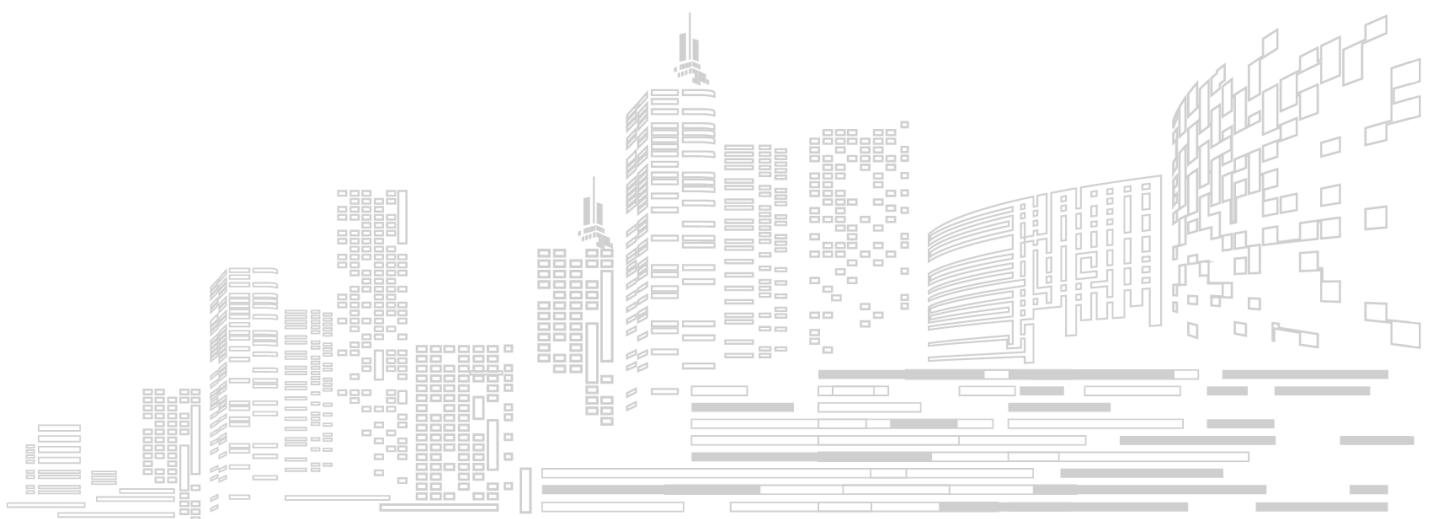
## 6. Deposition from Stakeholders

*"We saw a well prepared track, and we were impressed by the smooth and perfect organization under strict epidemic prevention measures."*

——Ivo Ferria, President of International Federation of Bobsleigh and Tobogganing

*"Since the 1980s, I have participated in the certification of all sled sites. This is not only great, but also the best certification I have ever seen!"*

——Walter, expert of International Course Luge Federation





## Attachment: Enterprise Related Information



**上海宝冶集团有限公司**  
SHANGHAI BAOYE GROUP CORP., LTD.

Company name: Shanghai Baoye Group Co., Ltd.  
Company Address: Shanghai  
Company website: <http://www.sbc-mcc.com>

### Company Profile

Founded in 1954, Shanghai Baoye Group Co., Ltd. is a core subsidiary of China Minmetals Corporation, one of the world's top 500 enterprises, and China Metallurgical Corporation. It has the first batch of special qualifications for general contracting of housing construction and smelting projects in China, as well as the highest qualifications for general contracting and professional contracting in China. It is a national high-tech enterprise, a national intellectual property demonstration en-

terprise, a national enterprise technology center, a national technical standard innovation base, and an advanced collective of central enterprises. In 2018, it successfully passed the "Shanghai Brand" certification and became an excellent representative of "Shanghai Service" in Shanghai's "Four Brands" strategy. Focusing on new industrial fields such as metallurgical engineering, large public buildings, super high-rise buildings, clean workshops of the electronic industry, theme park, smart cities, beautiful villages, investment and financing develop-



ment, we will research and develop prefabricated building technologies, explore digital intelligent construction, master key technologies of urban synthesized pipeline system, and implement the concept of green development through the whole industrial chain and life cycle of the project.

With a new concept and a broad vision, Shanghai Baoye has constantly innovated and made changes. It has created a series of excellent projects at home and abroad, such as the National Stadium, the main venue of the Beijing Olympic Games, the Shanghai World Expo building complex, the main stadium of the Shenzhen World University Games, the Nanjing Olympic Sports Center, the main venue of APEC, the Beijing Yanqi Lake International Convention and Exhibition Center, the Sunrise Oriental Hotel, the main venue of the BRICs conference, the Xiamen International Convention and Exhibition Center and the International Conference Center, the National Convention and Exhibition Center, the main venue of CIIE, Strait Grand Theater, the main venue of Golden Rooster and Hundred Full Blossom Film Festival, the National Snowmobile and Sledge center of Beijing Winter Olympics, shooting and archery modern pentathlon hall of Hangzhou Asian Games, Shanghai Disneyland, Universal Studios, Wusong International Mail Terminal, the first in Asia, Zhuhai center, the highest in Zhuhai and Macao at 330 meters, Longxiang headquarters building, the highest in Jilin at 238 meters, the 368 meter high Nanjing Golden Eagle Plaza, the largest single building in Asia, as well as the national memory base, Shanghai Hongqiao hub, Shanghai Pudong Airport, Guangzhou Baiyun Airport, Shenzhen Liantang port, Foxconn, TSMC, SMIC, Xiamen Tianma, Guiyang metro, Xi'an metro, Dubai racecourse, Central Bank of Kuwait building, Cambodia Siem Reap-Angkor International Airport and other landmark projects. It has formed domestic leading and international first-class brand advantages in large-scale high-end public and civil buildings, super high-rise buildings, electronic factories, theme

parks, medical, cultural and health care, rail transit, municipal infrastructure, industrial modular construction, prefabricated housing, large-span steel structure manufacturing and installation, BIM Technology and so on. Baoye people have written the strongest voice of China's construction with their sonorous footsteps of forging ahead, showing the world the strong strength of China's quality. It has formed domestic leading and international first-class brand advantages in large-scale high-end public and civil buildings, super high-rise buildings, electronic factories, theme parks, medical, cultural and health care, rail transit, municipal infrastructure, industrial modular construction, prefabricated housing, large-span steel structure manufacturing and installation, BIM Technology and so on. The staff of Baoye have written the strongest voice of China's construction with their sonorous footsteps of forging ahead, showing the world the solid strength of China's quality.

Shanghai Baoye has won many honors such as the National Special Prize for Scientific and Technological Progress, the National May 1st Labor Medal, the National Worker Pioneer, the National Youth Civilization Model, the top 100 enterprises with comprehensive strength in China's construction, and the AAA enterprise with social credit in China's engineering construction. It ranks among the top 20 enterprises in the "top 100 competitive enterprises in China's construction industry" and has won 47 "Luban awards", the highest honor of engineering quality in China's construction industry. It is the first in the industry to pass ISO9001 quality assurance system, ISO14001 environmental management system, OHSAS18001 occupational health and safety management system certification, and has passed American AISC, European standard en1090 and other international certifications.

BIM center of Shanghai Baoye Group Co., Ltd. is the first five-star enterprise BIM Center certification in China, the first batch of BIM technology



application and transformation demonstration enterprises in Shanghai, the chief editor of the first BIM application standard of MCC, and the only one in China that has participated in the whole process of BIM application of three international top projects, namely, Shanghai Disneyland, Universal Studios and the National Snowmobile and Sledge center for the 2022 Winter Olympics. Development history of BIM Center: in 2005, the group launched a single professional BIM application field; in 2011 it developed BIM application planning and guided application (encouraged application); in 2012, it standardized enterprise applications and achieved unified standards; in 2017, it was rated as one of the first batch of BIM Technology application and transformation demonstration enterprises in Shanghai. It has successively undertaken more than 1000 engineering consulting services in various fields, such as exhi-

bition venues, theme parks, commercial centers, universities, public buildings, high-end residential buildings and metallurgical industry. Relying on strong consulting service ability and rich practical experience, we have successively provided BIM consulting general consultants for the whole process for government platforms such as Shenzhen Municipal Public Works Bureau, Shenzhen Water Bureau, Xiong'an New Area, and large-scale real estate companies such as China Resources Land, Vanke Real estate, Longhu real estate and Zhujiang investment, so as to improve the quality and efficiency of management. In the face of the new normal of the market development of the construction industry, Baoye BIM center actively develops new fields such as digital city, smart industrial park, big data and artificial intelligence, and wholeheartedly provides customers with high-quality and efficient services.

## Corporate Culture



Build high-quality projects and build a lasting foundation

Build a beautiful Baoye, and build a first-class and most competitive engineering service provider of the whole industry chain and life cycle

Integrity, practice, innovation and win-win

Surpass oneself and dare to be the first

## Major honors in the Past Three Years



The Chinese University of Hong Kong (Shenzhen) Phase I Project (Xiayuan) General Contracting Section II - Teaching Building won the Luban Prize of China Construction Engineering in 2018-2019



Huangshi Olympic Sports Center-stadium project won the Luban Prize of China Construction Project in 2018-2019



Harbin Institute of Technology Shenzhen Campus Expansion Project (I, II, III bid sections) won the Luban Prize of China Construction Engineering in 2018-2019



Background The BIM application of the National Sliding Center Project of the 2022 Winter Olympics won the first prize in the "Longtu Cup" BIM Competition of the Chinese Graphic Society

## Employee Data

The company has more than 6000 employees, and the ratio of male to female employees is 9:1.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	100 million yuan	356.0935	446.2957	470.2841
Operating Income	100 million yuan	418.318	509.794	602.781
Total Profits	100 million yuan	9.7078	10.5893	11.3202

# Intelligent Construction Technology to Support the Winter Olympics

❖ BCEG No.3 Construction Engineering Co., Ltd.

## Introduction

BCEG No.3 Construction Engineering Co., Ltd. follows the design concept of “global vision”, “international standards”, “Chinese characteristics”, “big country style”, “science and technology leadership” of the international convention and exhibition center. In the construction of the second phase of the National Convention Center project, it actively and boldly tries all kinds of smart site control methods, comprehensively promotes the use of smart site management technology, and creates elegant, safe, convenient, pleasant and distinctive space and sustainable public buildings.



## SDGs

 <p>Goal No.9</p>	<p>With the concept of “science and technology leading”, build smart construction sites by using smart construction technology, independently developing innovative construction technology, and using new technologies such as automated construction technology and automatic monitoring technology.</p>	 <p>Goal No.17</p>	<p>Form deep strategic cooperation with Glodon, explore and realize the intelligent and refined improvement of personnel management, and improve the information and intelligent level of the construction site.</p>
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## CSR

 <p>Fundamental Responsibility</p>	<p>With the concept of “leading by science and technology”, build smart construction sites by using smart construction technology, independently developing innovative construction technology, and using new technologies such as automated construction technology and automatic monitoring technology. Strengthen quality and safety monitoring and relevant data analysis, and carry out refined management.</p>	 <p>Environment</p>	<p>Strengthen environmental monitoring, use BIM technology to carry out integrated application of steel structure deepening design and construction, and use appropriate methods to save steel consumption.</p>
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## 1. Case Overview

Since the reform and opening up, China's construction industry has experienced a process of rapid development. China's construction industry has become one of the important pillar industries of the national economy. As one of the state-owned construction units in Beijing, BCEG No. 3 Construction Engineering Co., Ltd. undertook the second phase project of the National Convention Center. It actively and boldly tried all kinds of smart site management and control methods, comprehensively promoted the use of smart site management technology. It also formed deep strategic cooperation with Glodon, with a capital of up to 8 million yuan, in order to explore and realize the obvious improvement of personnel management from extensive to intelligent and refined, improve the informationization and intelligent management level of the construction site, ensure the quality and efficiency improvement of the group, and boost the high-quality development of the industry.

The phase II project of the National Convention Center is built with the background and opportunity of building the capital as an important support-

ing node of China's international exchange center, an important landing platform of the "Belt and Road" strategy in the capital, and enhancing the ability of the core functional area of the capital to undertake large-scale international exchange activities. The main functions of the above ground buildings are exhibition center, conference center, high-end government affairs and business summit activity center. The main functions of the underground buildings are exhibition center, parking lot and auxiliary facilities. In addition, the project has undertaken the functions of the main media center (MMC) for the 2022 Beijing Winter Olympic Games and the Winter Paralympic Games. The project follows the design concept of "global vision", "international standards", "Chinese characteristics", "big country style", "science and technology guidance" of the international convention and exhibition center, adheres to the concept of people-oriented, green and healthy, fully considers the impact of urban ecological environment factors in Beijing, and creates elegant, safe, convenient, pleasant and distinctive space and sustainable public buildings.



Project Rendering

The project has actively promoted the transformation and development of the construction industry by using smart construction technology, independent research and development of innovative construction technology, automatic construction technology, automatic monitoring technology and other new technologies to build smart construction sites.

## 2. Case Background

Intelligent construction is an innovative construction method with high integration of information, intelligence and engineering construction process. Intelligent construction technology includes BIM technology, Internet of Things technology, artificial intelligence technology, etc. The essence of intelligent construction is to realize intelligent construction site based on physical information technology, and realize dynamic configuration production mode in combination with design and management, so as to transform and upgrade the construction mode. The emergence of intelligent construction technology makes the rapid integration and development of various related technologies. Its application in the construction industry makes the design, production, construction, management and other links more information-based and intelligent. Intelligent construction is leading a new round of construction revolution.

On July 3, 2020, the Ministry of Housing and Urban-Rural Development, the National Development and Reform Commission, the Ministry of Science and Technology and other 13 departments jointly issued the Guiding Opinions on Promoting the Coordinated Development of Intelligent Building and Building Industrialization, pointing out that it is necessary to take vigorous development of building industrialization as the carrier, digital and intelligent upgrading as the driving force, innovate and break through relevant core technologies, increase the application of intelligent building in all aspects of project construction, and

form an intelligent construction industry system integrating scientific research, design, production and processing, construction assembly, operation and other whole industry chains.

In recent years, China's construction industry has continued to develop rapidly. The scale of the industry has continued to expand. The construction capacity has continued to strengthen. BIM and other information technologies have been rapidly promoted. Independent research and development of special construction machinery and equipment has made positive progress. And the level of engineering design, construction, operation and maintenance information has continued to improve. However, for a long time, the construction industry has mainly relied on factor investment and large-scale investment to drive development. The degree of industrialization and information is relatively low. The proportion of enterprises' scientific and technological research and development investment is not high. The integration of the construction industry with advanced manufacturing technology, information technology and energy-saving technology is not enough. And the capacity of robots and intelligent construction equipment is not strong. It is urgent to use new technologies such as 5G, artificial intelligence and the Internet of Things to upgrade traditional construction methods.

## 3. Responsibility Actions

As a well-known enterprise in the construction industry of Beijing, Beijing Construction Engineering Group established an intelligent construction center in March 2019, aiming to create an industry-leading technological innovation platform of "Internet of Things+BIM+Architecture". Over the years, BCEG has always adhered to the spirit of craftsmanship, continued to promote enterprise reform and innovation, transformation and upgrading, and strengthened the entire green and smart industrial chain, playing a major role in the construction of the country and the capital city.

BCEG has fully promoted the construction of Beijing Daxing International Airport, Beijing Winter Olympics, Beijing World Expo, Beijing Urban sub center and Xiong'An new area, and has actively responded to the coordinated development of Beijing, Tianjin and Hebei, the construction of the Yangtze River economic belt, and the construction and initiatives of the "the Belt and Road". Its influence at home and abroad increases constantly.

### (1) Promote the construction of smart construction sites and help the healthy development of project employees

The second phase project of the National Convention Center is characterized by large scale, tight construction period, more cross operations, and more workers. Combined with the characteristics of the project, the project boldly tried to invest in the intelligent construction site management system. Based on the characteristics of the project, the project boldly tries to invest in intelligent site management system, including eight management systems, namely integrated management platform (including BIM5D platform, BIM use, PM management platform), personnel management system (including intelligent helmet system, face recognition system, real name management system), mechanical equipment management (intelligent switch box, tower crane anti-collision and visualization system), material management (ground pump system, steel component QR code system). Glodon BIM+intelligent construction site platform is adopted to integrate eight types of business management software and seven intelligent hardware

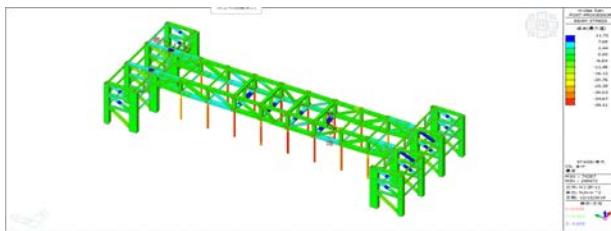


Main page of BIM5D Platform

information, including technology, safety, quality, production, labor, video monitoring, environmental monitoring, tower crane safety monitoring, and risk monitoring, so as to enhance the accumulation and analysis ability of production, quality, and safety related data, and use the accumulated big data to achieve the refined management of project production progress, quality, and safety.

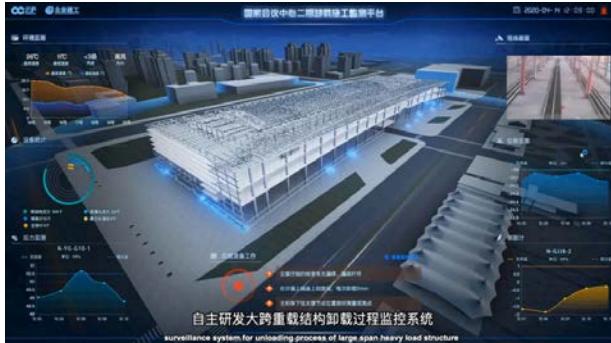
### (2) Intelligent construction technology for complex spatial structures to ensure construction accuracy and safety

The intelligent construction technology of complex space structure is based on the construction mechanics analysis of large-span heavy load two-way transfer truss internal force introduction, and the appropriate construction method and sequence are selected by simulating the influence of the two main construction methods of in-situ installation and integral lifting on its deformation and stress under different construction sequences. The construction process simulation analysis technology is selected to carry out the whole process simulation analysis of the structural installation and construction sequence. More detailed construction simulation has been carried out for the truss installation and unloading. The deformation and stress of the structure during the construction process have been analyzed. And the stress changes of key parts such as the transfer truss and the upper frame have been emphatically investigated to guide the construction and actively control the introduction of structural internal forces. Through the comparison of 5 different in-situ construction situations and 3 different integral lifting construction situations, it can be seen that the integral lifting method can reduce the stress at the end of the truss, but will increase the deformation and stress. The in-situ installation method can reduce the deformation and stress of the truss, and partly improve the force bearing effect through the rear closure of the lower chord end. Considering the height limitation of truss, the stress is more complex. As the Winter Olympic Games media center, the construction period is very tight. The construction method of high altitude in-situ installation is adopted, and the transfer truss upper frame structure needs to be constructed in advance before unloading.



In situ Installation Simulation Analysis

In the process of truss unloading, we independently developed a monitoring system for the unloading process of long-span and heavy-duty structures, assisted with the application of three-dimensional laser scanning and welding robots, and integrated BIM Technology, cloud platform technology, “Internet+” and other technologies. The overall idea referred to the “human nervous system”. We adopted wireless transmission technology, solar energy function, low energy photoelectric instruments and other hardware, as well as data cloud storage, cloud computing and other software. And we adopted modular design, including sensor system, data acquisition system, database management system, security early warning system, security assessment system, and three-dimensional visual dynamic display system. Each system module completed a specific sub function to obtain the full scale, full time and high-precision measured data of the structure under each process in the construction stage. It solved the problems existing in the traditional construction mode, such as relying on the experience of managers and technicians, lack of scientific and systematic methods, and high

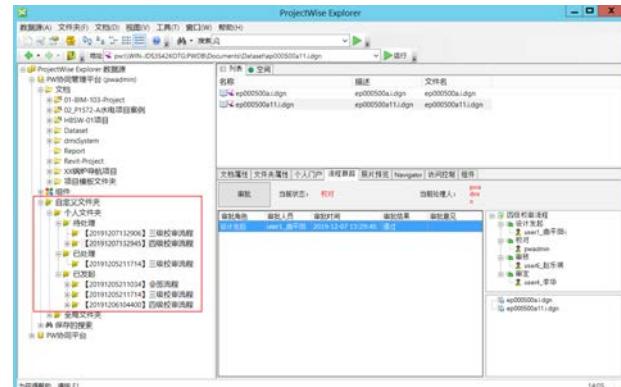


Project Unloading Construction Monitoring Platform Diagram

time-varying, and provided solutions for the transformation and development of building industrialization.

(3) Build an intelligent construction site by using BIM technology for full cycle landing management and data platform

Based on the whole life cycle management process of the project, the Guidelines for the Implementation of the National Convention Center Phase II Project - BIM is formulated. The guidelines set clear BIM application objectives, BIM application scope and application responsibilities. The technical, economic and operational requirements of the entire project were achieved based on BIM. In addition, the project uses PW platform to provide a shared working environment for all participating units. This platform project has realized the unified coordination of design and construction, and played a crucial role in collision inspection, drawing problem report, model updating and maintenance, construction scheme optimization and visual disclosure, construction progress simulation and other practical problems. Through BIM technology, the integrated application of steel structure deepening design and construction was carried out. The steel structure deepening design model was set up, and the structural internal force of the overall structure and long-span truss was calculated through the model using finite element software to find a reasonable construction method, which effectively reduced the use rate of large hoisting

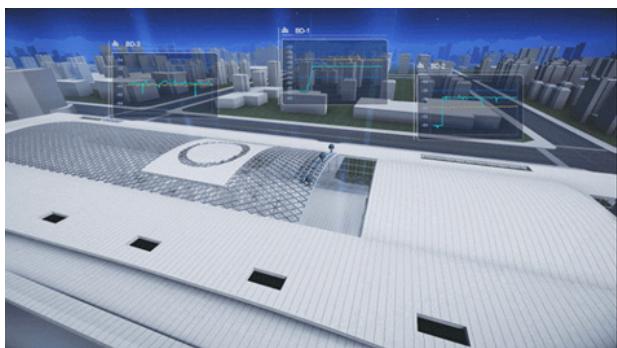


Intelligent Construction PW Platform Management

equipment, reduced the on-site welding workload, reduced the labor intensity of personnel, saved the use of steel, and realized the assembly, integration and economization of construction.

#### (4) Develop innovative construction technology and create a high-quality project for the Winter Olympics

The top floor banquet hall and roof garden of the second phase project of the National Convention Center are super span spaces. The new cable-arch structure of the roof is the upper convex cable-strut-supported shell structure. The top chord is a solid web box girder arch shell with orthogonal and oblique angles, which is light and simple. The upper convex linear steel cable is arranged at the bottom chord, which not only solves the horizontal thrust of the arch shell, but also meets the height limit of the building and the requirements for clearance. The project innovatively researched and developed the construction research and application technology of a new type of super long (252m) roof with the upper convex cable-strut-supported shell structure. The visual construction monitoring technology based on Beidou system is adopted for the first time to monitor the configuration of the upper convex cable-strut-supported shell super-long structure during the construction and operation period. And good results are achieved, with the accuracy exceeding that of the GPS system. The processing, fabrication, installation, sliding unloading and pre-stress control of the super long roof of the upper



Surface Slip Monitoring System  
Based on Beidou System

convex cable-strut-supported shell structure were deeply studied to ensure the safety and construction quality of the structure.

#### (5) Application of intelligent construction equipment to improve production efficiency

In view of the difficulties in construction welding - huge welding filling amount, the maximum section of the steel column is 2.2mx2.2m, the maximum section height of the steel beam is 2.3m, and the maximum plate thickness is 80mm, lithium electric rail welding robots were selected for the project to carry out large section thick plate welding. Good results have been achieved: the efficiency of automatic welding is 3 times that of manual welding, which greatly improved the construction efficiency. It can complete efficient manual walking welding. After the weld is formed, the appearance is smooth and consistent without grinding. It promoted the upgrading of building steel structure welding technology and changed the on-site welding management mode.



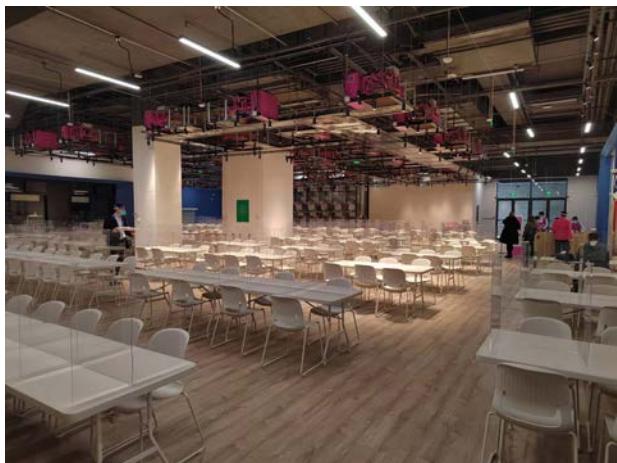
In view of the construction difficulties of the huge concrete floor construction workload, the project used laser ground leveling machine and ground troweling machine to assist the concrete floor construction, which has achieved good results: we saved more than 50% of labor, improved the construction efficiency by 3-4 times, reduced potential safety hazards, improved the overall construction comfort and construction efficiency, and provided strong support for the realization of green construction.



(6) Use multiple types of robots to serve the venues around the clock

As the main media center of the Winter Olympic Games and the winter Paralympic Games, the second phase project of the National Convention Center displayed a number of service robots for food delivery, material delivery, guidance, disinfection and sterilization and waste removal during the Games time, creating a “unmanned” digital service scene and providing  $7 \times 24$ -hour convenient service for journalists and authorized broadcasters of news media. For example, the epidemic prevention robot provides patrol and disinfection and sterilization services. The waste removal robot can judge the capacity by itself, go to the removal point, and then return to the temporary storage point.

In terms of epidemic prevention, Phase II of the National Congress relied on the intelligent epidemic prevention platform during the Winter Olympics to form an intelligent analysis system for video



Robot Restaurant

monitoring of the Winter Olympics. The restaurant providing catering services for the media has become a “smart restaurant”. The robot restaurant covered an area of about 6000 square meters and was divided into western fast food area and Chinese fast food area. During the operation period, about 120 catering robots, including hamburger robots, frying pan robots, rice cooking robots, snack robots, have been put into operation, serving thousands of people.

#### 4. Effect of Responsibility Fulfillment

The promotion and application of the project in construction by means of intelligent construction has not only improved the overall image of the construction industry, but also improved the work efficiency, technical level and safety level of the construction industry, so as to enhance the overall competitiveness of the industry and enterprises. The project has received more than 80 concentrated observations during construction. The project has successively won the “Beijing Dust Control Notification Commending Unit in 2019”, successfully passed the Annual Outstanding Award of the China Steel Structure Gold Award, the Beijing Structure Great Wall Cup, the Beijing Model Construction Site, and the acceptance of the Beijing Youth Safety Demonstration Post, and won the Excellent Case Award of the National Construction Project Labor and Skills Competition. At the same time, it has attracted extensive attention from all walks of life and received extensive publicity and reports from CCTV, Beijing Television, Beijing Daily, Capital Construction News and other mainstream media.

As the main media center of the Winter Olympic Games and the Winter Paralympic Games, Phase II of the National Convention Center is the latest and largest new venue in the Beijing area of the Winter Olympic Games. It integrates the two major functions of the main news center and the inter-



national broadcasting center. It is one of the most important non competition venues for the Beijing Winter Olympic Games. It is the headquarters for registered media during the Games. It has received more than 480000 media people, and nearly 4000 people work here on average daily. The venue operation team, bearing in mind the instructions of the General Secretary Xi Jinping when inspecting the venues during the preparation of the Winter Olympic Games, has always adhered to the Olympic concept of “green, shared, open and honest”, closely focused on the requirements of “simple, safe and wonderful”, and successfully completed the media operation and service guarantee of the Beijing Winter Olympic Games with a professional and efficient service level and a down-to-earth working style. The Beijing Winter Olympics has become the most-watched Winter Olympics so far. The main broadcaster, Olympic Broadcasting Service Company, has produced videos for more than 6000 hours, setting a new record in the history of the Winter Olympics. The scientific and technological innovation of venue facilities and considerate and careful operation services have also been widely praised and reported by the global media.

## 5. Future Outlook

After the Winter Olympic Games and the Winter Paralympic Games, the second phase of the project will be further renovated. After completion, it will be integrated with the current National Convention Center, forming a convention and exhibition complex with a total scale of nearly 1.3 million square meters. A large-scale convention and exhibition property group will be formed in the National Convention Center area, which will become a world-class international communication platform. It is positioned as a large-scale exhibition complex that can not only meet the needs of diplomatic and governmental activities of China's great powers

in the future, but also meet the needs of various high-energy business exhibition activities in China's international intercourse in the future.

In the future wave of intelligent construction, the group company will strengthen information empowerment, adhere to the deep application of BIM technology, and attach great importance to the research of advanced technologies such as the Internet of Things, cloud computing, 5G, and artificial intelligence. We will focus on forward-looking technologies, continue to tackle key problems and take the integrated route of industry, education, research and application. We will do a good job in the big data center platform, promote the digital transformation of the group, and build a small front office, strong middle office, and large back office expert system of the group. We will strengthen multi project linkage in application, and contribute to the integrated development and high-quality development of Beijing Construction Engineering Group Co., Ltd. In the future, we should continue to adhere to the spirit of seeking truth from facts and self-revolution, adhere to the problem oriented and goal oriented, and promote and apply more scientific research achievements to practice. In addition, we should follow the development trend of “new infrastructure”, strengthen scientific and technological research, enhance talent training and reserve, focus on building the group's intelligent construction base, link the upper and lower, and promote the transformation of achievements. We will promote innovation and reform of mechanisms and systems, take the initiative to seek innovation and change, make good use of the opportunity of the Group's preparation of the “Fourteenth Five Year Plan” development plan, strengthen top-level design, make persistent efforts, and create greater value for the Group's quality and efficiency improvement.

## 6. Deposition from Stakeholders

*“The engineering quality and design of the main media center are extraordinary”*

——Yanis, President of Olympic Broadcasting Service Company

*“In the process of preparing for the Beijing Winter Olympic Games and the Winter Paralympic Games, BOCOG has innovated the operation design scheme of the main media center for the Beijing Winter Olympic Games and the Winter Paralympic Games, integrating the two functions of the main media center and the international broadcasting center, which not only saved the occupied area, intensified venue space, shared equipment and facilities, but also improved the operation efficiency, enabling broadcasters and global media to enjoy better services here.”*

——Xu Zhijun, Deputy Secretary General of BOCOG





## Attachment: Enterprise Related Information



Company name: BCEG No.3 Construction  
Engineering Co., Ltd.

Company Address: Xicheng District, Beijing

Company website: <https://bj3j.bcegc.com/>

### Company Profile

BCEG No.3 Construction Engineering Co., Ltd. (hereinafter referred to as “the Third Construction Company”) is a Beijing municipal special qualification enterprise for general contracting of construction projects under the Beijing Construction Engineering Group Co., Ltd., with a registered capital of 1 billion yuan, an enterprise credit rating of AAA, and a Beijing trustworthy enterprise and quality management AAA certification unit. Since

1996, the Third Construction Company has successively passed the certification of ISO9001:2008 Quality Management System, ISO14001:2004 Environmental Management System and GB/T28001-2011: Occupational Health and Safety Management System. In 2010, the Third Construction Company was identified by the China Construction Industry Association as a pilot unit to implement the GB/T50430 Code for Quality Management of Engineering Construction Enterprises, and formulated the “1+1” management document.



It took the lead in obtaining the “1+1” double certificates of ISO901 and GB/T50430 quality management systems. At present, the company has 698 management personnel with senior and intermediate professional titles and professional and technical qualifications, and 429 national first and second class registered constructors.

The Third Construction Company has strong comprehensive supporting construction capacity, advanced management system, high-quality construction management talents, glorious tradition and long history. Since its establishment, it has left nearly 50 million square meters of various buildings for the world. In the 68 years of development, we have always adhered to the concept of “pursuing excellence and creating high-quality products”.

Our services cover the central and Beijing municipal party, government and military organs, universities, research institutes, medical and health, culture and entertainment, commercial tourism and civil housing projects. We have built many large landmark public buildings, such as the Great Hall of the People, the National Convention Center, the T3 Terminal of the Capital Airport, the Tianjin West Railway Station of the Beijing-Shanghai High-Speed Railway, the Beijing Municipal Government Affairs Service Center, Harbin Grand Theater, etc. We have built numerous high-quality projects, such as the National Library and Beijing Oriental Plaza, which have made outstanding contributions to the urbanization and modernization of the capital and even the whole country. Eight





projects have been listed in the History of World Architecture, and we have won 12 Luban Awards for Chinese Architectural Engineering, 21 National Quality Engineering Awards, 9 Zhan Tianyou Awards, 9 China Steel Structure Gold Awards, 280 ministerial awards such as Beijing Quality Engineering Awards, the Architecture Great Wall Cup and the Structure Great Wall Cup.

At present, the qualifications of the Third Construction Company include three general contracting qualifications, eight professional contracting qualifications, Grade A qualification in engineering design and construction industry, and Grade A qualification in lightning protection device testing. Among them, three general contracting qualifications are: special grade for general contracting of construction projects, grade III for general contracting of municipal public works, and grade III for general contracting of mechanical and electrical works. The eight professional contracting qualifications are: grade I for professional contracting of building decoration engineering, grade I for professional contracting of lifting equipment installation engineering, grade I for professional contracting of building mechanical and electrical installation engineering, grade II for professional contracting of building curtain wall engineering, grade III for professional contracting of foundation engineering, grade III for professional contracting of steel structure engineering, grade II for

professional contracting of fire protection facilities engineering, and grade II for professional contracting of electronic and intelligent engineering.

At the same time of creating high-quality projects, the Third Construction Company has also shouldered social responsibility. From earthquake relief to flood relief, from Shifang in Sichuan to aid to Hetian in Xinjiang, from security housing construction to urban-rural “hand in hand” joint construction, the Third Construction Company has been a lifelong pioneer, constantly overcoming urgent and dangerous tasks, and comprehensively demonstrated the strength and style of large state-owned enterprises.

The Third Construction Company has successively won dozens of honorary titles such as the National Customer Satisfaction Enterprise, the National Excellent Enterprise in Engineering Construction Quality Management, the National Demonstration Unit of Building Construction Safety Standards, and the National May Day Labor Award.

In the future, the Third Construction Company will continue to forge ahead towards the goal of leading enterprise groups in the same industry, continue to write a new chapter in history, and create new brilliance in the development of modern enterprises with a high sense of responsibility, a high spirit, and a solid work style.

# Advanced Planning, Science and Technology Driven: to Build an Efficient, Intelligent and Safe Operation and Maintenance Management Platform for China's Building Intelligent Pipe Corridor

◇ China Northeast Architecture Design & Research Institute Co., Ltd.

## Introduction

China Northeast Architecture Design & Research Institute Co., Ltd. adheres to innovation-driven, increases the training of scientific and technological talents, independently develops the operation and maintenance management platform of intelligent pipe corridor, and effectively guarantees the completion and operation of Shenyang South Canal underground comprehensive pipe corridor project through technology empowerment and technological innovation. The completion and operation of the project has laid a solid foundation for ensuring urban security, improving urban functions and realizing the construction of smart cities.





## SDGs

 Goal No.9	<p>It independently develops and innovates the operation and maintenance platform system, adopts the Internet + mode, integrates geographic information system (GIS), building information modeling (BIM), Internet of Things (IOT) and artificial intelligence (AI) technologies, and promotes the informatization and intelligent transformation of the construction industry.</p>	 Goal No.11	<p>Build a comprehensive pipe corridor management operation and maintenance platform, strengthen multifunctional underground infrastructure construction, and improve the safety level and disaster prevention and resistance ability of urban pipelines through monitoring, equipment management, BIM operation and maintenance management and coordination and linkage of mobile inspection system.</p>
 Goal No.13	<p>Precise design, construction and operation, reduce energy consumption and carbon emissions.</p>		

## CSR

 Fundamental Responsibility	<p>Through the integration of intelligent systems to deepen the design, the independent research and development of the operation and maintenance management platform of China's building smart pipe corridor, strengthen quality and safety management, increase scientific and technological innovation, and fulfill the basic responsibility of construction enterprises in multiple dimensions.</p>	 Labor Practice	<p>We should respect talents, strengthen their training and promote the building of a talented personnel team.</p>
 Environment	<p>Help reduce energy consumption and achieve green and low-carbon urbanization management.</p>	 Community Participation and Development	<p>We will build a smart and comprehensive pipeline system to guarantee safe, resilient and smart city infrastructure.</p>

## 1. Case Overview

Since 2014, China has been actively advancing the development of integrated underground pipe galleries as a part of the national development strategies. In 2015, Shenyang became one of the first pilot cities for underground pipe gallery construction in the country and established projects such as the South Canal Integrated Pipe Gallery, the Tiexi New District Integrated Pipe Gallery, and Wu'ai Street Integrated Pipe Gallery. In 2017, China Northeast Architectural Design & Research Institute Co., Ltd (the Northeast Institute) undertook the schematic design and research on the South Canal Integrated Pipe Gallery and gained independent intellectual property rights.

The South Canal section of Shenyang underground integrated pipe gallery project is 12.6 km in length, starting from the green belt north from South Canal Wenti Xilu bridge, ending at Shanlin road. The gallery is built along Shayang road, Wenyi road, North Binhe road, Xiaohe yan road, and Changan road, and it passes through Nanhu park, Luxun park, Youth park, Wanliutang park, and Wanquan.

The smart pipe gallery maintenance platform was launched in 2018; by 2020, the connection and display of the major four-ring networks—environmental control, fire protection, security and communication—and 20 subsystems. Currently, it has been officially put into use.

## 2. Case Background

In the construction process of underground infrastructure, all kinds of equipment—electricity, communication, water and drainage lines—often experience a series of issues due to flaws in overall planning and poor project management. Some common issues include repetitive road excavation, dense overhead line network, and frequent pipeline accidents. The development of integrated pipe gallery systems can help solve the issues above.

As General Secretary Xi Jinping pointed out when arranging flood prevention and control and disaster relief work in July, 2017, it is necessary to accelerate the development of underground pipe galleries in cities in order to improve flood prevention, reduce potential disasters, and expand relief capacities. The State Council has also issued two documents on infrastructure development and pipeline construction, strengthening the development of urban underground pipe systems. After the State Council issued the arrangement documents, the local governments took initiatives to build integrated underground pipe galleries and regarded them as important projects for the transformation of urban development and people's livelihoods. As of today, the newly constructed underground pipe galleries began to take effects: they have efficiently alleviated the issues of waterlogging and “road zippers,” which made citizens’ traveling and lives more convenient and enhanced the safety and resilience levels of urban pipelines.

The project design and planning process and relevant research work for Shenyang South Canal Integrated Pipe Gallery Project were launched in 2017. By September, 2018, the full pipelines were been fully connected. By December 2018, the construction of the whole system has been completed and was put into trial operations. 12.36 km in length and located in the old city district in Shenyang, the South Canal Integrated Pipe Gallery was the first pipe gallery employing the shield tunneling method in China. More than 1/3 of the shield section of the project is loated directly under the South Canal, where the terrestrial formation is diverse and complex, with many places having pebble layers of more than 30 cm deep, which posed great challenges for the shield tunneling process. The design, construction and maintenance processes all have great difficulties, which makes it the “first pipe gallery in China.” To achieve safe maintenance of the South Canal Integrated Under-



ground Pipe Gallery, the Northeast institute has not only completed in-depth design and integration of intelligent systems, but also took initiatives to research and develop a smart pipe gallery operations and maintenance management platform, which achieved a technological breakthrough.

Under the premise of relevant standard and specification for the construction of the pipe gallery, the China State Construction's smart pipe gallery operations and maintenance platform aims to support the operation of the pipe gallery throughout its full lifecycle. It addresses the issues experienced the design and construction phases due to the limits in the traditional management mode by incorporating BIM technology and provides data information and technological support for the operation of the pipe gallery at the later stage, which formulates a comprehensive management system for the whole lifecycle of the pipe gallery. The technology of the management platform employs the Internet + mode, integrating geographic information system (GIS), building information model (BIM), Internet of Things (IOT), and artificial intelligence (AI) technology. Furthermore, the service-oriented architecture model (SOA) is adopted, which can maximize the needs of different users and facilitate subsequent upgrades and maintenance with its modular design, independent function in each mode, and the flexibility in its usage. The system can achieve the integration of interaction, real, comprehensive and intuitive display of the comprehensive pipe gallery, bringing a real and interactive presence to the customers.

### 3. Responsibility Actions

China Northeast Architectural Design & Research Institute Co., Ltd is dedicated to building projects, carrying out innovation in management and technology, and enhancing project quality and efficiency, in hopes to make the construction of the pipe gallery more effective and "smart."

#### (1)Platform system innovation, ensuring information exchange and work efficiency

Integrative pipe gallery is one of the important symbols of modern urban infrastructure development in the 21st century. It integrates municipal pipelines such as electricity, communications, gas, heat, water supply and drainage into one system, which achieves comprehensive planning, design, construction and management of an essential basic infrastructure for the daily city operation. As an urban pipeline infrastructure that combines many types of pipelines in one, the pipe gallery bears the responsibility of the transferring of media, energy and information, which is a physical infrastructure on which urban development and survival relies, making it the "lifeline" of the city. The integrated pipe gallery avoids "zippered operation" and reserved sufficient space for the follow-up work in the laying, operations, maintenance, inspection and management of the pipelines to all be done in the pipe gallery. This makes the pipe gallery cost efficient and land efficient, which plays an important role in reinforcing the of construction and management of urban roads.

As urban economy rapidly develops, the problems of insufficient scale and quality of comprehensive pipeline management would begin to emerge. Many cities experienced incidents such as rainwater logging, pipeline leakage and explosion, and roads caving in, which heavily affects urban livelihood, property security and the order of urban operations. Optimized smart pipe gallery operation and maintenance platform adopts many modern information technologies such as BIM, GIS, robotics, wireless telecommunication technology, Internet of Things (IoT), and mobile terminals. This allows factors such as environment, video surveillance, lighting, fire protection, and electricity to be monitored through one system and displayed on one interface, which avoids isolated display and control of each elements of the situation of the pipe gallery and coordinately ensures the normal

and operations of the pipe gallery with real tie data. This is an important part of smart city construction. Ten people participated in the research and development process of this platform, 9 of which are male and 1 was female.

The smart pipe gallery operation and maintenance management platform supports the aggregation and integration of data from various service areas of the pipe gallery. Through the integration of GIS, BIM, IOT and other technologies, the pipe gallery security system, environmental system, fire protection system, communication system and other types of data, the management platform can achieve the macroscopic and microscopic organic combination of comprehensive pipe gallery operation and maintenance monitoring system. This allows rapid query and data retrieval and creates vivid display of the current situation of the pipe gallery with the BIM model. This also achieves an integrative approach to the operation and maintenance management of pipe gallery by combining geographic information system (WebGIS), 3D geographic information system (3DGIS) and BIM model system, which maximizes the convenience and practicality from the user's end.

The functions of the platform is divided into four parts: pipe gallery monitoring system, equipment management system, BIM operations and management system and mobile inspection system. Through the coordination and connection between the four systems, the platform can monitor and set alerts for the main body of the pipe gallery and ancillary facilities at once. The data on ancillary facilities include the gas detector data, exhaust equipment data, drainage equipment data, power system related data, lighting conditions, etc. Through software designated by hardware manufacturers, the platform an extract and monitor real-time data and display them on the platform. From the platform, the monitoring personnel can receive relevant data on the alerts or malfunctions of certain parts of the pipe gallery; based on this

data, they can formulate inspection and emergency response tasks and dispatch relevant personnel.



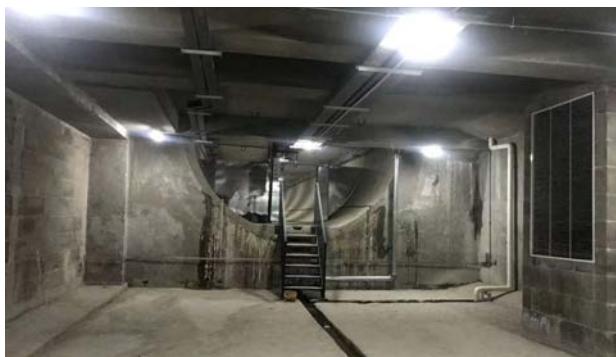
Image| The Master Control and Command Platform

## (2)Innovative technological platform, leading digital transformation

The smart pipe gallery operation and maintenance management platform adopts the “Internet +” technology, integrating geographic information system, building information model, Internet of Things, and artificial intelligence technology into one system. The platform monitors the operation indicators of each system in the pipe gallery with real-time data, and automatically completes the emergency handling of relevant alerts and mechanical faults according to the collection and coordination of real-time data on site. Using BIM technology, the model of the pipe corridor can be clearly visualized, which can be used as a public information exchange platform. The designers, construction companies and property rights entities of the pipe gallery can extract and view the relevant information within their own authority. At the same time, BIM technology can simulate the corridor pipeline laying and arrangement, which is accurate and direct. This can in turn improve the construction efficiency, facilitate reasonable arrangement of the progress of the project, and provides an accurate and visualized reference for the future comprehensive utilization of underground pipeline resources and scientific layout, pipeline usage approval and other works.

## Innovative Construction

The Shenyang South Canal Integrative Pipe Gallery is the first project in China to adopt the shield tunneling method. The pipe gallery is a large, circular basement. This “basement” has an inner diameter of 5.4 meters, and it was divided into two storeys. During the construction process, first, the contractor divided the circular pipe gallery in half horizontally through support formwork, steel binding and concrete pouring. Then, within the upper half of the basement, a partition wall was built in the middle, which creates two cabins. This divides the single hole pipe gallery into three sections, which gave exclusive spaces to the six major pipelines, reduced manpower needed during the construction process, and shortened the construction period, creating a model of the shield tunneling model employed in underground integrated pipe galleries.



Image| Shield Tunneling in the Pipe Gallery

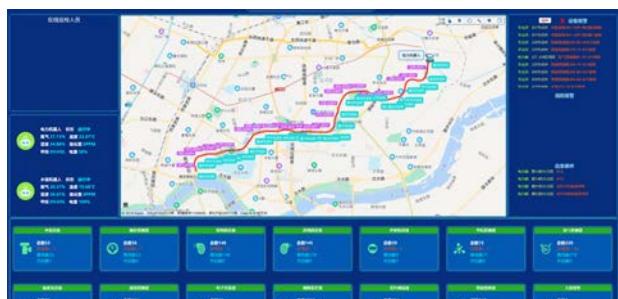
### Innovative Technology

The pipe gallery operations and maintenance management platform can monitor the statuses and conditions of all types of equipment in the gallery. At the same time, it would report on mechanical faults and alerts, which helps assess the objective situation and formulate flexible emergency response plans, which not only satisfies different situations, but also help create different plans for the same type of equipment under different conditions.

### Digitalized System

The digitalized system employs WEB+.

BIM+GIS+AI+IOT technology, integrating environmental system, security system, fire protection system, communication system, and electricity system. This achieves the visualization of real-time spatial data from the internet. This makes the real time information on each system of the underground integrated pipe gallery centralized, unified and intuitively displayed on the computer interface. At the same time, the system can turn on lighting equipment in the corresponding section according to the configured linkage strategies, and extract videos from security cameras of these sections to comprehensively visually monitor places such as the internal environment, the equipment room, the entrance of the pipe gallery. The videos can be switched to the front of the monitoring screen. This provides a safe, reliable, timely and effective smart control system for the managers of the pipe gallery. The effect of the system is shown in the image below.



Image|Digitalized Control System

### Lightweight Modeling

The BIM model contains a large amount of information and data, so it takes up a significant amount of memory space in the process of discretization, especially when loading the BIM model in the GIS platform. Through BIM modelling, the spatial layering and positions of the underground pipelines can be intuitively displayed, with which one can search for various attributes and spatial information on the pipeline; the system also supports cross-section, net distance, and collision analysis. The system can help users comprehensively man-

age the pipe gallery with a standardized method. Using BIM technology to accurately and intuitively simulate the layering and arrangement of the pipelines in the gallery, the system can enhance the efficiency of pipeline construction and contribute to the reasonable arrangements of relevant work in the future, providing valuable reference for the holistic planning of underground resource utilization and works around pipeline usage and approval. BIM modeling can automatically generate multi-resolution gradation models through dynamic data loading technologies. Through the platform, the lightweight processing of BIM data can be carried out in a way that avoids the consequential data loss or abnormality in traditional lightweight processing, ensuring the integrity of the data. At the same time, combining BIM and GIS, the system can integrate the underground pipeline data and store them in one place. Additionally, the system can utilize accurate simulation of underground pipelines and provide accurate raw data for future renovation or retrofitting.

### 3-D Visualization

Because of the narrow space in the pipe gallery, reserving enough space for future retrofitting work is essential. Applying the BIM technology, one can precisely simulate the layout of the pipelines, which increases the efficiency of construction work. The real time monitoring of the conditions provides great help to the pipe gallery operations company, the monitoring personnel, the on-site inspection personnel, the owner companies of the



Image|3-D Visualization of Pipelines

pipelines, and personnel for gallery access approval. The effect of 3-D visualization is shown in the image below.

### (3)Creating Culture of Innovation, Enhancing Talent Management

The Northeast Institute believes that the “human talents are the first resources,” and treated the identification, development, management and cultivation of talents in science and technology as one of the key strategies for the company’s development. The company emphasizes the recruitment, use, and training of talents, and is dedicated to creating an environment that respects knowledge and talents. The company continues to upgrade the diversity in expertise and the technical proficiency in its talent team by actively cultivating high talents with doctoral degrees, which ensures the sustainability of science and research works.

The Northeast Institute’s main tasks in special talent planning include expanding the service capacity of human resources, enhancing the hiring quality and allocation of talents, expanding the coverage of employee training, establishing talent incentives such as salary benchmarking, introducing employee training and management guidelines, and building a team of instructors and trainers within the company. This mainly includes arranging study tours visiting good practice cases, training on digitalization of applications, and team building activities. Through the abovementioned methods, the company not only enhanced the quality and efficiency of corporate management, but also improved the enterprise’s competitiveness. Meanwhile, the design specialists have acquired skills in software applications, which allowed them to use the software to transform 2D sketches of irregular buildings to 3D modeling, to visualize the innovative architectural concepts, and to better express the design concepts of architectural schemes. This also provides strong technical support for further development of the scheme and



later implementation, which enhances the company's capacity for original design, methods for architectural sketching and the degree of completion of architectural projects.

The team's research on digital design technology began in 2007. In 2011, the first BIM center in the survey and design industry was established by the Liaoning Province. The center is a support organization of the "Liaoning Building Information Modelling Research and Development Project Center" and the "Liaoning Provincial Building Information Modelling (BIM) Professional and Technical Innovation Center." In 2021, the center was designated as one of Liaoning Province's first batch of center for promoting digital transformation. The center is the main contributor to the compilation of 2 national standards, 3 industry standards, 3 group standards, and 10 local standards. The center was also the chief editor of a number of Liaoning BIM standards, realizing BIM technology coverage in the whole process from design-construction-operation and maintenance, and participating in the compilation of two Liaoning Provincial CIM standards. Since 2011, the center has played a key role in the enterprise's successful application process of national high-tech enterprises for four consecutive times, and it made significant contributions

#### 4. Effect of Responsibility Fulfillment

The smart pipe gallery operations and maintenance platform made full utilization of the BIM and GIS technologies, which aided comprehensive digital transformation and processing of all aspects of urban infrastructure relevant to human livelihoods. The platform achieved effective allocation and management of resources and reduced at least 20% of operations and maintenance costs. From the aspect of development of smart cities, the utilization rate and convenience of digital resources in-

creased at least 75%. On the basis of core technical achievements, the smart pipe gallery continued to enhance its theoretical framework, carry out engineering practices and create high-tech products, which realized the steady development goals and created great economic values. Additionally, because the platform adopted innovative technology such as big data, intelligence, telecommunication, and internet of things, the platform can actively promote the digital transformation of the construction industry. By building a digital platform, conducting enterprise technology research, product transformation and other services, the platform has brought the enterprise to a leading position in the industry.

The development of and the big data analysis and application in the South Canal Integrated Pipe Gallery Operations and Maintenance Platform will certainly provide comprehensive data analysis and decision support services to government, operations enterprises and owners. Meanwhile, once the integrated pipe gallery enters the operation stage after its completion, it will help ensure city's safety, improve urban functions, promote integrative and highly efficient urban transformation, enhance urban taste, which builds a solid foundation for the development of a smart city. While it improves industry development, the quality of municipal management and quality of life, the platform also contribute to the green development goals. It is closely associated with the sustainable urban development goals and can help reduce energy use and carbon emissions, achieving great performances in making significant impacts on the green and low carbon urban development.

In 2018, the smart pipe gallery operation and maintenance platform obtained the computer software copyright registration of the China State Construction Intelligent Pipe Gallery

operation and maintenance management platform. In addition, it received many awards, including the third prize of science and technology of China State Construction Group in 2018, the 9th “Innovation Cup” Building Information Model (BIM) Application Competition prize, and the second prize of the “2020 Gold Label Cup BIM/CIM Application Maturity Innovation Competition Operation and Maintenance Group”. In 2021, the smart platform independently developed by China Construction Northeast Institute was included in the smart city construction application project of State-owned Assets Supervision and Administration Commission of the State Council. The certificate is shown in images below.



Image|China State Construction Science and Technology Prize



Image|Software Copyright

Image|The 9th “Innovation Cup” Building Information Model (BIM) Application Competition prize

## 5. Future Outlook

The China State Construction Smart Pipe Gallery Operation and Maintenance Platform is the key R&D result of China Northeast Architectural Design & Research Institute Co., Ltd in digital transformation. Applying the “Internet +” model,

the platform integrated BIM+GIS+IOT+AI WEB technologies in one system, which creates a safe and controllable environment for the digital development in the industry and ensures the sustainability and new competitiveness in the development of the industry.

(1)Digitalize the whole production chain with focus on core technology

Starting from optimizing the digital management system of BIM and the digital application of BIM technology, the Northeast Institute aims to establish a BIM digital design, construction, operation and maintenance process management platform, combining the practical demands and effectively adopting BIM, Internet of Things, big data, cloud computing, mobile communications, blockchain, artificial intelligence, robotics and other related technologies. This would hopefully improve the overall level of informatization of construction methods, develop a “digital twinning” city and smart city, and promote digital transformation. Adopting BIM forward design, the platform may optimize the design process and support data exchange and cross-discipline information sharing, as well as information sharing across the design and production, and construction stages. The digital design methods such as BIM can achieve optimization in coordinated and collaborative design. Integrating the application of BIM, GIS, 3D measurement and other information technology and simulation analysis software, the platform can carry out performance simulation analysis, design optimization and deliverables in each phase. Integrating digitalization into the whole process of project planning, design, construction, delivery and development, the platform can fully reflect the overall characteristics of informatization, intensification, greening and industrialization to improve the quality of construction projects and promote the high-quality development of the construction industry. Using BIM technology and an information management platform based on unified data



and interface standards, it can support the sharing and transmission of information at all participants and stages, and promotes the digitalization, networking and intelligent technology application of the whole process.

(2)Enhancing the capacity of digitalization, promote urban transformation, and establishing a solid ground for smart cities

The “14th Five-Year Plan” Engineering Survey and Design Industry Development Plan proposed to promote the BIM application in the full lifecycle of buildings, the digital delivery of engineering projects, and the digitalization, standardization and integration in design. In addition, it proposed to design and apply public service platforms by promoting the application of BIM software and integration with CIM platform, actively explore

the integration of digital project deliverables and data from basic CIM platform, and develop mechanisms for data synchronization.

The development of and the big data analysis and application in the South Canal Integrated Pipe Gallery Operations and Maintenance Platform will continue to provide comprehensive data analysis and decision support services to government, operations enterprises and owners.

The project will also become a representative project in the development of pipe galleries in China. The successful operations of the pipe gallery will help ensure city’s safety, improve urban functions, promote integrative and highly efficient urban transformation, enhance urban taste, which builds a solid foundation for the development of a smart city.

## 6. Deposition from Stakeholders

*“One of the biggest highlights of the South Canal Integrated Pipe Gallery is that it conducted independent research and development of the smart operation and maintenance platform. When the alarm goes from the environmental monitoring system, it is connected to the relevant fan pump equipment to ensure the safety of the operation and maintenance personnel and equipment within the pipe gallery. When the infrared dia-beam or dual detector detects a person’s intrusion, the security system would send out an alarm signal and activate the lighting and surveillance video in corresponding areas. It would further send the alarm and project the video from the site onto the large screen in the master control center.”*

——JIN Changjun,General Manager of Shenyang China State Construction Pipe Gallery Development Co.,Ltd

## Attachment: Enterprise Related Information



Company Name: China Northeast Architecture Design and Research Institute Co., Ltd.  
Company Address: Shenyang, Liaoning Province  
Company Website: <https://nein.cscec.com/>

### Company Profile

China Northeast Architectural Design and Research Institute Co., LTD. (hereinafter referred to as China Construction Northeast Institute) is a national large-scale comprehensive architectural survey and design unit, which was founded in 1952. It is one of the six regional architectural design institutes established by the central government to adapt to the economic construction of New China. It is affiliated to China State Construction Group Co., LTD., one of the world's top 500 enterprises.

China State Construction Northeast Institute has the qualification and ability to carry out territorial space planning, whole-process consultation, design and construction. The company has design qualification of Class A in urban and rural planning, Class A in construction industry (construction engineering), Class A in municipal industry (except gas engineering and rail transit engineering) and Class A in engineering investigation and synthesis. Has the construction project construction general contracting Class 1 qualification. Its subsidiaries





have 18 professional qualifications, such as engineering supervision (housing construction engineering A, highway engineering, municipal public engineering) Class A, construction drawing (housing construction engineering, over-limit high-rise building engineering, municipal infrastructure engineering) examination Class A, foundation and foundation engineering professional contracting Class A, etc.

Build northeast courtyard has eight comprehensive design institute in Shenyang headquarters, municipal design institute, institute of planning and design institute, institute of green building, innovation technology, digital design and research institute, periodical management, general contracting company, build the east geotechnical engineering co., LTD., China construction engineering consultant (Liaoning) co., LTD., Shenyang east building construction drawing examination consulting co., LTD. It has 4 regional design institutes in Shenzhen, Dalian, Shanghai and Fuzhou. In Shenzhen has set up the construction of Macau decoration engineering Co., LTD. It has 19 branches in Xiamen, Xiongan and Hainan.

Since 2011, it has been recognized as a high and new technology enterprise. It has 4 provincial engineering and technology centers, and is recognized as the National prefabricated construction industry base. It has led the establishment of Liaoning Solid Waste Industry Industry-University-Research Alliance. It is the host of three national core periodicals: Architectural Design Management, Concrete and Building Energy Conservation.

The company has 2818 employees, including 2 national engineering survey and design masters, 15 Liaoning engineering survey and design masters, 18 experts enjoying the special allowance of The State Council, 2 chief experts of CSCC, 1 expert of CSCC, 384 people with professional registration qualification. There are 130 professor-level

titles, 521 senior titles and 692 intermediate titles.

Since its establishment, the institute has completed more than 35,000 kinds of industrial and civil architectural designs, involving various industries, throughout the country and dozens of countries and regions in Europe, Asia, Africa and so on. It has won more than 1000 national, provincial and ministerial excellent design awards. The Institute has edited and participated in the compilation of more than 100 national, industrial, provincial and municipal technical standards and design codes, among which the National Masonry Committee and Civil Building Electrical Committee are at the leading level in this field. China STATE Construction Northeast Institute in all previous national survey and design units in the comprehensive strength of the evaluation of the top 100, ranked among the best architectural design units, in the domestic and foreign construction industry enjoys a high reputation. In recent years, it has been awarded “Excellent Survey and Design Institute” by China Survey and Design Association, and selected as “One Hundred Contemporary Chinese Architectural Design Institutes” by China Architectural Society.

Adhering to the core values of “quality assurance, value creation” and the enterprise spirit of “integrity, innovation, transcendence and win-win”, China Construction Northeast Institute strictly implements the national construction guidelines and standards. Fully implement GB/T 19001-2016, GB/T 24001-2016 and GB/T 45001-2020 standards in engineering design and technical consultation, and pass the digital engineering management system review according to ISO19650 standard. The company is first design enterprise in China to obtain four certifications of digital engineering management system, software and hardware evaluation of building information model application, and digital engineering project service at the same time, ensuring to provide high-quality products and satisfactory services to users.

## Corporate Culture

Quality Assurance

Value Creation

### Major honors in the Past Three Years

Order	Time	Project	Awards
1	2021	Key technologies for the construction of large complex commercial	Third prize for technological progress of Liaoning province
2	2021	Key technology and application of partially filled concrete steel pier (PCFST Pier) that can be assembled for construction	Second prize of JHF Engineering Award
3	2021	Research and application of key technologies for structural design and construction of prefabricated steel Bridges in cold regions	First prize of Science and Technology Progress of urban and rural construction in Heilongjiang Province
4	2020	Research and application of BIM-based split design technology ++ for prefabricated buildings	Second Prize of Science and technology Progress of urban and rural construction in Heilongjiang Province
5	2019	Energy consumption standards for civil buildings-	First prize of Huaxia Construction Science and Technology Award
6	2019	Development and application of collaborative design software for prefabricated concrete structures based on autonomous BIM platform	Second Prize of JHF Engineering Award



Urban and Rural Construction Science and Technology Award Certificate



Huaxia Construction Science and Technology Award Certificate



## Employee Data

There are 1,881 male workers and 937 female workers.

## Performance Data in Recent Three Year

Index	Unit	2019	2020	2021
Total Assets	100 million	10.51	12.00	14.31
Operating income	100 million	11.96	12.82	17.81
Total Profit	100 million	0.22	0.37	0.22

# Implement the Design of Medical Building Under the Principle of “Flexible Conversion Before and During an Outbreak”, Lead the Construction of “Resilient City” in Health and Safety

◇ Central-South Architectural Design Institute Co., Ltd.

## Introduction

Central-South Architectural Design Institute Co., Ltd. actively promotes the innovative design of medical buildings based on the concept “flexible conversion before and during an outbreak”, and participates in the construction of medical and health infrastructures in several large and medium-sized cities in China with digital (BIM) technology, which is conducive to improving the medical and health hardware reserves of cities in response to public health emergencies, and contributing to the construction of a stronger and more resilient public health system in terms of software and hardware.





## SDGs

 Goal No.3	<p>Accomplish 38 anti-epidemic projects, including the Leishenshan (Thunder God Mountain) Hospital and 21 mobile cabin hospitals with more than 30,000 beds in total, which play an important role in treating the COVID-19 patients and controlling the epidemic.</p>	 Goal No.9	<p>Promote the innovative design of medical buildings based on the concept of “flexible conversion before and during an outbreak”, and complete dozens of medical building projects based on the concept of “flexible conversion before and during an outbreak, grading response”, improve the city’s medical and health hardware reserves in response to public health emergencies.</p>
 Goal No.10	<p>Promote the concept of “flexible conversion before and during an outbreak, grading response”, optimize the regional distribution of high-quality medical resources.</p>	 Goal No.11	<p>Construct hospitals under the concept of “flexible conversion before and during an outbreak”, compile relevant industry specifications of Design code for dual - use design of large public facilities in Hubei province, so as to contribute to a stronger and more resilient public health system in terms of hardware and software for the city.</p>
 Goal No.12	<p>Select energy-saving and consumption-reducing equipment and systems in a reasonable way, reduce losses of construction materials, improve efficiencies of provisional facilities and revolving materials, and build sustainable medical infrastructure.</p>	 Goal No.13	<p>Green planning, green design and green construction will be run through the whole project to obtain significant effects of energy-saving and consumption-reducing.</p>

## CSR

 <p>Fundamental Responsibility</p>	<p>Insist on innovation-driven development, use digital technology, and participate in the construction of medical and health care infrastructure in many large and medium-sized cities. Compile relevant industry specifications of Design code for dual - use design of large public facilities in Hubei province for industry development. Conduct independent research and development on EPC construction management platform to assist site management, and improve working efficiency of quality and safety management.</p>	 <p>Environment</p>	<p>Green planning, green design and green construction will be run through the whole project. Select energy-saving and consumption-reducing equipment and systems in a reasonable way so as to obtain significant effects of energy-saving and consumption-reducing.</p> <p>Conduct precise material placement and fine management to reduce the loss rate of building materials and improve efficiencies of provisional facilities and revolving materials.</p>
 <p>Community Participation and Development</p>	<p>Active engagement in the fight against the epidemic and accomplishment of 38 anti-epidemic projects with our own strengths could play a vital role in guarding public health in the face of public health emergencies and lay a good foundation for building a “healthier, safer and more resilient city”.</p>		



## 1. Case Overview

Public health emergencies are gradually becoming one of the biggest risks to global economy and security, and the COVID-19 pandemic has brought long-term and profound impact to the world's political, economic and social life. At the early stage of epidemic outbreak, Central-South Architectural Design Institute Co., Ltd. based in Wuhan has accomplished 38 anti-epidemic projects, including Leishenshan (Thunder God Mountain) Hospital and 21 mobile cabin hospitals, with more than 30,000 beds in total, playing an important role in treating the COVID-19 patients and controlling the epidemic. When the epidemic was under control, our company further promoted the innovative design of medical buildings based on the concept of "flexible conversion before and during an outbreak", and completed dozens of medical building projects based on the concept of "flexible conversion before and during an outbreak and grading response", such as Wuhan Yunjingshan Hospital and Huangpi District People's Hospital, to improve the city's medical and health hardware reserves in response to public health emergencies, and to pursue the concept of "resilient city" construction with health and safety.

## 2. Case Background

The 21st issue of *Qiushi* (Seeking Truth) in 2020 published an important article by General Secretary Xi Jinping, *Some Major Issues of National Medium- and Long-term Economic and Social Development Strategy*. The article states, "We should improve urbanization strategies, consider safety of people's lives and their physical health as the basic goal of urban development, further promoting urbanization with people at its core, and bringing healthier, safer, and more livable cities". "Create livable, resilient and intelligent cities, and establish high-quality urban ecosystems and safety systems." In the *Proposal of the Central Committee of the Communist Party of China on the 14th*

*Five-Year Plan for National Economic and Social Development and the 2035 Vision* released in November 2020, "urban resilience" has become one of the core objectives of sustainable urban development, the core of which is to respond to changes or shocks in an effective way, and to deploy resources reasonably so as to quickly recover from disasters.

On August 17, 2020, the Department of Planning, Development and Informatization of the National Health and Wellness Commission of China issued the "Notice on the Issuance of Technical Guidelines" for building Convertible Wards based on the concept of "flexible conversion before and during an outbreak (for Trial Implementation)". It proposed that full use of informatization and wisdom should be made to improve the intelligent operation and management of general hospitals based on the concept of "flexible conversion before and during an outbreak". We should also accelerate data sharing and business collaboration between hospitals and disease prevention and control institutions, and strengthen the construction of intelligent hospitals.

"A healthier, safer, and more resilient city" is a clear goal for future urban development. The design of a comprehensive hospital based on the concept of "flexible conversion before and during an outbreak" constitutes a key part of the construction of resilient city. As one of the six earliest comprehensive architectural design institutes in China, with nearly 70 years of experience in medical and health care architectural design and dozens of medical architectural design practices since the outbreak of the epidemic, we have practiced medical architectural design method under the concept of "flexible conversion before and during an outbreak, grading response" and used digital (BIM) technology, participated in the construction of medical and health care infrastructure in many large and medium-sized cities in China. We have Compiled relevant industry specifications of De-

sign code for dual - use design of large public facilities in Hubei province, contributing to the construction of a stronger and more resilient hardware and software public health system in cities.

Following the implementation of the project, Central-South Architectural Design Institute Co., Ltd. has further fulfilled the social responsibility of state-owned enterprises, won itself a good social reputation, and put into practice the core value of “Innovation and Creativity, Sincerity and Proficiency”.

### 3. Responsibility Actions

“Flexible conversion before and during an outbreak, grading response” stands as the critical measure for the sustainable development of cities and major public health risks. When there is no epidemic, we can plan ahead, reserve resources and optimize the regional distribution of high-quality medical resources; When the epidemic comes, the emergency plan should be in place and switched quickly, the major epidemic treatment base should be launched in short order, steady emergency medical resources should be guaranteed, so as to respond to public health emergencies in an effective way.

The following contents will use Wuhan Yunjingshan Hospital and Huangpi District People’s Hospital as typical cases to illustrate the concept of “flexible conversion before and during an outbreak, grading response” in medical architectural design, hoping to set a constructive example for a series of projects in large cities in response to major public health events.

(1) The design overview of Wuhan Yunjingshan hospital based on the concept of “flexible conversion before and during an outbreak”

Wuhan Yunjingshan Hospital is located in Jiangxia District of Wuhan City, which is also the urban area that Leishenshan (Thunder God Mountain)

Hospital stands. It covers an area of 252,000 square meters (including 172,000 square meters of ground floor construction area and 80,000 square meters of underground construction area), with 1,000 beds of “flexible conversion before and during an outbreak”, and space reserved for temporary emergency hospital, which accommodates 1000 beds. Designers involved in the project reach a total of 53 people, including 28 male employees and 25 female employees, whose working areas involve architecture, structure, HVAC, water supply and drainage, electrical, architecture intellectualizing, interior, curtain wall, landscape, floodlighting, and medical engineering.

It is known that the four types of treatment sites, namely, “mobile cabin hospital, temporary hospital, designated hospital and critical care hospital”, have played a key role in coping with the public health emergencies in the fighting against the COVID-19 in Wuhan. This treatment mechanism with classification, stratification and diversion is able to allocate valuable medical resources in a scientific and reasonable way. With its efficient anti-epidemic work, we get out of the dilemma of run on medical resources at the early stage of the epidemic.

The layout of Wuhan Yunjingshan Hospital follows the practical experience of Wuhan. It launches the strategy of “flexible conversion before and during an outbreak”, and optimizes resource allocation to realize efficient medical treatment system. First of all, Wuhan Yunjingshan Hospital realizes rapid conversion of “before and during an outbreak” in terms of functional partitioning, with three major functional areas operating at ordinary times, namely, comprehensive medical area, administrative and living area, and reserved emergency area. The reserved emergency area can be used as a fitness and recuperation area in normal times to optimize medical and recuperation resources. In times of epidemic, the three areas mentioned above will be quickly converted into two, the contaminated area

and the clean area. The contaminated area, separated from the clean one, is leeward. Integrated medical area is the focus of streamline in normal practice. In times of epidemic, patient streamline, dirt streamline and medical and nursing streamline are clearly separated and set up independently of each other.



Overall Effect of Wuhan Yunjingshan Hospital



Reality Image of Wuhan Yunjingshan Hospital

Wuhan Yunjingshan Hospital also makes full use of the strategy of grading response in the hospitalization function, classifying buildings in terms of usual diagnosis and treatment mechanism. The disorderly and uneven buildings are set up as in-patient complex, rehabilitation complex, mid-end elderly building and high-end elderly building according to their respective functional characteristics and the demand of landscape resources. During the epidemic, a four-tier treatment system, which includes mobile cabin hospital, temporary emergency hospital, critical care hospital and designated hospital, is adopted for different response levels. The parking building is converted to a mobile cabin hospital for patients with mild symptoms, the emergency area is reserved for the

construction of a temporary emergency hospital, the inpatient complex and rehabilitation complex are converted to critical care area, the mid- to high-end elderly inpatient building is converted to a designated hospital, and local medical and technical areas are also converted simultaneously, with the clean area operating independently. Correspondence can be found between the four-tier treatment system and the system of tiered diagnosis and treatment. Along with the changes of epidemic, the resource allocation with differentiation mentioned above is capable of mutual adjustments, and is determined in the light of actual situation, ensuring safety isolation in hospitals and avoiding the waste of medical resources, improving the efficiency of specialized medical care.



“Flexible Conversion Before and During an Outbreak, Grading Response” Planning

(2) People's hospital in Huangpi District (Central Hospital Area) design overview of “flexible conversion before and during an outbreak” and BIM technology application

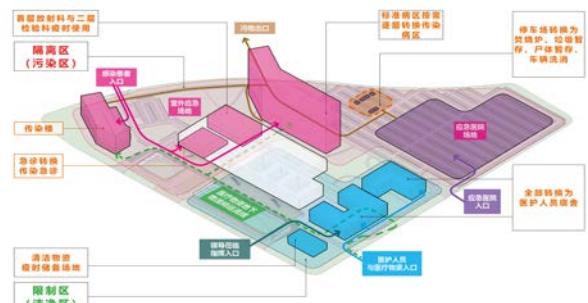
The construction of People's Hospital in Huangpi District (central hospital area) is based on the standards of Grade-A tertiary hospital under the concept of “flexible conversion before and during an outbreak”. It covers an area of 240,000 square meters (including 172,000 square meters of ground floor construction area and 68,000 square meters of underground construction area), with 1,000 beds under the concept of “flexible conversion before and during an outbreak” and 200 beds for infectious

disease. Designers involved in the project reach a total of 59 people, including 31 male employees and 28 female employees, whose working areas involve architecture, structure, HVAC, water supply and drainage, electrical, architecture intellectualizing, interior, curtain wall, landscape, floodlighting, and medical engineering.



Overall effect of People's Hospital in Huangpi District  
(Central Hospital Area)

People's Hospital in Huangpi District is graded as Grade-A tertiary hospital normally while it can be transformed into an infectious disease hospital during the epidemic. The transformation requires that the hospital must be relatively flexible to switch its functions between usual and epidemic times, and that a large amount of hospital resources can be orderly put into treatment against epidemic outbreaks of infectious diseases in a short period of time.

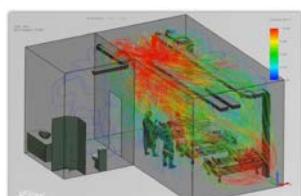


“Flexible Conversion Before and During an Outbreak” Planning

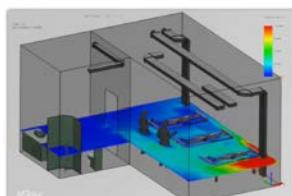
The project adopts the designer-led EPC model for construction. Project information sharing and

collaboration are especially critical since there are many parties and complex relationship involved. The BIM forward design concept is integrated into the design process of “flexible conversion before and during an outbreak” to make effective use of building information and share it. With its focus on designing of “flexible conversion before and during an outbreak”, the results of BIM forward design are repeatedly simulated and modeled to test the reliability and stability of multi-system co-operation under different operating environments.

① Based on BIM technology, we simulate and analyze the “flexible conversion before and during an outbreak” scheme for optimal design scheme. At the same time, the leading XFLOW fluid simulation technology is used to simulate the air distribution and pollutant diffusion in the ward, so as to optimize the design scheme to maximize the protection of medical and nursing staff, and to prevent cross-infection.



Epidemic Status - Indoor Airflow Analysis



Epidemic Status - Bed Height Cloud Map

② A large number of applications for design optimization are carried out based on the BIM model. Analysis and calculation of wind environment, day lighting, fire evacuation simulation, etc. are conducted with BIM model. The landscape effect, in addition to the building net height and machine room are respectively optimized by REVIT+LUMION and BIM, which builds deepening model of the machine room, simulates installation routes and reserves lifting holes.

In view of the complexity of mechanical and electrical pipeline, and heavy workload of management characterized by the hospital project. It

is supposed to apply the self-developed electro-mechanical design software as the forward design tool for electromechanical profession. The drawing of electromechanical pipelines can be completed directly by the software, and the self-developed pipeline turning algorithm can be used to automatically carry out the overall automatic pipeline synthesis.

③ In order to solve the problems of EPC management, we independently develop EPC construction management platform to assist site management, realizing lightweight without any losses. The platform allows both smooth browsing on mobile terminal and version management of drawings, improving the efficiency of drawing information sharing and facilitating the use of site management. In addition, the platform has important functions such as schedule management, quality and safety management, hazard source identification of project, project data management, online approval management and construction settlement. The construction management platform speeds up site efficiency, enhances construction progress, realizes trace management of the construction process, and guarantees further refinement of work.



EPC Construction Management Platforms

(3) Related measures of environmental protection of project

Fully adopting the design adapted to Wuhan's regional climate characteristics, both of the projects

use green building technology, reasonably choose energy-saving and consumption-reducing equipment systems, so as to achieve significant energy-saving and consumption-reducing effects. They improve micro-environment by courtyard setting and landscape adjustment, and achieve the goal of controlling the total amount of runoff and the use of rainwater resources by sponge city measures.

During the construction of the project, we actively implement the concept of green planning, green design and green construction, try to use assembled materials for interior walls, interior decoration, exterior walls, pipelines, etc. We carry out precise materials and fine management to reduce the loss rate of construction materials, and to improve the reuse rate of temporary facilities and turnover materials. This avoids generation of too much construction waste, and achieves effective resource saving, environmental protection and reduction of construction waste.

Dirt rooms and dirt elevators in outpatient, medical and technical departments, and inpatient care units are set up in the hospital, dedicating to the collection of medical pollutants, sealed packing and transportation. Specialized protection and disposal facilities, where medical pollutants are concentrated for disposal and shipped out by the site-specific sewage outlet, are installed for medical waste and dirt. Medical wastewater is collected in the hospital's sewage treatment station for disinfection, and can be discharged only after reaching the standard.

#### 4. Effect of Responsibility Fulfillment

In 2020, the company won the honorary title of "National Advanced Group in Combating the COVID-19 pandemic" and "National Advanced Grassroots Party Organization". When the epidemic was under control, the company helped Wuhan city complete more than ten large general

hospitals under the concept of “flexible conversion before and during an outbreak”, which shored up weak link of the public health system, and made full use of informatization and intelligence to improve the level of intelligence construction of general hospitals under the concept of “flexible conversion before and during an outbreak”.

The completion of Wuhan Yunjingshan Hospital and Huangpi District People’s Hospital (central hospital) has marked further improvement of Wuhan’s public health emergency and service guarantee system under the concept of “flexible conversion before and during an outbreak”, from management of early warning information, disease control and prevention, disease treatment, to storage of emergency supplies. It has also shored up the weak link of the public health system (including two projects introduced in this passage). It is projected that beds (convertible) under the concept of “flexible conversion before and during an outbreak” in Wuhan will reach 9600, to promote sustainable urban development of the construction of a “resilient city”. In addition, BIM standardized process construction has been carried out in the project, and a complete BIM collaborative process and management platform have been established to enhance the intelligence level of the project construction.

## 5. Future Outlook

In the future, we should pay attention to the improvement of urban public health, prevention and mitigation of disasters in the course of rapid urban construction and development process, to build a “resilient city” with the ability of tolerance, adapting and recovering quickly in special environments, and to make the city safer and more capable of resisting risks. At the same time, it is also necessary to take active use of digital and intelligent tools to improve urban functions and enhance urban resilience, so as to achieve delicacy management and long-term sustainable development of cities.

As an important participant in urban construction, Central-South Architectural Design Institute Co., Ltd. also actively cooperates with leading enterprise like Huawei, France Dassault, building a multi-disciplinary and large collaborative PLM (Product Lifecycle Management) application platform in joint efforts to promote paperless design and construction throughout the construction industry. During the 14th Five-Year Plan period, the company is determined to transform into a digital high-tech service provider for modern city construction, and to contribute to the construction of digital and intelligent resilient cities.



## 6. Deposition from Stakeholders

*The Guanggu South Health Industrial Park is booming, with hundreds of thousands of people working or moving in and around the industrial zone in the next 5 to 10 years. Those people could enjoy quality medical service since they live in close proximity to Yunjingshan Hospital.*

——Wang Chao, Director of the Wuhan Yunjingshan Hospital

*Yunjingshan Hospital is a national Grade-A tertiary geriatric-specialized hospital and an international medical service center under normal conditions, and it can be converted into an infectious disease hospital during the epidemic period, in which 1,000 beds will be used to treat patients, and 1,000 beds catering to the demand in serious epidemic situation can be temporarily built in the reserved area.*

——Lu Jie, Project Manager of China Construction Third Engineering Division Co., Ltd. (Construction Organization)

*Grade-A tertiary general hospital(Huangpi District People's Hospital) is built to guarantee the interest, well-being and happiness of people by shoring up weak link and strengthening foundation of medical health service system following epidemic.*

——Zeng Sheng, Party Secretary of Huangpi District Committee

*The BIM forward design concept devised by The Huangpi District People's Hospital (central hospital area) lays foundations for a number of factors like “flexible conversion before and during an outbreak”, overall setting, functional layout, and flow transformation. With advantages in data model integration and efficient information transfer by BIM, this project can efficiently enhance the collaborative working ability, providing a great help to its rapid construction.*

——Ruan Shijun, Deputy Governor of Huangpi District People's Government, Wuhan City, Hubei Province

## Attachment: Enterprise Related Information



Company Name: Central-South Architectural Design Institute Co., Ltd. (CSADI)  
Company Address: Wuhan, Hubei Province, China  
Company Website: [www.csadi.com.cn](http://www.csadi.com.cn)

### Company Profile

Being one of the six earliest comprehensive architectural design institutes in China, Central-South Architectural Design Institute Co., Ltd. (CSADI), founded in 1952, is one of the “Top 100 Enterprises in National Survey and Design Industry” and “Top 100 Architectural Design Institutes in Contemporary China”. In 2020, the company was again ranked as one of the “Top 80 Chinese Contractors and Top 60 Engineering Design Enterprises” by the Engineering News Record (ENR) of the United States. It was also awarded the honorary titles of “National Advanced Group in Combating the New Coronary Pneumonia Epidemic” and “National Advanced Grassroots Party Organization”.

The company centers on architecture and planning design, with its focuses on providing customers with technical and management services for the whole process of construction projects. It has the design qualification of Grade A in urban and rural planning, Grade A in geotechnical engineering of engineering survey, Grade A in engineering cost consulting enterprise, Grade A in credit of construction engineering and municipal public works, Grade A in supervision of housing construction engineering, Grade A in design of construction engineering, landscape gardening, commercial and food industry (frozen and refrigerated engineering), municipal industry (water supply engineering and drainage engineering), and Grade B in Construction engineering general contractor,





and Grade A in foundation engineering professional contractor. The company is equipped with national leading technology in the fields of public buildings, super high-rise buildings, large-span space structure and complex structure, Jingchu architecture, BIM application, “Internet+” technology application, etc., providing specialized and whole-process engineering technology and management services, such as architectural design, urban planning, municipal engineering, EPC general contracting, various engineering special design and consulting, green technology design and consulting, engineering survey and geotechnical engineering, engineering consulting and project planning, project management and engineering supervision, special design and construction integration, etc., for society with high quality and efficiency.

As a high-tech and an intellectual-concentrated enterprise, the company regards talents as the core resources for enterprise development, and is committed to cultivating the innovative consciousness and stimulating the innovative vitality of talents. There are more than 1900 skilled personnel, including 2 national survey and design masters, 35 experts at the provincial and ministerial level or above, such as experts receiving special allowances from the State Council, national young and middle-aged experts and young and middle-aged experts with outstanding contributions in Hubei Province, and nearly 600 registered personnel of various types, creating a high-quality professional technical and management team.

For nearly 70 years, more than 19,000 projects have been completed in 30 provinces, municipalities, autonomous regions and in nearly 40 countries and regions, among which over 800 projects have been awarded the national, ministerial and provincial Excellent Design Awards and Prize for Progress in Science and Technology. The Yellow Crane Tower and Wuhan Opera House designed by the company won the Grand Prize of Architectural Creation for the 70th and 60th Anniversary of

the Founding of the People’s Republic of China. Other projects such as Guangdong Science Center, Yan'an Railway Station, Hubei Provincial Museum and Shenzhen International Trade Center won the Grand Prize of Architectural Creation for the 60th Anniversary of the Founding of the People’s Republic of China. Among them, Guangdong Science Center also won the Golden Award of National Excellent Engineering Survey and Design and the Fédération Internationale Des Ingénieurs Conseils (FIDIC) Centennial Award for Outstanding Major Architectural Projects. Xiamen North Station project won the International Association of Bridge and Structural Engineering (IABSE) Outstanding Structure Award (Finalist), the highest award recognized in the international bridge and structural engineering industry.

In recent years, Central-South Architectural Design Institute has been adhering to the strategic guidance of “three transformations and three upgrades”, and further consolidating the traditional design business. With high-quality development of enterprise as its goal, the Institute has promoted the transformation of EPC business model with design as its core, and whole personnel, elements and process as its impetus. The company has built a number of influential EPC projects, winning it good reputation and social credibility, and achieving leap-forward development. In the meantime, with its talent, technology and project advantages, Central-South Architectural Design Institute vigorously promotes the construction of professional team and implements platform management, making continuous refinement in the professional field and maintaining its leading edge in the industry.

In 2020, during the COVID-19 pandemic, Central-South Architectural Design Institute, bearing in mind the mission of state-owned enterprises, acted on orders and headed for the frontline against the virus, completing 38 anti-epidemic construction projects in one month, including the Lei Shen Shan (Thunder God Mountain) Hospital,

and providing strong support for the prevention and control of the epidemic in Hubei and Wuhan. Though against the complex background of decline in industry growth and epidemic prevention and control, the company achieved an upward trend in all operational indicators. 2021 marks the opening year of the 14th Five-Year Plan, and based on this new development stage, the company implemented new development concept and made every effort to build a new development pattern, contributing to steady progress of the business indicators on the basis of 2020, with its operating revenue, net cash

return and profit indexes increasing by 56.65%, 25.90% and 46.79% respectively in the first three quarters compared with the same period in 2020.

Looking to the future, the company will continue to focus on technological innovation and design creativity, adhere to the principle of market-oriented with technology as the core, insist on creating first-class works, creating-class talents, providing first-class services, making unremitting efforts to promote the development of China's construction technology and to build a beautiful China!

## Corporate Culture

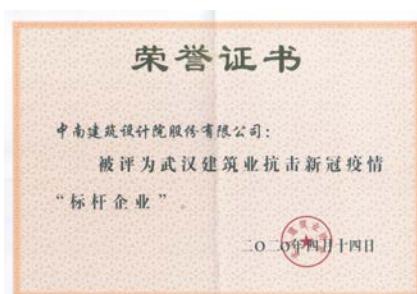
Innovation and Creativity

Sincerity and Proficiency

## Major honors in the Past Three Years



National advanced group in fighting against the COVID-19 pandemic



"Benchmarking Enterprise" of fighting against the epidemic in Wuhan construction industry



Enterprise with Outstanding Contribution to the Fight against the COVID-19 pandemic in 2020



Wuhan Le Shen Shan (Thunder God Mountain) Hospital Project was awarded the first prize of the Industry Excellent Survey and Design Award for COVID-19 Treatment Facility Design (New Project)



Renovation of the Jiangxia Dahuashan Outdoor Sports Center for Mobile Cabin Hospital Project was awarded the First Prize of the Industry Excellent Survey and Design Award for COVID-19 Treatment Facility Design (New Project)



Wuhan Tianhe Airport T3 Terminal Project was awarded the First Prize of Excellent (Public) Architectural Design in the 2019 Industry Excellent Survey and Design Award



The reinforcement and renovation project of Military Expo Exhibition Building was awarded the First Prize of 2019 Industry Excellent Survey and Design Award for Excellent (Public) Buildings

Wuhan Leishenshan (Thunder God Mountain) Hospital won the Grand Prize of the 11th "Innovation Cup" BIM Competition in the category of "Fight Adversity in Close Solidarity".

Huangpi District People's Hospital won the First Prize of "Medical" in the 12th "Innovation Cup" BIM Competition

## Employee Data

There are 1,226 male employees in the company, accounting for 62.55%, and 734 female employees, accounting for 37.45%.

Among the middle and senior managers, there are 1 female and 8 male members in the 9 leading teams, 46 males and 5 females in the middle level positions, and 41 males and 11 females in the middle level deputy positions.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	million yuan	1333	3057	3371
Operating Income	million yuan	2003	3181	3681
Total Profits	million yuan	142	156	173





# Technology Enables Innovation to Create Green and Livable Buildings for Wings

◇ China MCC22 Group Co., Ltd.

## Introduction

China MCC22(MCC means China Metallurgical Group Corporation ) Group Co.,LTD. after more than ten years of hard study, through constant technological innovation, gradually break the shackles of traditional, developed with characteristic of company prefabricated building three technology products, complete the transformation of technical achievements and a wide range of application, let more people enjoy the prefabricated building products bring different experiences.



## SDGs

 <p>Goal No.9</p>	<p>Adhere to independent innovation, improve innovation management system, build industry-university-research-application platform, strengthen technology research and development, and promote the transformation and application of scientific and technological achievements.</p>	 <p>Goal No.12</p>	<p>Prefabricated buildings practice green development mode, reduce resource consumption and environmental pollution, and achieve quality improvement and consumption reduction.</p>
 <p>Goal No.13</p>	<p>Research and development of prefabricated steel-concrete structure system to realize energy saving and material saving, and effectively promote the green development of the construction industry.</p>	 <p>Goal No.17</p>	<p>Strengthen communication and co-operation with the National Ministry of Housing and Urban-Rural Development, Hebei Provincial Department of Housing and Urban-Rural Development, Tangshan Municipal Bureau of Housing and Urban-Rural Development and other government departments and industrial chain enterprises; Strengthen school-enterprise co-operation and build a good platform for production, learning, research and use.</p>

## CSR

 <p>Fundamental Responsibility</p>	<p>We will adhere to independent innovation, build platforms for production, education, research and application, strengthen technological research and development, and promote the transformation and application of scientific and technological achievements.</p>	 <p>Environment</p>	<p>Prefabricated buildings practice green development mode, realize energy saving and material saving, and effectively promote the green development of the construction industry.</p>
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## 1. Case Overview

Innovation is the primary driving force for development and the strategic support for building a modern economic system. The rapid transformation of scientific and technological achievements into real productive forces is the driving force for economic development. In other words, rapid transformation of scientific and technological achievements is the best innovation. "The China metallurgical construction green" as a 22 prefabricated building products brand, after ten years of painstaking study, walked out of a "technology patent, patent standardization, standard industrialization and industrial marketization" road, the achievements of the technical system and technology into a brand to promote the company higher technology driving force of the development of high quality.

In order to let the people live on quality more reliable, more safe, more environmental protection, green building, 22 embodied in 2009 on the exploration of prefabricated construction technology, from the beginning of national policies, lack of fabricated to the national various provinces and cities now fully implementing prefabricated buildings, through constant technology innovation research and development, gradually break the shackles of traditional, It has studied three major technical products of prefabricated buildings with the company's characteristics, completed the transformation of technical product achievements into a wide range of promotion and application, so that more people can enjoy the different experience of prefabricated building products, and practice the responsibility and responsibility of central enterprises.

### 2. Case Background

With the development of domestic building energy-saving technology and the improvement of green construction technology requirements, the

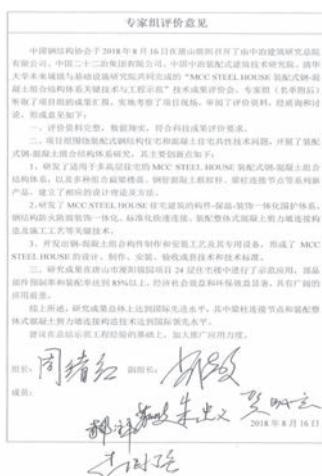
construction industry, as a high energy consumption industry, has been listed as the key supervision industry of PM2.5. Significant changes to the way the development of prefabricated building is built, is pushing supply side structural reforms and the new urbanization development, the important measures to save resources, reduce the pollution of construction, improve labor productivity and the quality and safety level, is conducive to the construction industry and information technology industrialization depth fusion, foster new industry new kinetic energy, promote dissolve excess capacity. For the construction industry, the rapid development of the traditional model in the first few decades has brought many problems, such as the quality, quality, comfort and service life of the houses, which are inconsistent with the goal of building a beautiful China. The practice of green development in prefabricated buildings is not only an important direction for the construction industry to implement the spirit of the 19th National Congress, but also an internal requirement for promoting the construction of ecological civilization. The application of prefabricated building system and its products is of great significance in promoting the development of prefabricated building technology, enriching and perfecting the prefabricated building product system and expanding the prefabricated building market in China.

Twenty-two smelters is because of the earthquake aid Tangshan and the birth of the enterprise, more than 40 years, large-scale participation in the construction of new Tangshan, and the hero of the city's common development, blood harmony. After the earthquake repair Tang steel, 28 days refining out of the first furnace "Zhiqi steel" began, from the rubble of the ruins of the earthquake shed built from that moment, let the people live on a safer, more solid house to become the heart can't give up feelings. After ten years of research and development, MCC Green completion set technology system and three core products have been formed, which are prefabricated steel-concrete

structure system, prefabricated concrete structure system and prefabricated low energy consumption building. Among them, the prefabricated concrete structure technology system with the most intuitive quality, the most reliable connection and the most convenient construction, and the prefabricated steel structure technology system with a broad prospect have been identified as the “international leading” by the Academician Group of the Chinese Academy of Engineering.



Academician Expert Group Scientific Expert and Technological Achievements Evaluation Site



Opinions on Evaluation of Scientific and Technological Achievements

From the “few fellow travelers” at the beginning of the journey to the “hot onlookers” now, the “ingenuity spirit” of intelligent construction and the original intention of building green and livable buildings for 100 years have never been shaken.

### 3. Responsibility Actions

Housing is the key to people's livelihood, related to the quality of life of thousands of families. From “low and humid shanty buildings” to “small high-rise buildings, elevator rooms, urban and rural wide buildings”, urban life has been constantly upgraded, and residents' sense of housing acquisition happiness has been significantly improved. Thus realize the design, production, construction, decoration, logistics, operation and maintenance of multi-stage information sharing and transmission. China metallurgical wisdom green plant adopts the most advanced intelligent, digital management system, realize the product from the standardized design, factory production, assembly, construction, information management, intelligent application, the whole life cycle of a seamless intelligent management, not only maximize the production efficiency, and realize the source of the product quality control and the entire information acquisition, It reflects the highest level of prefabricated construction production in China.



MCC green construction smart factory production line display

(1) Broaden the thinking and optimize the layout, building technological innovation “reservoir”

Whitehead, a famous British philosopher, once likened innovation to “the adventure of thought”. Only when we break through the tradition in

thought, have the spirit of striving for self-improvement, and have the courage to explore and practice, innovation will have great potential. Make construction from “building” to “smart” prefabricated construction, not only changed the traditional backward mode of production, construction industry has brought a construction technology innovation and industry upgrading of new “revolution”, the housing construction opened a new road to green development, and this among them, the importance of innovation and mastering the core technology is self-evident.

In achieving “made a car house” adventure, China metallurgical green building focus on green building, to the “sharing of coordination development of green innovation” for the development idea, the use of the first batch of “national prefabricated construction industry base” platform, with a double dream all premium quality advantage of enterprise resources, to establish “general factory+factory” “project+factory” management model, In addition, Zunhua production base is used as the technology distribution center and R&D hub platform to form core control and service support for Xingtai, Huaibei and other branch plants, consolidate and improve the productivity of core technologies. With the three major products of China Metallurgical Green Construction as the carrier, relying on independent intellectual property technology, master core technologies and pay attention to the formation of “patent group”. In the whole industrial chain of design, development, construction, production, management and service,



MCC Green Construction Smart Factory Management Platform

the transformation of scientific and technological achievements is accelerated, so that the brand of “MCC Green construction, assembly future” gradually has a voice in the market competition, and provides strong technical support for MCC to build an industry leading enterprise.

## (2)Build a platform to gather elements, planting core technology “test fields”

At present, the domestic research on prefabricated buildings is not perfect, and there is a great space for scientific and technological innovation. In the face of the iterative upgrading of prefabricated building technology, MCC Green Construction always focuses on industrial development, based on the research and development of the whole industrial chain and the whole life cycle. Study and analyze one by one the “bottleneck” technical links such as the grouting sleeve connection quality inspection problem of prefabricated concrete structure, the anti-corrosion and fire prevention problem of prefabricated steel structure, etc. The company obtains a major frontier technology breakthrough through school-enterprise cooperation and the introduction of high-end talents, and then finds out the direction and path of innovation and upgrading. Relying on “prefabricated construction academician workstation” and “China metallurgical prefabricated construction technology institute” (Hebei), with tsinghua university, China metallurgical construction science research institute, China construction science research institute, Yanshan university, Harbin Institute of Technology, such as signed a strategic cooperation agreement, set up a good production, study and research, with the platform, the advanced technology based on market, solve the contradiction between technology and market, We will enhance our ability to transform science and technology, promote the transforma-

tion of scientific and technological achievements, and promote the integrated development of science and technology with the economy.

MCC green system built around the three products to prefabricated construction for the whole industry chain, covering research and development design, mold production, construction of various links such as installation, with the core technology to the external surrounding the spread of the “product” mode, set up 28 subject research and development team, the topic research goal and patent, method and so on specific indicators to carry out the scientific research achievements to the head, To realize the research-and-development and operation team mechanism oriented by the subject, so that every link in the industrial chain has professional researchers to conduct research; Through the “Dingding” management system, the working group established on the company’s new ZhongDA information platform is managed, forming a new building industrialization work platform. Through mobile phones, computers and other real-time work, it can effectively solve the task coordination of different groups of personnel from multiple departments in the research institute, and improve the work efficiency.

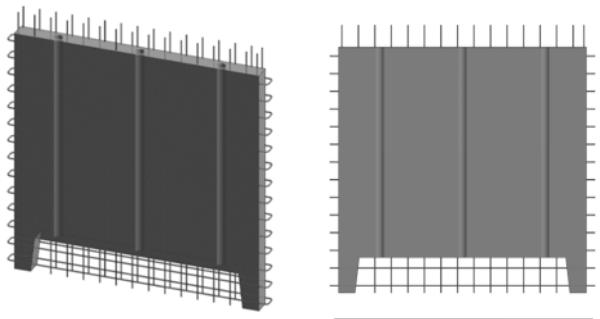
(3)Strengthen the system and open up the path, strive to be the “front-runner” for achievement transformation

Only when the scientific and technological achievements move from the laboratory to the industrial application can they truly realize their innovative value. The lack of subjective power in the current development of assembled concrete structure mainly results from the high construction cost of the existing assembled concrete structure system and the high precision operation requirements, which lead to the difficulty of production,

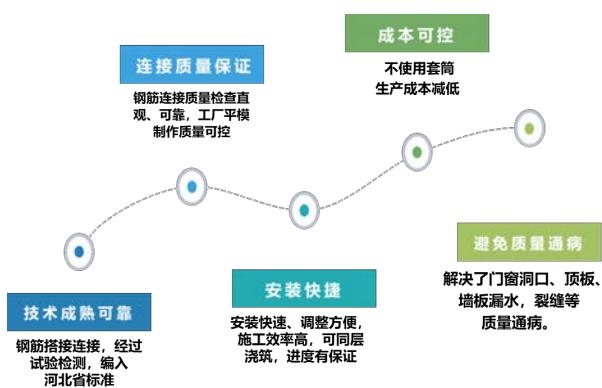
installation and detection techniques and the low efficiency. With the support of the national “12th Five-Year” Science and Technology Support Plan “New Prefabricated Concrete Building Technology Research and Demonstration”, Hebei Province Construction Science and Technology Research plan “Prefabricated concrete shear wall Structure residential Technology Research and Demonstration” and other projects, MCC Green Construction after 6 years of efforts, Taking the key links of theoretical analysis, design, production and construction of prefabricated concrete structure as the breakthrough point, through the vertical connection method of prefabricated shear wall, supporting production technology, production mold innovation and installation scheme optimization and other means, the system carried out the research and demonstration of prefabricated concrete shear wall structure residential technology. Innovative research and development of the bottom lap joint assembly integrated concrete shear wall structure system for high seismic intensity area, and the development of supporting equipment and production line, to solve the production, construction and installation process problems, formed an engineering application system. Through repeated practice, and puts forward the casting pipe from integrated control technology, the reserved hole pouring technology, horizontal component connection and installation technology, solve the cold bridge, water seepage, superimposed slab edge slurry leakage and prefabricated wall after pouring zone of concrete difficult problems, such as implementation from the integration of technology research and development to production, construction installation engineering application of the system..

Case 1: Assembly of monolithic concrete shear wall structure system

In view of the characteristics and shortcomings of the “sleeve grouting connection technology”, combined with the characteristics of the seismic fortification intensity of Tangshan area of 8 degrees, the “lap connection technology in the post-cast section” was jointly developed with China Academy of Building Science, namely: A part of the post-casting area is reserved under the precast wall, and the upper and lower walls are distributed with reinforcing bars to be lap connected in the post-casting area. The reinforcement bars in cast-in-place edge members are lap connected or mechanically connected, and the reinforcement bars in the precast part are connected by grouting sleeve. The height of cast-in-place at the bottom is determined according to the lap length of the vertical reinforcement distribution of the wall limb.



Wall Vertical Connection Technology

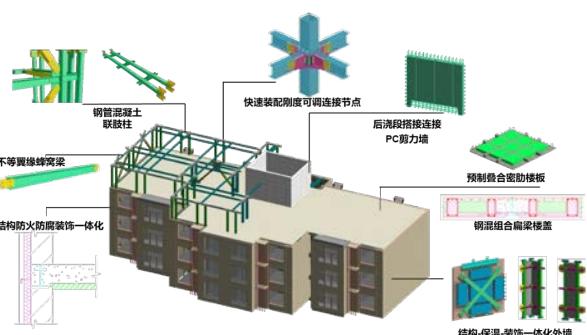


This technology through the enterprise research

and development and marketing of organic combination in 2013 began to bulk self development project on the application in the company, and in 2018, organized the conference fabricated products, through the demonstration guide, industry exchanges, let more enterprises understand the technology, accept the project products, so as to achieve the goal of mass marketing

Case 2: Assembling integral concrete shear wall structure system

Prefabricated steel-concrete structure system: It is a new generation of “prefabricated steel-concrete structure system” jointly developed by China MCC22 Group Co.LTDChina Metallurgical Building Research Institute Co., LTD., and Tsinghua University, which realizes the separation of gravity system and lateral force system. Structure form for the steel frame - support - shear wall structure, floor and wall are fabricated structure, wall with retaining wall structure with heat preservation - decoration integration, floor adopts prefabricated composite ribbed floor: steel steel column, floor stair, within the enclosure wall and heat preservation, partition wall, the ledger wall components adopt highly integrated, modular assembly rate above 86%. In August 2018, the trademark registration of “MCC Lvjian Steel Structure House” was completed.



This technology solves the common problems such as imperfect housing design, steel beam exposure, wall cracking, anti-corrosion and fire protection validity period and structure service life mismatch in the promotion and application of steel structure buildings, especially in the process of industrialization. The structural technology research and application of prefabricated high-rise steel structure housing are carried out. To achieve energy conservation, environmental protection, cost reduction and efficiency at the same time to solve the steel structure housing maintenance system is not matching, beam and column exposed and other common problems, greatly promote the development and upgrade of the industry, promote the progress of design concept.

The results solve the common problems of traditional steel structure buildings such as poor adaptability of beam and column exposure function, more welding on site, high cost of anti-corrosion and fire prevention and insufficient durability. Compared with the traditional steel structure and the same precast rate PC structure, the construction period can be shortened by about 30%, the amount of steel is reduced by more than 15% compared with the similar steel structure housing, the material loss is reduced by about 60%, the building energy saving reaches 75%, the labor saving 50%, the construction and later operation and maintenance cost is lower, the cost is more economical. Can realize the recycling of steel, the main material recovery rate is more than 90%, effectively promote the green development of the construction industry.

#### 4. Effect of Responsibility

MCC Green Construction adheres to “surface work” to “deep work”, and takes multiple measures simultaneously to open up the “last kilometer” of effective results transformation, striving to be the “vanguard” of effective results transformation. Reconstruct the organizational structure of

the company’s science and technology platform, constantly improve the management system, organically combine the four aspects of “science and technology innovation platform, transformation of scientific and technological achievements, leading scientific and technological talents, and talent training” together, and promote cooperatively; Increase efforts to promote the company’s scientific and technological achievements, patents, construction methods, standards and new technology, new technology, new materials and new equipment in the application of four new technologies in the project, improve work efficiency, achieve the implementation of technical achievements, to achieve the purpose of reducing costs and increasing efficiency; Take the company to provide subjects, research carriers and personnel, universities to do theoretical research and support for the company’s research and development projects to carry out in-depth research; Strengthen contact, exchange and cooperation with the National Ministry of Housing and Urban-Rural Development, Hebei Provincial Department of Housing and Urban-Rural Development, Tangshan Municipal Bureau of Housing and Urban-Rural Development and other government departments and industrial chain enterprises, grasp the industry trends and policy guidance, and provide direction and road support for R&D; Strengthen cooperation with universities to carry out targeted training of professional and technical personnel and training bases, graduate training bases, etc., to enrich the company’s reserve personnel training channels.

In vigorously promoting prefabricated construction “design - production - construction - management - service” in the course of the construction of the whole industrial chain, China metallurgical green building, with effective patent achievements as



the gripper, make everyone to innovation “pre-research generation, research and development generation, production generation, reserve generation” system of product innovation, constantly inspire creativity and endogenous power of innovation, With practical and effective innovation to continuously improve the economic benefits of enterprises, continue to promote the sustainable growth of enterprises.

So far, prefabricated concrete structure declared 115 related patents, being granted method 5, access to the “science and technology progress prize in Hebei province” two, get nine appraisal of science and technology achievements, 55 prefabricated steel structure system to declare related patents, being granted method two, get one “in Hebei province scientific and technological progress second prize”, access to technology appraisal results in item 1; MCC Green Construction assembly low energy consumption building has applied for 11 related patents, obtained 1 provincial and ministerial level construction method, obtained 1 scientific and technological appraisal results, and obtained 2 special technical projects in Hebei Province. With the continuous standardization and systematization of prefabricated concrete structure technology of MCC Green Construction, the company is responsible for and involved in the compilation of 9 national, industrial and local standards in the field of prefabricated construction. Successively won the China Association of Construction Enterprise Management (CACEM) science and technology progress award of project construction, construction industry in Hebei province won the first prize in science and technology, the CACEM micro innovation prize, construction industry in Hebei province science and technology progress award two second, Hebei youth entrepreneurial in-

novation contest bronze, CACEM high promotion value in patents and micro innovation achievements prize, second prize of Tangshan worker technology innovation The third prize; The technical system of prefabricated steel and concrete composite structure has won the special prize of steel Structure Design Competition of China Steel Structure Association, the special prize of Science and technology of China Metallurgical Group, the first prize of science and technology of China Steel Structure Association, the second prize of science and technology of China Installation Association, the second prize of science and technology of Hebei Province, and the second prize of engineering design of national metallurgical industry.

In recent years, the patent promotion and application of this achievement has covered the Beijing-Tianjin-Hebei region, and more than 60 prefabricated engineering designs, engineering construction and technical services have been carried out. The demonstration projects of project achievements have exceeded 100, and the demonstration projects of prefabricated buildings have been promoted and applied over 5 million square meters, and the supply of parts and components is more than 200,000 cubic meters. In Anhui Huai-bi, Xingtai, Zunhua 3 new parts production bases, 11 new production lines, the design capacity can reach 600,000 cubic meters.

## 5. Future Outlook

In the long run, developing housing industrialization is an important way to reduce building energy consumption. According to the preliminary statistics, the use of industrial production mode, concrete, steel has been effectively saved, waste reinforcement and leakage of concrete loss rate has been greatly reduced; Curing steam, water

recycling, the whole construction process of water consumption is greatly reduced; Because the surface of the precast component is smooth and flat, the plastering decoration is no longer needed, and a large amount of building mortar is saved. As prefabricated construction reduces the amount of scaffolding and formwork required, electricity consumption is also reduced. In short, the energy

saving and consumption reduction in the process of residential construction is very obvious.

It is believed that prefabricated buildings will become evergreen trees in the history of green building development and reform through continuous technological innovation, integration and intelligence.

## 6. Deposition From Stakeholders

*Twenty-two metallurgical group co., LTD. China in the field of prefabricated construction has been walking in the forefront of the industry, dare to do the first person to eat crab, practice of state-owned enterprises social responsibility, adhere to more than 10 years of beginner's mind is constant, will eventually get with characteristic of his own company, China metallurgical green building products, has won the acceptance of experts and the industry, the technology products of the popularization and application of powder innumerable, should make greater efforts to promote. Let more people benefit.*





## Attachment: Enterprise Related Information



Company Name: China 22 Metallurgical Group Co. LTD

Company Address: Tangshan, Hebei Province

Company Website: <http://www.22mcc.com.cn/>

### Company Profile

China 22 MCC Group Co., LTD. (referred to as China 22 MCC Group), established in 1997, is one of the top 500 enterprises in the world and an important backbone of China Minmetals. It is a comprehensive large enterprise group whose main business is general contracting, real estate development, technical equipment manufacturing and diversified industries.

China 22 Metallurgical Group has construction engineering and metallurgical engineering con-

struction general contract of the special grade qualification; Grade 1 qualification for general contracting of mining engineering, petrochemical engineering, municipal public engineering and mechanical and electrical engineering; First-class qualification for professional contracting of steel structure engineering and foundation engineering; Grade II qualification for professional contracting of electronic and intelligent engineering, port and navigation equipment installation and water traffic control engineering, building decoration and decoration engineering, power transmission and transformation engineering; Three-level qualification for general contracting of highway



engineering and railway engineering; Third-level qualification for professional contracting of environmental protection engineering; Real estate development Grade 1 qualification; Class A qualification in engineering design and construction industry and metallurgy industry; Grade C qualification of municipal engineering design road engineering; Have independent foreign operation rights. It has a professional company matching the main business, with survey, design, scientific research institutions and various construction machinery to meet the needs of engineering construction. With AN ANNUAL capacity OF 700,000 tons, The company has three large-scale modern industrial parks, which mainly produce steel structure products for industrial and civil construction. It is awarded as a national steel structure manufacturing special class enterprise by China Steel Structure Association. 22 metallurgical group in China since the 1950s, and a large number of national or local joining into the construction of steel construction, buildings, stadiums and municipal engineering projects, as well as building materials, energy, chemical industry, electric power, transportation, water conservancy, etc all kinds of engineering and industrial and civil construction projects abroad. More than 100 projects have won Lu Ban Award, Zhan Tianyou Award, National Quality Project Award, National Customer Satisfaction Project, Provincial and ministerial Project Award, etc. Some of the projects have set the national record for the shortest construction period of similar projects. China 22 Metallurgical Group has always adhered to the "integrity of the society, customer satisfaction proud" business philosophy, is committed to "build brand, integrity cast the future", both inside and outside the motherland, the great river north and south cast a monument.

China 22 MCC Group of talents, complete professional, sophisticated equipment, advanced technology, cultural harmony. There are 4935 employees, including 3313 with bachelor's degree

or above, 972 registered first-class construction engineers and 2350 middle and senior professional technical personnel. Steel structure engineering technology research center is a national production technology research branch, national industrial base of prefabricated construction, enterprise technology center, the Beijing municipal enterprise technology center in Hebei province, Hebei heavy equipment manufacturing engineering technology research center of prestress, new type construction in Hebei province industrial technology innovation center, China metallurgical heavy industries (Tangshan) co., LTD. R&dD center, member of Hebei province cooperation focus The unit has one MCC engineering technology center, one research institute, and one sub-base of national technology standard innovation base. It has established an innovation system with enterprise technology center as the leader, and has 21 innovation studios at provincial and municipal level. The company has 6 national construction methods, 153 provincial and ministerial construction methods, more than 1600 authorized patents (including 200 invention patents), 21 computer software copyright registration certificates, and more than 50 national, industry, local and association standards as chief editor. With a complete quality assurance system and scientific management system, in the same industry in the country to take the lead through the quality, environment and occupational safety and health management system certification. For the national "contract respecting, keeping promises" enterprise, national AAA credit grade enterprise, national construction engineering famous brand enterprise, national excellent construction enterprise, national quality management advanced enterprise, national high-tech enterprise. And won the national civilization unit, the national "May Day" Labor certificate, the central enterprise advanced collective, the State-owned Assets Supervision and Administration Commission of the State Council advanced grass-roots Party organization, the Chinese en-



terprise Culture Construction advanced unit, the national Science and Technology Progress Second Prize, the National major technology and

equipment achievement Award, the National skill talent cultivation outstanding contribution Award and other honorary titles.

## Corporate Culture

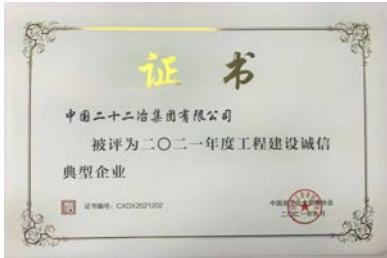
The construction of characteristic corporate culture provides strong cultural support for the realization of the company's strategic goals. Guided by the core socialist values, with the purpose of enhancing the cohesion of the company and comprehensively improving the management level and competitiveness of the company, we will build a cadre team of "loyalty, unity, responsibility and integrity". Through building a multi-cultural pattern of "a hundred schools of thought contend, a hundred flowers blossom and a hundred flow", Good interpretation "staff to live and work in peace and

contentment, enterprise progresses day by day, respected customer praise, society" of the new enterprise culture connotation, forming strong competition consciousness and the execution culture, build enterprise core competitive ability, realize the comprehensive coordinated development of the company's material and spiritual civilization, to reach the company grow rich long, achieve the reputation of "construction of good faith happiness 22 embodied" good vision. Strive to enter the advanced ranks of corporate culture construction of MCC during the Fourth Five-Year Plan period.

## Major honors in the Past Three Years

The company won the national "AAA credit rating of engineering Construction industry", "AAA credit rating of construction industry", "Typical enterprise of engineering construction integrity", "Advanced Enterprise of

Construction industry", "AAA Credit rating of Construction industry" and "Best Practice Case of Internet development of engineering Construction industry" in Hebei Province. Enterprise integrity, visibility and reputation continue to improve.



Typical enterprise of integrity in engineering construction in 2021



The top ten cases of integrity construction in the engineering construction industry in 2021



2020 Best practice case of Internet development in engineering construction industry



2019 Advanced Construction Enterprise of Hebei Province



Enterprise credit rating certificate

## Employee Data

There are 4,935 employees in the company, including 1,264 female employees, with a male-to-female ratio of 2.9:1. Among middle and senior managers, 265 are female employees, accounting for 17.5%.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	100million	259.5713	268.3425	284.061
Operating Income	100million	156.2719	191.5677	247.1094
Total Profits	100million	1.5879	2.0609	2.4218



# HPAL, A Solution to World Lateritic Nickel Ore Developing Problem

❖ China ENFI Engineering Co., Ltd.

## // Introduction

The China ENFI Engineering Co., Ltd., upholding the original mission of “mining for the nation”, established the first laterite research team in China to carry out core technology research, overcame a number of key technical problems, and continued to promote the application of technology. All these efforts has contributed to meeting China’s increasingly urgent demand for nickel resources supply, promoting industry progress and industrial upgrading.



## SDGs

 Goal No.9	Established the first laterite research team in China to carry out core technology research, overcome a number of key technical problems, and continue to promote the application of technology. Facilitated high-quality development of the whole industry.	 Goal No.12	Paid special attention to environmental protection, developed efficient, energy-saving and technically reliable materials and equipment, and achieved standard or zero emission of heavy metal pollutants in wet smelting and material preparation.
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## CSR

 Fundamental Responsibility	Established the first laterite research team in China to carry out core technology research, overcome a number of key technical problems, and continue to promote the application of technology. Facilitated high-quality development of the whole industry.	 Environment	Paid special attention to environmental protection, developed efficient, energy-saving and technically reliable materials and equipment, and achieved standard or zero emission of heavy metal pollutants in wet smelting and material preparation.
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## 1. Case Overview

Nickel, of strong long-term strategic importance, is a bulk basic raw material for the production of stainless steel and a key raw material for the production of new energy batteries and important alloys. The China ENFI Engineering Co., Ltd. (China ENFI) has started its research and development in laterite high pressure acid leaching (HPAL) smelting technology since the beginning of this century. One after another, they have solved the world's problems in the low-cost development of laterite nickel ore in the traditional field and new energy field, making a number of key breakthroughs. The company has become the only enterprise in the field of laterite nickel ore development in China that has the ability to provide whole-process engineering services of mining, processing and smelting, and the ability to integrate smelting and extraction materials. In the continuous promotion of technology application, China ENFI has driven the large-scale development and utilization of rich laterite resources in countries along the "Belt and Road" with "Chinese technology", contributing to the speeding up of the construction of a new development pattern in the resource sector, optimizing the structure of overseas investment and promoting international production capacity cooperation.

## 2. Case Background

Global nickel resources are mainly divided into two categories: copper-nickel sulfide ore (40%) and nickel laterite ore (60%). The exploration of new sulfide ore resources has made no progress in the past two decades. To ensure the sustainable global nickel resources supply, the development of laterite nickel ore became an urgent demand. However, constrained by technical monopoly and engineering problems, by the 2000s, there had been few successful cases of large-scale development of laterite nickel ore worldwide.

Due to the low tenor of laterite nickel ore (usually

1%-2% of nickel) and the inability to enrich the ore by beneficiation, high pressure acid leaching (HPAL) technology is required. Since HPAL requires the core process operating temperature to reach above 250 degrees, operating pressure above 5MPa, and the addition of sulfuric acid to facilitate the reaction, the slightest mistake in engineering and production operation will cause irreparable losses and even lead to project failure. Only a few companies in the world mastered this technology, and even though there was related experience in foreign countries before ENFI's breakthrough, all the completed projects before encountered the dilemma of "postponed construction period, increased investment and delayed production", and there was few successful case.

## 3. Responsibility Actions

China ENFI was the first professional design organization established after the founding of the People's Republic of China to restore and develop China's non-ferrous metal industry. It has long been upholding the original mission of serving the country through mining, and has continued to contribute to the progress of the industry and industrial upgrading. In 2002, in order to meet the increasingly urgent demand for nickel resources in China, China ENFI took the lead in setting up a special laterite research team in China and making plans for tackling the key technical problem-laterite nickel ore high pressure acid leaching. The team is headed by the company's leadership, with the deep cooperation of many departments from process to equipment, and is supported by more than 50 core backbone of each department, more than 30% of whom are Doctors.

(1) Piloting the process of efficient and economic utilization of global laterite nickel ore

In a situation where there was neither foundation in China nor successful experience abroad, China ENFI spent 10 years in independent research and

development, eventually broke through the core process technology limitation and successfully developed the process of producing nickel-cobalt from nickel-containing cobalt ore (Patent ZL200910237208.4), which solved the problem of efficient and economic development and utilization of low-tenor laterite nickel ore resources for the whole world.

In 2003, China ENFI undertook the technology and equipment development, engineering design and equipment set for the Papua New Guinea Rui-mu Nickel and Cobalt Project (“PNG Project”) invested by China Metallurgical Group Corporation(MCC). The project applied the self-developed high pressure acid leaching-nickel-cobalt precipitation technology for the first time, and became the only project presenting stable operation among more than ten laterite nickel mines in the world at the same time, which opened a new page of laterite wet smelting process and made China’s high-temperature wet metallurgy technology leap to the international leading level. Moreover, it achieved continuous renewal and iteration in the process of continuous innovation and optimization of the original process.



The Papua New Guinea Rui-mu Nickel and Cobalt Project applied China ENFI’s independently developed high pressure acid leaching-nickel-cobalt precipitation technology

Subsequently, China ENFI successfully applied the HPAL technology to the OBI project of Ly-

gend Co., Ltd. in Indonesia and Morowali project in Huayue. With years of continuous research and development, technology accumulation and production practice, the cost intensity of such projects was successfully reduced from US\$50,000 to less than US\$20,000 per ton of nickel. These projects were completed and put into operation more quickly, shortening the average production period from two years to less than half a year.

With a comprehensive understanding of the nickel and cobalt industry chain, China ENFI has developed a number of core technologies for HPAL of laterite nickel ores in the treatment of low-tenor ores and applied for more than 100 patents. On this basis, the company also invented a new precipitation technology to prepare nickel and cobalt hydroxide products (MHP), and obtained a series of invention patents around “production of MHP products from laterite nickel ore”. These achievements can reduce project investment by more than 30% and production cost by more than 40% compared with foreign technologies. To note that, the technology can recycle cobalt metal efficiently while extracting nickel, which makes laterite nickel ore the second largest source of cobalt supply in the world and expands the resource supply path for the global new energy material industry.

## (2) Making breakthroughs in new energy materials preparation technology to enhance industry autonomy

In recent years, the development of the new energy vehicle industry is seeing an increasing trend, driving the vigorous development of the new energy battery material industry. China ENFI has advanced the layout, fully considered the efficient connection with the downstream new energy base material production, so as to improve efficiency of the whole process route from resources to battery material production.

Relying on the whole process engineering service from mining, processing to metallurgy and the integration of smelting and extracting mate-

rials, China ENFI has successfully developed the process route of direct preparation of high purity battery-grade nickel sulfate from laterite nickel ore, which for the first time connected every steps of material production between laterite nickel ore and the production of new energy batteries. This technology helped realize the development and application of low-grade complex laterite nickel ore resources on a large scale, with low cost and low energy consumption, making China's laterite nickel smelting technology and equipment completely free from the original foreign technological constraints.

Since 2013, China ENFI nickel laterite core technology team has started a new journey towards the preparation of new energy materials, developing battery-grade nickel sulfate, cobalt sulfate and ternary precursor preparation processes using nickel cobalt hydroxide prepared from laterite as raw material. After three years' technology research and development and two years' engineering implementation, China ENFI successfully completed the MCC New Materials Project in Caofeidian, Tangshan in five years. Since then, the total amount of nickel metal (nickel sulfate, cobalt sulfate and ternary precursor materials) has reached 36,000 tons per year.



The MCC New Materials Project in Caofeidian

### (3) Breaking the constraints of core materials and equipment to realize technology independence

In the field of wet laterite smelting, China ENFI has completely removed concerns about stability

of the source ore supply; perfected the three-stage preheat + autoclave + three-stage flash technology; solved the heat recovery problem; solved the key material problems in the process environment of high temperature, high pressure, high acid chemical corrosion and high solid abrasion; developed super large preheat, autoclave, flash tank for the preparation of titanium-palladium alloy, tantalum alloy and other high performance materials; developed advanced control systems to achieve automatic control and safe, stable and continuous production of high-pressure acid leaching plants. In addition, the company has also realized the automatic control of the whole process, solved the problem of difficult control of high temperature system, developed a simulation model, and solved the problem of engineering technology connection and matching of the whole process of "mining-washing-slurry conveying-smelting". These all filled technology gaps in China.

As for the production technology of nickel-cobalt hydroxide precipitation products, China ENFI adopts the patented technology of sodium hydroxide precipitation nickel-cobalt developed independently, avoiding the problems of high toxicity and difficult control of hydrogen sulfide precipitation nickel-cobalt technology adopted by Canada, Australia and Japan. The company's technology achievement has also solved the problems of unachievable raw material requirement, high cost and high magnesium content of the product of active magnesium oxide precipitation nickel-cobalt. Moreover, the successfully developed transcrystalline precipitation technology, was not only easy to operate, but also had the water content of the product dropped from 73%-75% to 50%-55% and produced less production consumption, greatly improving the stability of production process. Therefore, products of the nickel-cobalt hydroxide precipitation technology can connect with the downstream material preparation in a more effi-

cient way.

In terms of independent core equipment, China ENFI has gradually turned to domestic core equipment and components, and has developed a series of high-efficiency, energy-saving and technically reliable materials and equipment to effectively save project investment.



Night view of Lygend applying China ENFI's technology to OBI Project in Indonesia



Construction site of Lygend OBI Project in Indonesia

#### 4. Effect of Responsibility Fulfillment

In terms of industry progress and global resource security, China ENFI successfully developed HPAL technology, which solved the world-class problem of efficient and economic development and utilization of low-grade laterite nickel ore resources; made the direct preparation of high-purity battery-grade nickel sulfate from laterite nickel ore possible, realizing large-scale, low-cost and low-energy development and utilization of low-grade complex laterite nickel ore resources; broke through the restrictions of core materials and

equipment, gradually gained independence in technology and large-scale equipment, so that China's laterite nickel smelting technology and equipment are completely free from the original foreign technological constraints, which has strongly promoted the high-tech and high-quality development of the industry.

In terms of environmental protection, China ENFI, as a "national team to implement green principles", has not only strove for excellence in products, but also paid great attention to environmental protection in the smelting process. It has fully realized the standard and even zero emission of heavy metal pollutants in wet smelting and material preparation, promoting the benign and sustainable development of the industry.

In terms of honors, the MCC New Materials Project, which applied China ENFI'S HPAL technology, won the first China Construction Engineering Luban Awards in 2020-2021.

In terms of high end media coverage, Science and Technology Daily published an article entitled "High Pressure Acid Leaching Technology Unleashes High Efficiency in Low-Tenor Laterite Nickel Ore" at the end of 2021 to give high praise to the technology while featuring China ENFI's HPAL technology applied by Lygend in the OBI project in Indonesia and giving high praise to the technology.

#### 5. Future Outlook

Although in nickel smelting, especially laterite nickel ore smelting, China started relatively late, it has achieved leapfrog development in the past 20 years. This could not have happened if there weren't the national innovation-driven strategy, the leadership of the "Going Global" strategy, the implementation of the "Belt and Road" initiative, the steady growth of the national economy, the transformation and upgrading of China's nickel



smelting industry, and China's research and development system integrating industry, institution, research center, and application. With the breakthrough of China's core process technology in the nickel smelting industry, related core equipment, supporting industrial model, technology and industrial workforce have also become more mature and stronger, further promoting the continuous popularization of the leading technology that is high in efficiency, environmental-friendly and economical. Then with the development and expansion of Chinese investment, Chinese enterprises, Chinese technology, Chinese equipment and Chinese standards in the international arena, the development of nickel laterite resources is bound to be much easier and China's prosperity will also lay the foundation for a relative stable resource prices and supply. It can be believed that Chinese power has played and will continue to play an important driving role in the process of changing

the technological landscape of the nickel smelting industry.

The mature application of HPAL technology developed by China ENFI has provided important support for China's nickel smelting industry. In the future, with the national goal of "carbon peaking and carbon neutrality", China's nickel smelting industry will have to meet more higher requirements in low-carbon production. China ENFI has launched the research and development of a new generation of "molten pool smelting" nickel smelting technology. This technology will replace the existing electric furnace smelting process and will play a leading role in energy saving, consumption reduction, carbon emission reduction and green development of the industry. Grasping the new technology and process, China ENFI is promising in the field of nickel smelting.

## 6. Deposition from Stakeholders

*"With high sense of responsibility, effective organization, professional technology and efficient work results, your company has guaranteed the smooth progress of the construction of the project (our company's OBI project in Indonesia).*

”

——Lygend Resources & Technology Co., Ltd.

## Attachment: Enterprise Related Information



**MCC 中国恩菲**

Company Name: The China ENFI Engineering Co., Ltd.

Company Location: Haidian District, Beijing

Company Website: liumf@enfi.com.cn

### Company Profile

The China ENFI Engineering Co., Ltd., also named as China ENFI Engineering Corporation (“China ENFI”), formerly known as the China Nonferrous Engineering and Research Institute, was established in 1953. It was the first professional institution set up with the aim of recovering and developing nonferrous metal industry. China ENFI is now a subsidiary of one of the world’s top 500 enterprises - China Metallurgical Group Corporation, with the Engineering Design Integrated Qualifica-

tion Class-A.

Through more than sixty years of trials and hardships, China ENFI has participated in more than 12,000 engineering projects in over 30 countries and areas, wholeheartedly devoted to nonferrous metal industry. The company has emphasized on technology innovation and high-end consultation, constructing itself into one of the few robust domestic enterprises being able to provide services from consultancy, design, construction, investment to operation. China ENFI’s three main business fields are





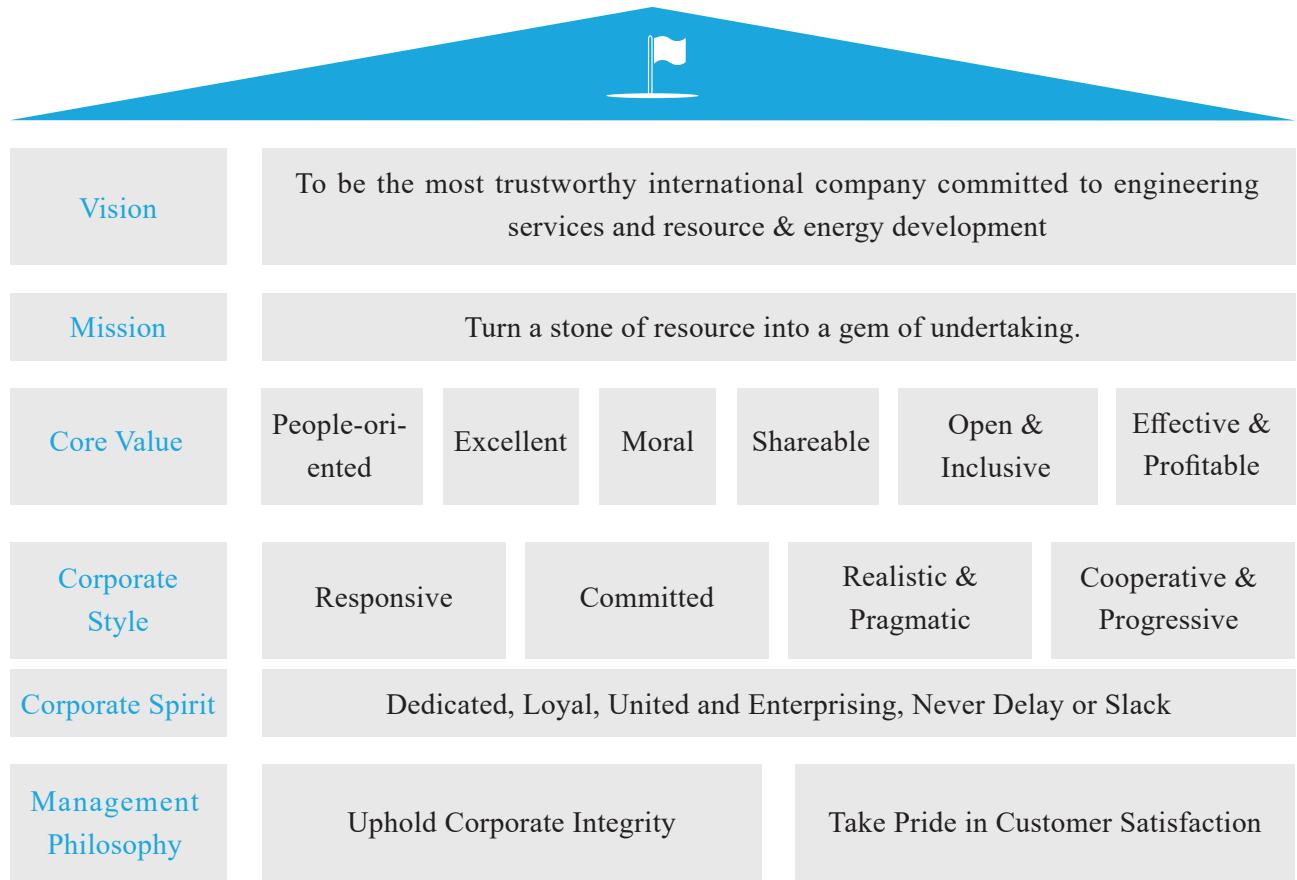
scientific research, engineering service and industrial investment, subdivided into nine segments including non-coal mining, nonferrous metallurgy, water resources, energy environment, new high-tech materials, municipal culture and tourism, urban minerals, intelligent equipment and property management. These forms diversified business clusters with outstanding core capabilities, clear competitive advantages, international operations and distinctive features, which ensures the company's whole life cycle services ability from general contracting, project managing, engineering consulting, designing, cost consulting, supervising, environment evaluating, and material supplying.

As a technology leader in the industry, China ENFI has design teams of more than 40 specialties in geology, mining, mineral processing, tailing, smelting, construction, structuring, electrical engineering, thermal engineering and other related public and auxiliary support, led by teams of highly qualified talents including academicians of the Chinese Academy of Engineering, national and industry-leading design masters, and 100 Doctors. The company has set up 8 national platforms including National Engineering Research Center of Silica-based Materials Preparation Technology and National Metal Mining Engineering Technology Research Center, and 22 provincial and ministerial platforms including academician expert workstations, 2 post-doc-

toral research stations, ENFI Research Institute, Mining Economic Research Institute, China Metallurgical Low Carbon Technology Research Institute, Yanshi R&D Base. Relying on these platforms (also called "833221"), a large number of technological innovations with high market value have been created, won more than 1,000 national and provincial awards, and obtained more than a thousand authorized patents (more than 50% are patent for innovation). China ENFI has taken the leading position, guiding the industry to develop continuously towards a more intelligent, ecological, wise and green future.

At present, China ENFI is leading the new infrastructure reform in the mining industry, taking the national strategy as the guide, accelerating the "digital, integral, smart and international" transformation under the pattern of "dual circulation", and making every effort to build the enterprise into a national team of non-ferrous mining and metallurgy, a leader in green environment protection and an innovator in emerging industries. During all these process, the company has kept adhering to the principle of high technology and high quality development, making unremitting contribution to the progress of the mining industry and industrial upgrading. ENFI has been devoting itself to becoming the most reliable international integrated engineering service provider and energy and environment developer.

## Corporate Culture



## Major honors in the Past Three Years

1. In 2022, the annual production capacity of 100,000 tons of zinc and 60 tons of indium smelting technology reformation of Yunxi Wenshan Zinc and Indium Smelting Co., Ltd. designed by China ENFI won the National Quality Engineering Award.



1

2. In 2021, China ENFI won "China Nonferrous Metal Industry Science and Technology Award" for 11 technology innovation.



3

3. In 2021, the project of "Research and application of key technologies for efficient recovery of scandium resources from nickel ore in laterite" (No.CRESTA2020-03-048) won First prize of rare Earth Science and Technology Award with China ENFI as the major contributor.



6

4. In 2021, China ENFI's patent for innovation, "The invention relates to a process and device for continuous copper smelting using oxygen bottom blowing furnace" (ZL200610113798.6) and "A side-blow immersion combustion molten pool smelting plant that blows oxygen-rich air and pulverized coal" (ZL201610321896.2) won China Patent Excellent Awards.



5. In 2020, China ENFI's patent for innovation, "the invention relates to a polysilicon reducing furnace" (ZL201110185383.0) won a silver medal of Chinese Patent, and the "Nickel hydroxide products and preparation method" (ZL201410425999.4) won a honorable mention of Chinese Patent.



7

6. In 2020, the MCC New Materials Project contracted by China ENFI won Luban Award of China Construction Engineering.

7. In 2020, China ENFI won the 2020 Workplace Health and Safety Environment Innovation Case Award.

8.In 2020, China ENFI's "Mine rail transport unmanned driving system technology" won the fourth National Equipment Management and Technology Innovation Achievement Special Prize.



8

9.In 2020, the atlas "Concrete Structure Construction drawing plane overall representation method Drawing rules and construction details (cast-in-place concrete slab staircase)" 16G101-2 compiled by China ENFI's specialists was awarded 2019 Industry Excellent Survey and Design Award -- the first prize of Excellent Architectural engineering Standard Design by China Exploration & Design Association.



9

10.In 2019, Cathode copper - Smelting System Engineering owned by Qinghai Copper Industry Co., Ltd. and contracted by China ENFI won the National Quality Project Award.



10

11.In 2019, the comprehensive upgrading and expansion project of incineration of household waste and sludge proposed by CECEP (Linyi) WTE Co., Ltd. and designed by China ENFI won the National Quality Project Award.



11



12. In 2019, China ENFI won the China Digital Simulation Application Outstanding Enterprise Award.



12

13. In 2019, Cathode copper - Smelting System Engineering owned by Qinghai Copper Industry Co., Ltd. and contracted by China ENFI was awarded as "2017-2018 China Non-ferrous Metal Industry (Ministerial level) Quality Project".



13

14. In 2022, China ENFI won the award of "China's Power Industry Quality Project" for the design of municipal household waste incineration power generation project in Shangqiu.

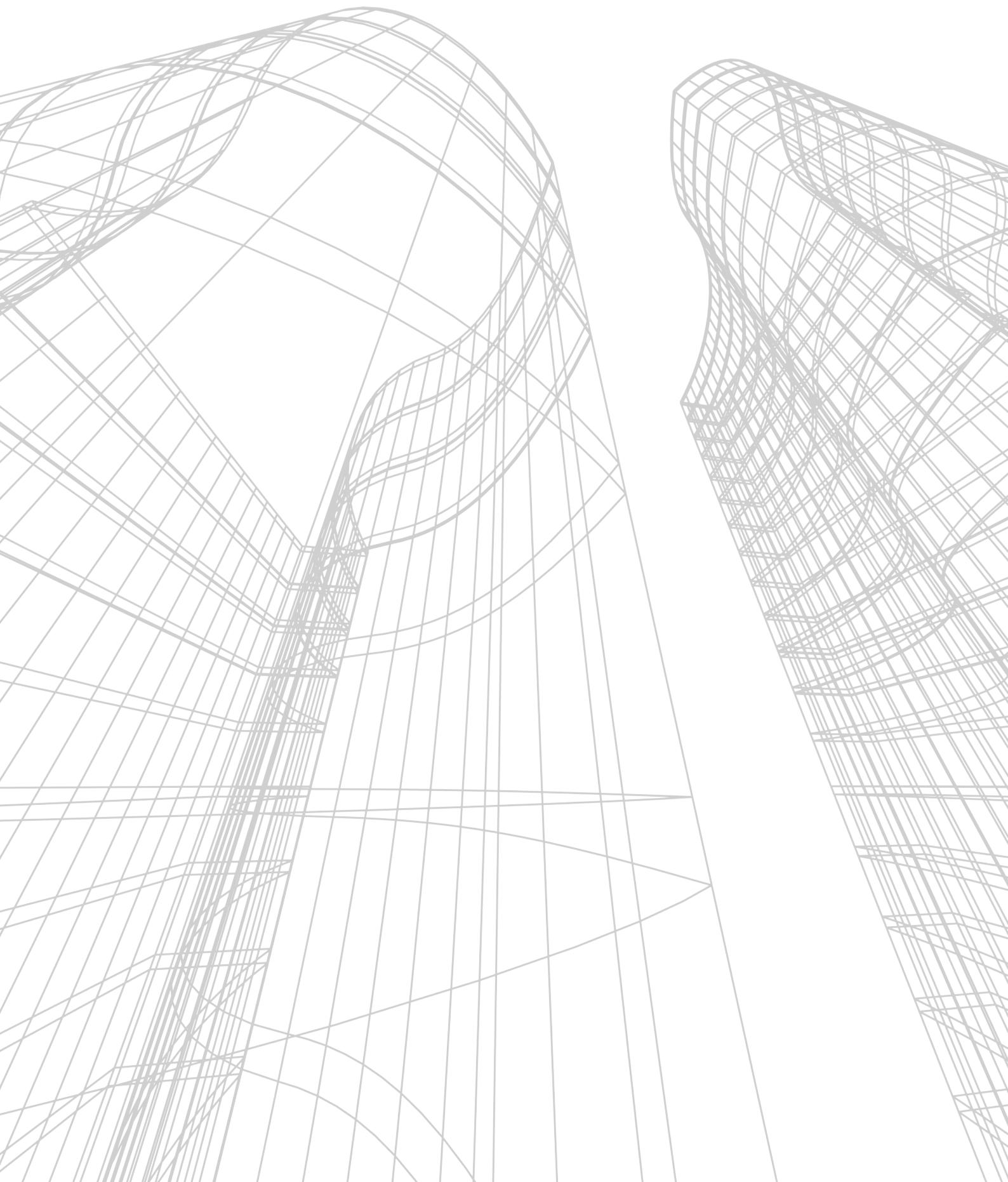


14

15. In 2019, China ENFI won the National Quality Project Award for the design of the comprehensive recycle of rare metal from copper anode slime project for Jinchuan Group Co., Ltd..



15



# ORGANIZATIONAL GOVERNANCE



Organizational governance refers to the system by which construction enterprises make and implement decisions to achieve their goals, including formal governance mechanisms and informal governance mechanisms. The former is based on established structures and procedures, while the latter is related to a company's culture and values and is often influenced by its leadership. Organizational governance is the internal decision-making framework and the core function of enterprises.



# Five Responsibilities in One Build a Happy Life

◇ Jiangsu Suzhong Construction Group Co., Ltd.

## Introduction

Jiangsu Suzhong Construction Group Co., Ltd. has actively built its own characteristic “five-in-one” responsibility mode, comprehensively integrated social responsibility commitment into corporate governance, and led the sustainable development of enterprises.

共筑责任 持续发展

-中国建筑业企业履行社会责任联合倡议单位-



中建一局集团建设发展有限公司  
CHINA CONSTRUCTION FIRST GROUP CONSTRUCTION & DEVELOPMENT CO., LTD.



中国十五冶  
15MCC



河北建设集团  
HEBEI CONSTRUCTION GROUP



蘇中建設



## SDGs

 Goal No.9	Jiangsu Suzhong Construction Group Co., Ltd.. has actively built its own characteristic "five-in-one" responsibility mode, comprehensively integrated social responsibility commitment into corporate governance, and led the sustainable development of enterprises.	 Goal No.11	Adhere to the public, environmental responsibility, to "create a better living space and environment".
 Goal No.17	Hand in hand with a number of enterprises to promote the construction industry enterprises to fulfill social responsibility; Participate in international cooperation projects on corporate social responsibility to enhance the influence of responsibility.		

## CSR

 Organizational Governance	Establish and continuously improve the social responsibility management system, fully integrate social responsibility into corporate strategy, daily operations and staff management.	 Community Participation and Development	Carry out social responsibility practice activities to build a harmonious and beautiful community.
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## 1. Case Overview

Jiangsu Suzhong Construction Group Co., Ltd. (Suzhong Construction in Short) adheres to its business philosophy of “sincerity, trust, kindness and beauty,” the values of “teamwork, integrity, innovation and sharing,” and the missions of “creating a beautiful living space and environment” in its business operations. Motivated by the culture to carry out social responsibilities, Suzhong construction has developed a responsibility management system—the “five-in-1 model”—that incorporates its own distinguished characteristics. The system aims to continue to 1) enhance social responsibility management, 2) deepen the study on responsibilities, 3) fulfill responsibilities in practice, 4) pay attention to communication of responsibilities, and 5) conduct social responsibility evaluation. The model has received recognition and respect from stakeholders.

## 2. Case Background

The international society has long reached a general consensus to fulfill corporate social responsibilities and promote sustainable development. Corporate social responsibility has also become a global common language and value system for determining the existential value of enterprises and the cornerstone of sustainable development for enterprises. The 14th Five Year Plan suggested to promote high quality development of private enterprises and encourage private enterprises to fulfill social responsibility. Therefore, social responsibility is an obligation that private enterprises should fulfill, and it also implicitly highlights the brand image of the enterprises.

Suzhong Construction has been actively integrating social responsibility to the core of the corporate culture for a long time, and has been taking voluntary initiatives to implement General Secretary Xi's messages, including: “Enterprises be good ‘corporate citizens’ who think of the water

source as they drink and give back to the society at the same time as they develop themselves; and this is a necessary social responsibility that enterprises need to fulfill;” “only wealth with love is truly meaningful wealth, and only enterprises who actively bears the social responsibility can be the most competitive enterprises;” “as private entrepreneurs get rich, they must follow good examples, enhance patriotism, and fulfill social responsibilities. The ones who get rich first should help the ones who get rich later and actively participate in social welfare work.” The company developed the “five-in-one” social responsibility management system, to incorporate social responsibility into its corporate strategies, daily operation and employee management. The system has received recognition and respects from stakeholders, and becomes an important structure for developing a “private enterprise group holding in related diversified industries with prominent main businesses.”

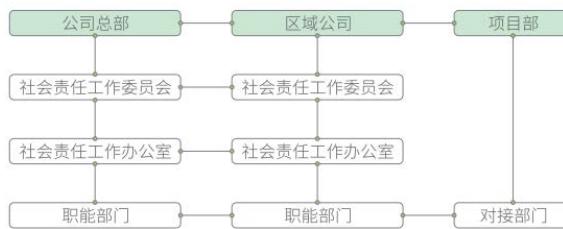
## 3. Responsibility Actions

Suzhong Construction adheres to its business philosophy of “sincerity, trust, kindness and beauty,” the values of “teamwork, integrity, innovation and sharing,” and the missions of “creating a beautiful living space and environment” in its business operations. Motivated by the culture to fulfill responsibility, Suzhong Construction has continued to strengthen its social responsibility management system, which effectively enhances its capacity to fulfill responsibility in practice.

### (1)Enhance Responsibility Management

Suzhong Construction established a social responsibility organizational management structure that runs through the headquarter, regional companies, and project departments, to ensure that social responsibility is carried out throughout every layer from top to bottom of the company's system. At the headquarter, the senior executives and department heads formed a social responsibility working

committee to lead social responsibility related work in the company. The social responsibility work office is also created under the committee, and the working body is located in the Department of Comprehensive Management. The office are mainly responsible for devising social responsibility work plans and management systems, organizing social responsibility actions and internal and external communications, and preparing social responsibility reports. In regional companies, the social responsibility committee for the regional companies and the subsidiary social responsibility work offices were established. The main working bodies are located in the human resources department. At the project departments, the communications and reporting structures were clarified.

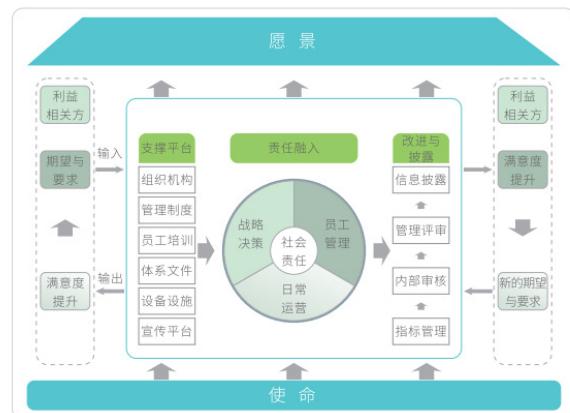


Flowchart of Suzhong Construction Social Responsibility Management System

## III2 In-Depth Studies on Social Responsibility

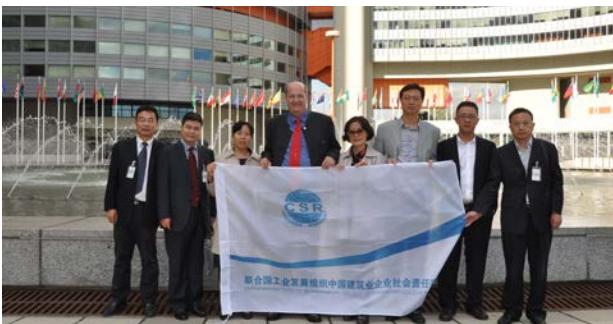
**Investigating the Integration of Responsibilities.** Suzhong Construction has conducted in-depth studies on domestic and international social responsibility standards, including "Guidance on Social Responsibility" according to ISO 26000 and GB/T 36000-2015, "Guidelines on Sustainable Development Reporting" (F4), "Stakeholder Participation Standards" (AA1000), "Canadian Guidelines on Corporate Social Responsibility." The company has continued to carry out comparative studies on world-renowned construction companies and analyzed the new trends in social responsibility information disclosure. The company has also actively incorporated social responsibility practices into the corporate strategy, daily operation and employee management, aiming to enhance the applicability and practicality of the standards in enterprises, promote social responsibility management in enterprises, and

explore how private construction enterprises can incorporate social responsibility into its management system.



Visualizing Suzhong Construction's Social Responsibility Management

**Strengthen International Cooperation.** Since 2014, Suzhong Construction has continued to participate in United Nations Industrial Development Organization's project—Development of Corporate Social Responsibility in the Construction Sector in China—and has become the project's pilot enterprises. The company participated in the preparation of the "Corporate Social Responsibility Evaluation Criteria for the Construction Industry," which makes it the first private enterprise to participate in the preparation of this standard. The standard has been published on July 1st, 2018, and has been effective since October 1st, 2018. The publication of this standard has formed strong support for the implementation of social responsibility in construction enterprises in China. Meanwhile, as the pilot enterprise of Phase I of the project, the company participated in overseas study tours, organization of regional project research. Suzhong Construction also incorporated social responsibility into the projects undertaken by the company, carried out social responsibility evaluation in pilot projects, continued to improve its social responsibility management system, brand social responsibility actions, and increase the company's social impact.



## Overseas Study Tours on Corporate Social Responsibility

Conduct research projects. Suzhong Construction has actively participated in social responsibility research projects. In 2018, the company participated in the Ministry of Science's research on "Guidelines for the Implementation of Corporate Social Responsibility in the Chinese Construction Industry" and China Institute of Standardization's research project on "Social Responsibility Management Systems—Requirements and Guidance for Use." The publication of these standards created positive effects on improving China's social responsibility standard system and leading the implementation of corporate social responsibility in the construction industries.



## Kick-Off Meeting at the Ministry of Science

### (3)Carrying Out Responsible Actions

With responsible attitudes, Suzhong Construction has worked with stakeholders and consciously put social responsibility into practice. The company fulfilled its responsibility for employees and built the stages for employees' career development. The company also values responsibility for consumers and provided reliable products and services to its customers. The company is dedicated to fulfilling responsibility for the shareholders and created positive values for the shareholders. The company continues to be responsible for its partners and works to create mutual benefits. In addition, the company actively fulfills its responsibility for the public and the environment by building a harmonious community and putting green development in practice. Through responsible actions, the company has contributed to the development of better living spaces and environment.

Company's Good Practices in CSR, published on  
"Junior Reader on CSR in the Construction Industry"

#### (4) Emphasizing communications of responsibilities

Publishing social responsibility report. The company has improved its CSR information disclosure system to enhance the communications and exchanges on CSR related topics. Suzhong Construction actively identifies stakeholders; through diverse approaches such as preparing and publishing social responsibility reports, publicizing through

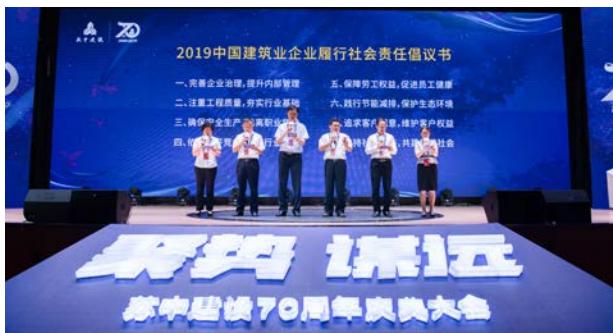


company's media platforms, communicating with mainstream media, and participating in social responsibility forums, the company has shared social responsibility philosophy, measures and performances with its stakeholders and responded to their concerns. This has created a healthy environment for the fulfillment of social responsibility. Since 2015, the company has been preparing social responsibility reports for 7 years, which effectively increased the transparency of the company's business operation.



The 2021 Social Responsibility Report  
of Suzhong Construction

**Issuing Responsibility Proposals.** In 2019, at the celebration of the 70th Anniversary of the Company's establishment, Suzhong Construction issued the "2019 Proposal for Chinese Construction Enterprises to Fulfill Social Responsibility" along with many central enterprises, including China



Enterprise Representatives Reading Off the "2019 Proposal for Chinese Construction Enterprises to Fulfill Social Responsibility"

Construction First Group Construction & Development Co., Ltd, China 15th Metallurgical Construction Group Co., Ltd, Beijing Construction Engineering Group, Zhongtian Construction Group Co., Ltd, and Hebei Construction Group Corporation Limited. This aims to promote the fulfillment of social responsibility in the construction industry and raise the industry's awareness for social responsibility.

#### (5) Social Responsibility Evaluation

Suzhong Construction has comprehensively integrated the social responsibility related standards into the daily management and operations of the company, continued to enhance the company capacity for social responsibility practices, developed a "brand" with social responsibility for the company and became responsible "corporate citizens." In 2019, the company's social responsibility performance was evaluated and has been awarded the "Outstanding" level in responsibility fulfillment.



Certificate for Corporate Social  
Responsibility Evaluation

## 4. Effect of Responsibility

Under the guidance of the five-in-one management model, Suzhong Construction's social responsibility management and practices have been highly recognized by the stakeholders and was given "Outstanding" level in Corporate Social Respon-

bility Performance Evaluation by the UNIDO Development of CSR in China's Construction Industry project. The company also was awarded such as the "Red Cross Humanitarian Aid Meritorious," "The Most Caring Donor Enterprise," "The Most Socially Responsible Star Enterprise in Charity Works" in Nantong city, and the "Most Caring Enterprise Charity Enterprise" and the "Star Charity Enterprises" in Hai'an city. The chairman of the board, Mr. Zheng Honghu, was rated as "Haian Charity Donation Model", "Hai'an 2014-2018 Annual Charity Donation Advanced Individual" and "National Social Poverty Alleviation Advanced Individual".

The company won the "National May Day Labor Award", "Chuangluban Award Project Outstanding Contribution Award", "National Excellent Construction Enterprise", "National Contract-abiding and Trustworthy Enterprise", "Jiangsu Civilized Unit" and other honorary titles, with a total of 30 Chuangluban Awards, 25 National Excellence Awards, more than 1,000 ministerial and provin-

cial quality projects, entered the top 500 Chinese enterprises for 20 consecutive years, and entered the ENR Top 80 Chinese Contractors for 18 consecutive years.

## 5. Future Outlook

Suzhong Construction is entering a new stage of development at which it will explore the development philosophy of "leading the responsibility with the brand and driving the brand with responsibility," and dedicate full efforts into making Suzhong a responsible brand. Under the guidance of professional think tanks, Suzhong Construction will ride with the global responsible development trends, enhance research on corporate management practices, improve the management models of the responsibility management system, strengthen the publicization of good practices. The company will further create a healthy atmosphere for fulfilling responsibilities, and will continue to strive for "creating a better living space and environment."

## 6. Deposition From Stakeholders

*"I hope that Suzhong Construction can achieve faster development and expand into a broader, global market, with social responsibility integration, evaluation and continuous improvement as its foundation."*

——Florian BERANEK, Lead Expert Responsible Business Development at UNIDO



## Attachment: Enterprise Related Information



Company Website:<http://www.szcg.com.cn/>  
Company Address:Haian,Jiangsu Province

### Company Introduction

Jiangsu Suzhong Construction Group Co., Ltd.. was established in February 1949, established as a standard joint-stock company in December 1998, and restructured into a private enterprise with self-management and self-responsibility for profits and losses in June 2005. The company is one of the first national housing construction engineering construction general contract of the special grade

qualification enterprises, the company is committed to investment, construction, operation, with foreign contract rights, mainly industrial and civil construction, set architectural design, equipment installation, decoration, municipal public engineering, fire engineering and overseas engineering business in one. It has the general contracting ability to undertake urban comprehensive construction, large public facilities, super tall buildings, large industrial plants and other projects.



The company is a well-known “Nantong Iron Army” one of the main forces, Jiangsu Province construction leading enterprises. Successively won the “national May Day labor diploma” outstanding contribution award “” and” engineering “the contract heavy credit enterprise”, “national excellent construction enterprise”, “national advanced construction enterprise”, “national excellent enterprise construction project quality management” best “jiangsu province construction enterprise”, “jiangsu province famous construction contractor” “mayor of nantong quality prize” and other honors. It is “AAA credit enterprise of Jiangsu Province” and “head office key Customer” of China Construction Bank. In 2021, the company ranked No. 323 in China’s Top 500 Enterprises, No. 142 in China’s Top 500 private Enterprises and No. 21 in Jiangsu’s Top 200 private enterprises.

The company’s business throughout the country in 30 provinces, municipalities, autonomous regions and Central Asia, Southeast Asia, Africa and other regions, to win the market with quality, to win customers with integrity, fully show the construction “iron army” elite division style, in 2021 to achieve the construction output value of more than 75 billion yuan. Company has built the Wuxi sea billow wealth center, Xinjiang change especially electrician technology research and development center, Shanghai world expo the pavilion pavilion, Taiwan pavilion, Ireland, the Inner Mongolia museum, Shenyang Hong building, Beijing Air China headquarters building, Nanjing central international, Qitaihe party and government office center, Linyi Boerman hotel, dongtai culture art center and so on one batch of DaTiLiang, difficult, and influence A landmark project. Cumulative Luban Prize 30, 25 national high quality project, more than 1000 national patents, method, QC results and industry standards, and the

Yangtze cup, yulan, grassland cup, cup, taishan cup, Huangshan century cup, cup, Tian-shan cup, Longjiang cup, Bayu, Xixia cup, cup of Haihe river and Anji cup, etc. 1000 provincial projects with high quality, The qualified rate of the project is 100%.

The company actively implements structural adjustment and strategic transformation, focuses on building a related diversified industrial holding private enterprise group with outstanding main business, vigorously develops three major businesses, namely construction, urban infrastructure investment and operation, and environmental protection project investment and operation, and carries out industrial layout and business extension centering on core competence. We will deepen the development of specialized sectors such as general contracting, municipal roads and Bridges, design consulting, building intelligence, and mechanical and electrical equipment installation, and complete the transformation and upgrading from a housing builder to a private enterprise group holding related diversified industries.

Adhering to the corporate mission of “creating a better living space and environment” and the core values of “team, integrity, innovation and sharing” and the corporate spirit of “striving for excellence”, Efforts to integrate “engineering general contracting (EPC) services provider, urban infrastructure, environmental protection industry investment cycle service providers and service providers” three business integration, deep melting production interaction, layout of the capital market, accelerate the business transformation, establish industry ecology, in order to realize enterprises “production billions of scale, the market value of billions mild” grand goal and make unremitting efforts!



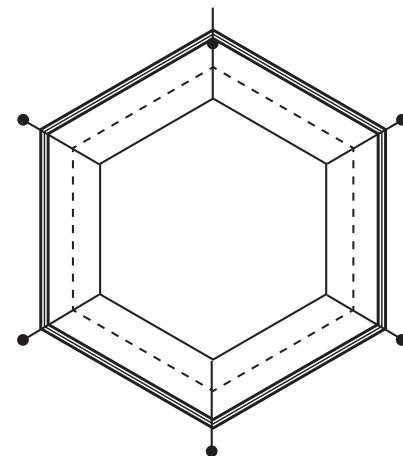
## Corporate Culture

### Mission

To create a better living  
space and environment

### Vision

To build a private enter-  
prise group with promi-  
nent diversified industries



### Values

Team integrity, inno-  
vation and sharing

### Enterprise spirit

Strive for excellence

### Management policy

environmental protection, health,  
building the era of high-quality  
goods, integrity and law-abiding  
to build a monument in Suzhou

### Business philosophy

Sincere to letter perfection

## Major honors in the Past Three Years

Award Name	Award Content	Award Time	Award Picture
323rd on China's Top 500 Companies	Top 500 enterprises of China	2021	
The 142th of China's top 500 private enterprises	China's top 500 private enterprises	2021	
No.14 of Top 80 ENR contractors in China	Top 80 ENR contractors in China	2021	

Award Name	Award Content	Award Time	Award Picture
NO. 90 of Top 100 enterprises in the Yangtze River Delta in 2021	Top 100 enterprises in the Yangtze River Delta in 2021	2021	
Winning unit of National "Ankang Cup" Competition	Winning unit of National "Ankang Cup" Competition	2020	
Engineering construction integrity typical enterprise	Engineering construction integrity typical enterprise	2020	
Engineering construction integrity typical enterprise	Engineering construction integrity typical enterprise	2019	
Yitai Huafushijia Housing Project (the second phase)	The Luban Prize for Construction Project	2020	
National North Football Training Base first phase project football stadium	The Luban Prize for Construction Project	2020	
Jixi City People's Hospital new outpatient, medical technology and ward building	The Luban Prize for Construction Project	2021	
East Building of commercial office project, Block 09-01, Beicai Yuqiao Community	National Quality Project Award Countries with superior quality prize	2019	



Award Name	Award Content	Award Time	Award Picture
Outpatient ward complex building Affiliated Hospital of Inner Mongolia Medical College	National Quality project	2020	
Horse Island art and culture theme resort hotel	Horse Island art and culture theme resort hotel	2020	
Baishang Magnolia Mansion residential area project	Jeme Tin Yow Award Gold Award for Outstanding Residential Community	2019	
1# public rental apartment building and 10 (Gaomidian public rental housing) projects	Jeme Tianyou Outstanding Residential District Gold Award single item	2019	
Jiangxiangyuan 9#10#11#15#16# resi- dential building Project	Jeme Tianyou Outstanding Residential District Gold Award single item	2019	
Zexin mansion	Tianyou Outstanding Residential District Gold Award single item	2020	
Evergrande Jade Huating	Jeme Tianyou Outstanding Residential District Gold Award single item	2020	

Award Name	Award Content	Award Time	Award Picture
European Sunshine City Phase II (residential building) 1#~4# building project	Jeme Tianyou Outstanding Residential District Gold Award single item	2021	
Taiyuan Happiness Lane Phase II Project	Jeme Tianyou Outstanding Residential District Gold Award single item	2021	
Jiacun Urban village reconstruction (Phase I) Land 15 project	Jeme Tianyou Outstanding Residential District Gold Award single item	2021	
Greentown Square Phase I 1A office mechanical and electrical installation project	Jeme Tianyou Outstanding Residential District Gold Award single item	2019	
Mechanical and electrical installation project of commercial office building base, block B, section 2 (Olympic sports south zone No.2 project), etc. 5 projects	Jeme Tianyou Outstanding Residential District Gold Award single item	2020	
Horse Island art and culture theme resort hotel	Jeme Tianyou Outstanding Residential District Gold Award single item	2021	
National Construction Project construction site safety production standardization learning exchange program	5 projects have won the title of national standard chemical industry	2021	
National Construction Project construction site safety production standardization learning exchange program	4 projects have won the title of national standard chemical industry	2020	
National construction project construction safety production standardization site	4 projects have won the title of national standard chemical industry	2019	

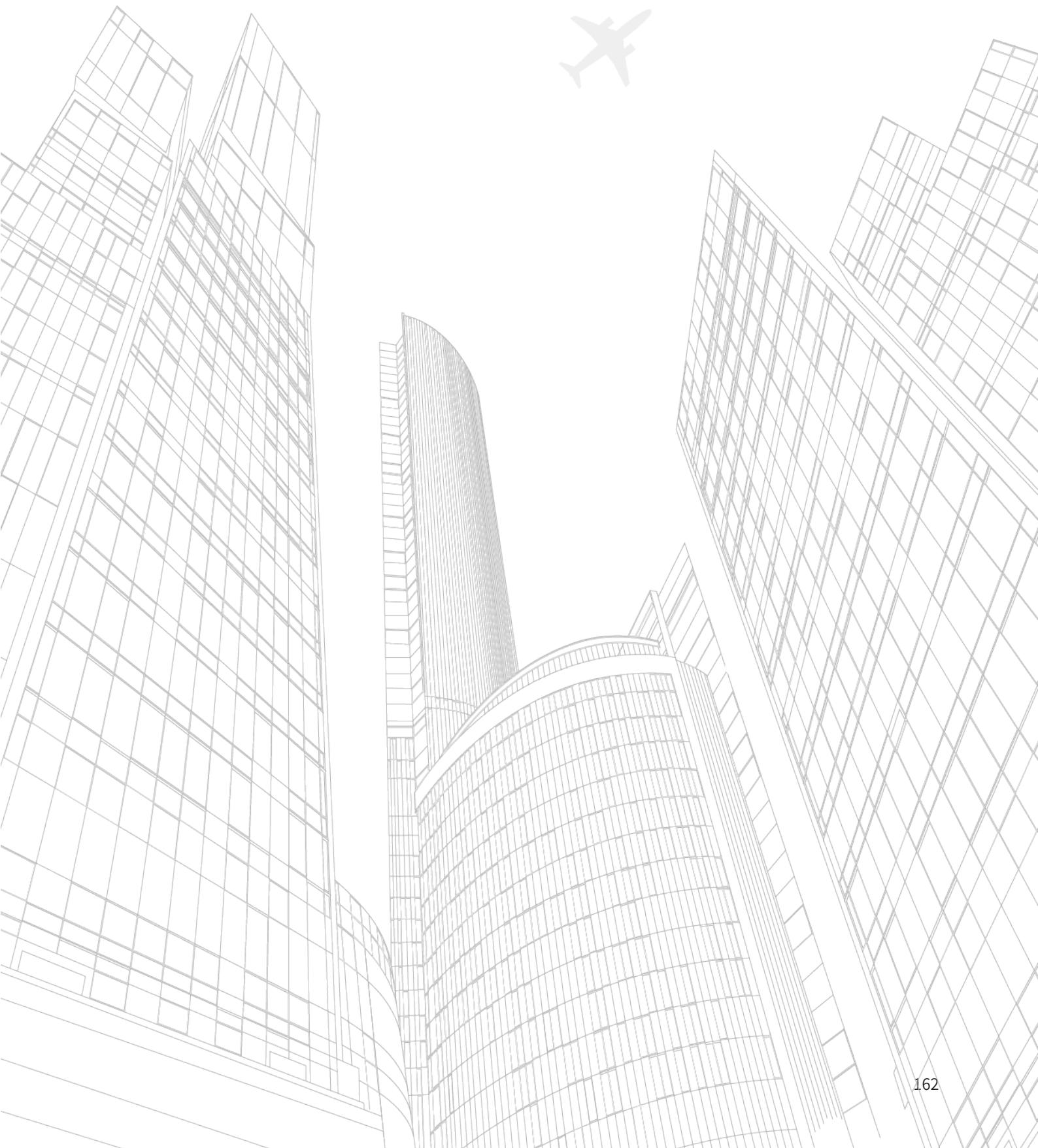
## Employee Data

The ratio of male to female employees is about 97:3; About 5 per cent of middle and senior managers are women.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total assets	100 million	278.6	328.39	301.86
Operating avenue	100 million	415.96	426.33	460.76
Total Profits	100 million	11.04	12.37	6.58



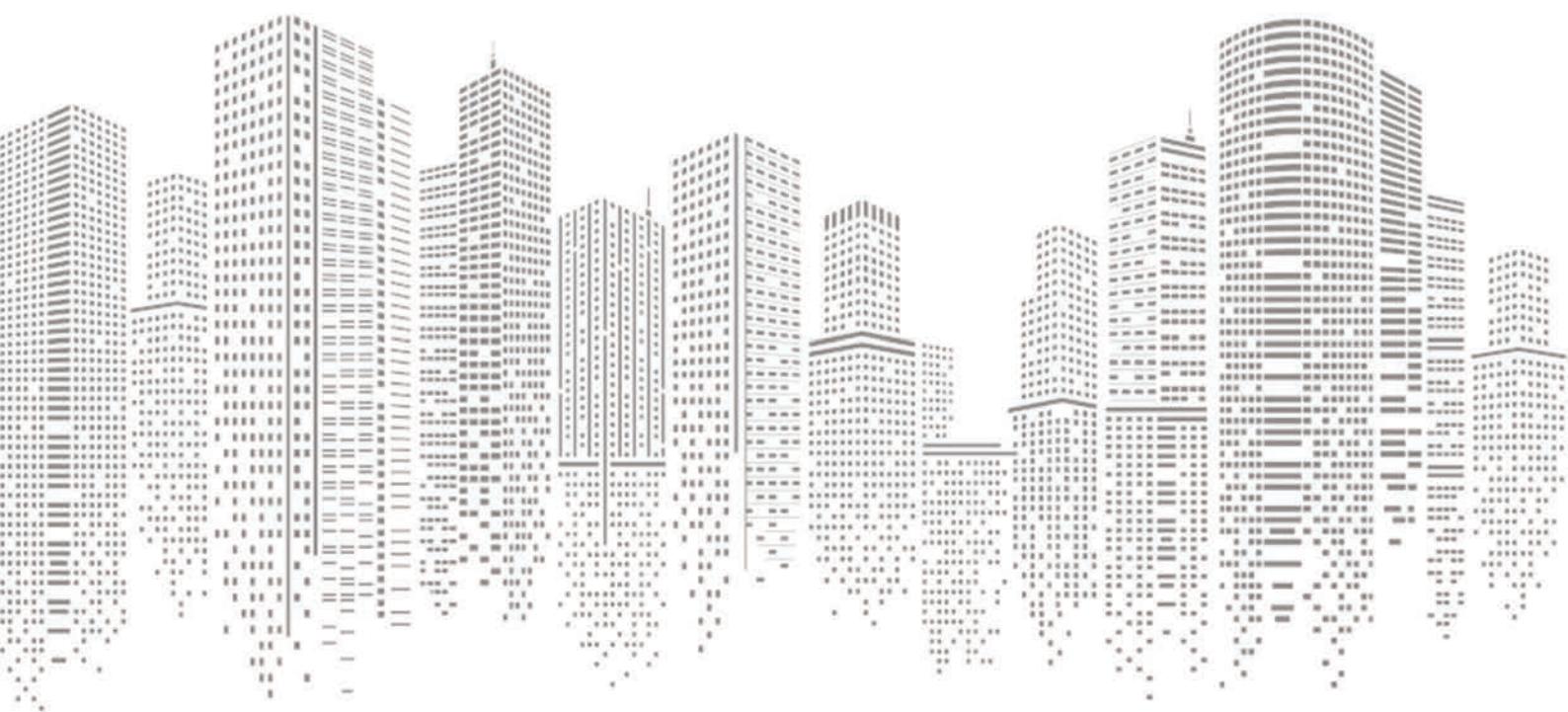




# HUMAN RIGHTS



Human rights are fundamental rights for all, and respect for human rights is essential to the rule of law and to social justice and fairness. As business can also influence individual human rights, it is appropriate for business to take responsibility for respecting human rights within their sphere of influence. The three main topics covered are civil and political rights, economic, social and cultural rights, and fundamental principles and rights at work.



# Adhering to Gender Equality Policies. Assisting Female Workers in Their Career Development

◇ General Construction Company of CCTEB Group Co., Ltd.



## Introduction

General Construction Company of CCTEB Group insists on gender equality, pays attention to the development of women, and provides equal employment and promotion opportunities for women. Wang Xiaohong's story vividly illustrates their responsibility to protect the rights and interests of female workers and promote their development.





## SDGs

 Goal No. 5	Insist on gender equality, implement equal pay for equal work, guarantee equal participation of female workers in the democratic management of enterprises, establish a long-term mechanism for the protection and care of female workers, provide equal opportunities for the promotion of female workers, and effectively safeguard the various legitimate rights and interests of female workers.	 Goal No.11	Undertake the construction of the Wuhan Vulcan Hill Hospital at a critical time, effectively enhancing Wuhan's ability to withstand the risks of public health emergencies.
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## CSR

 Human Rights	Adhere to gender equality, care for female workers, protect the legitimate rights and interests of female employees and provide equal opportunities for their development.	 Community Participation and Development	In a time of crisis, it undertook the construction of the Wuhan Vulcan Mountain Hospital, making an important contribution to fighting the epidemic and protecting the lives and health of the local population.
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## 1. Case Overview

General Construction Company of CCTEB Group has always insisted on gender equality and empowered its employees with an equal, inclusive and diversified corporate culture to create a good corporate atmosphere. The company protects the rights and interests of female workers in accordance with the law, provides equal development opportunities for female workers, builds a good platform for them to establish their career, and help them achieve self-development. Wang Xiaohong is one of the many female employees of the company, and her story is an epitome of the company's care for female employees and their development.

## 2. Case Background

Women's rights and interests are fundamental human rights. Since the 18th Party Congress, the Party Central Committee, with Xi Jinping at its core, has attached great importance to the development of women's cause and made the protection of women's rights and interests a firm national will. General Secretary Xi Jinping has made a series of important statements on adhering to the basic state policy of gender equality and safeguarding the legitimate rights and interests of women and children, promoting women's equal exercise of democratic rights in accordance with the law, their equal participation in economic and social development, and their equal enjoyment of the fruits of reform and development, and guiding the development of China's women's cause to march forward in the right political direction. Since the 18th National Congress, the country has carried out the basic state policy of equality between men and women, and has continuously increased its efforts to formulate, amend and implement laws and regulations relating to the protection of women's labor rights and interests, in order to seek a higher degree of protection for women's labor rights and interests, enhance women's capacity for self-de-

velopment, and promote gender mainstreaming in the workplace.

By creating gender-equal employment opportunities and working conditions, enterprises, as the mainstay of the market economy, not only increase their attractiveness and cohesiveness, but also bring economic benefits to them in the long run and are conducive to maintaining social stability and enhancing people's sense of well-being. State-owned enterprises have an exemplary role to play in the promotion of gender equality. The company has long insisted on gender equality, safeguarded the legitimate rights and interests of female workers, and actively built a platform for female workers, who account for 13% of the total number of workers, to build their careers and contribute to their growth and development.

## 3. Responsibility Actions

All along, the company has attached great importance to the construction and development of female workers and created a good environment of gender equality. The company insists on gender equality, implements equal pay for equal work, guarantees equal participation of female workers in the management of the enterprise, establishes a long-term mechanism for the protection and care of female workers, provides equal opportunities for the promotion of female workers, effectively safeguards all the legitimate rights and interests of female workers, continuously improves the satisfaction of female workers. A number of advanced models of female workers have emerged, effectively promoting the healthy and harmonious development of the enterprise.

Wang Xiaohong, known as the iron lady of the company, has been showing excellent performance on the construction site with her unique charm, and has become the "construction site rose" praised by everyone with her solid skills, fighting spirit and excellent achievements. She is a typical



representative of the company in caring for female workers and paving the way for their growth.

#### (1)Onboarding: “stupid work” to sharpen “real skills”

In July 1982, Wang Xiaohong joined the China Construction Third Bureau, starting her first job. “At the beginning, I was not good at it, I didn’t know anything, I had no experience and no knowledge, so I was often busy and missed things.” When she first entered the workplace, she encountered many setbacks, but she was not discouraged by them. On the contrary, she strengthened her learning in practice, studied whenever and wherever she could, got up early and stayed up late to read drawings, went to the site, checked equipment, climbed the grid, not only studied book knowledge, but also went to the site with questions, asked colleagues for advice and eventually kept up with the new technology. “The more I learned, the more I wanted to be challenged with something more difficult, and in the non-stop challenge I also fell in love with the job.”, she said. The many years of honing her skills have helped her to develop her skills and solve many major problems for the smooth progress of the project construction.

#### (2)Development: “budget clerk” progresses to “golden abacus”

In 2012, Wang Xiaohong was transferred to the Marketing Department of the General Contracting Company to engage in bidding work, and the first project she bid for was the Tianhe Airport T3 project, the largest terminal building in Central China. At the time, she was competing with an 11-member bidding team, and when she learned of the situation, she showed remarkable drive and confidence. “They needed 6 months to complete the costing, I was confident I could do it in 3 months!” Through day and night research and careful gate-keeping, she eventually took 2 months and 26 days to complete the preliminary costing work, making

a good start for the later bidding.

Because of her “fast, accurate and hard” calculation, the company leaders decided to transfer her to the Ministry of Commerce, followed by another “hard bone”. In order to solve the settlement problem with the owner at that time, Wang Xiaohong, who was over 40 years old, spent every day in the owner’s office, taking out the documents and checking the quantity of works with the owner one by one. In the end, the project created value for the company, and she also gained the respect and recognition from the owner.

Because she also has to take care of other business of the company, her desk and filing cabinet are densely packed with drawings, design changes, site visas and other documents. “Engaging in calculation requires patience and loneliness on the one hand, and on the other hand, we need to use our brains to work, work with our hearts and work with ingenuity.” Wang Xiaohong knows the importance of reducing costs and increasing efficiency of the project, and her excellent business quality has won her the title of “Golden Abacus”.

#### (3)Teaching: “Craftsmen” promote “passing on their skills”

In 2018, the general contracting company successfully won the project of Chuzhou Huike Electronics Clean Plant, which was the largest electronic clean plant in the world at that time. In the face of the difficult task, the company decided to let Wang Xiaohong take charge of the project as the installation manager of the general contracting company’s Chuzhou Huike project general contracting department and lead the production of the project’s steel structure. Due to the tight schedule of the project, nine months in Chuzhou, Wang Xiaohong had to grasp the production and the business at the same time. Finally, their team of three people completed the difficult task of 20,000 tons of steel structures in 68 days.

One flower alone is not spring. Having been in the

industry for more than 30 years, Wang Xiaohong understands that the development of an enterprise cannot rely solely on the progress of individuals, so the ability of the team is particularly important. Therefore, at the age of over 50, she still travels around the country, leaving her figure in more than 100 key projects, passing on her years of experience to young people without reservation, and the dozens of apprentices she has led have become the backbone of various projects.

“We are ordinary workers on the road to greatness, and each of us should see ourselves as an outstanding artist, not a mediocre craftsman, and we should pass on our ideas and experience while perfecting ourselves.” This is Wang Xiaohong’s belief, and her action.

#### (4) Setting off again: the experienced one at the front line

In early 2020, a sudden outbreak of a new type of coronavirus pneumonia swept through Wuhan, posing a serious threat to people’s lives, and causing a serious impact on economic and social development. On 23 January, the Wuhan Government held an emergency meeting and decided to build the Wuhan version of “Little Tangshan” - Vulcan Hill Hospital in Caidian. At this critical moment of unprecedented severity of the epidemic in Wuhan, China Construction Third Bureau accepted the sacred mission of building the Vulcan Hill Hospital with the responsibility of a central enterprise in Wuhan.

As a steel structure expert with more than 30 years of experience, on 26 January, 53-year-old Wang Xiaohong was invited to the construction site of Vulcan Hill Hospital for technical guidance. After joining the construction team of Vulcan Mountain Hospital, Wang Xiaohong became the “backbone” of the steel structure construction part of the project, serving as the deputy head of the steel structure team, leading a team of 18 managers and 196 workers. Her arrival has given everyone a “shot

in the arm”. Faced with harsh construction conditions, material shortages, cold weather, complicated work processes and staffing arrangements, she coordinated the four major aspects of the project: drawings, technology, materials and site, and made hundreds of phone calls every day. Day and night work was the norm at the time.

Thanks to everyone’s efforts, the Vulcan Mountain Hospital was officially delivered on 2 February, and was built in 10 days, demonstrating the new speed of China’s construction and Hubei’s firm determination to fight the epidemic. Behind this is the hard work of every builder, and among them is an active party commando team of 15 women, including Wang Xiaohong, who are on the front line and have made an important contribution to the high quality of the project.



Wang Xiaohong at the construction site of Vulcan Hill Hospital

## 4. Effect of Responsibility Fulfillment

Led by the spirit of striving for excellence, General Construction Company of CCTEB Group has



2022 “March 8” Women’s Day seminar and commendation meeting



produced a number of advanced female workers and collectives. In their ordinary work posts, they wield intelligence and passion, and write a happy and beautiful life.

## 5. Future Outlook

The company will always adhere to the concept of people-oriented, actively fulfill the responsibilities of employees and work together with them to develop together with the company. The company

will continue to strengthen the construction of the workforce, protect the legal rights and interests of employees and provide a good platform for their development; at the same time, it will continue to adhere to gender equality, actively care for female employees, provide equal employment and promotion opportunities for female employees, create a broader space for women to grow and help more women to achieve success!

## 6. Deposition from Stakeholders

*“Female workers are half of the force supporting the high-quality development of the three bureaus, and all of them have made excellent achievements in their positions. Trade unions at all levels should do a good job in safeguarding the rights and interests of female workers and special care activities for female workers. We should study in depth the ideological situation, psychological dynamics and spiritual and cultural needs of the female workers’ team, speed up the building of a platform for skills competitions and innovation and creativity for female workers, carry out activity planning through multiple channels, and promote the formation of a good atmosphere in which all talents can be developed.”*

——Chen Zhenmin, Deputy Secretary of the Party Committee and Chairman of General Construction Company of CCTEB Group Co., Ltd.

*“In the construction industry, there are relatively few female comrades. There are those who work on materials, those who do logistics, those who are responsible for disciplinary supervision and those who do health and epidemic prevention ..... Although we are in different positions, we have proved with practical actions that we are not inferior to our male comrades in the construction of Vulcan Hill Hospital.”*

——Lv Li, Secretary of the Discipline Inspection Committee and Chairman of the Trade Union of the Installation Branch of General Construction Company of CCTEB Group Co., Ltd.

## Attachment: Enterprise Related Information



Company name: General Construction Company

of CCTEB Group Co., Ltd.

Company Address: Wuhan City, Hubei Province

### Company Profile

General Construction Company of CCTEB Group Co., Ltd. was established on April 8, 1995 in the wave of reform of the national construction enterprise system. Carrying the glorious mission of “strengthening the strength, cultivating talents, accumulating experience and improving reputation for the development of the Bureau Group”, it upholds the character of striving for excellence and refines the “three qualities” of “outstanding brand, excellent quality and noble taste”. The company has gradually grown into a pillar company of construction business and an excellent front-runner of the China Construction Group. At present, there are 16 departments and 1 office, 3 business centers (EPC Business Center, Overseas Business Center and New Business Center) and 1 platform-type unit (Engineering Equipment Technology Company) in the company’s headquarters. There are 9 main secondary operating units and over 300 projects under construction, distributed in 8 provinces and 2 cities in China and 6 countries including Pakistan, Maldives and Sri Lanka.

① With the greatness of the country in mind, the company builds high-quality projects. The company has built a number of first products in the fields of super high-rise, large span, deep foundation pit, airport station building, science, education, culture and health. The company has built the Wuhan Coca-Cola joint plant, the first in Asia in terms of construction area (the company’s first Luban Award); the Wuhan World Trade Building (248m), the first ultra-high-rise building in Central China; the first “bridge-building-in-one” large-scale railway station building in China; Raffles City Chengdu, the world’s largest light-colored fair-faced concrete complex; four large domestic airport terminals (T2 and T3 at Wuhan Tianhe Airport, T2 at

新时代商务中心  
租售热线: 87365588



Zhengzhou Xinzheng International Airport, and T2 at Chengdu Shuangliu Airport); China's tallest structural building - Tianjin 117 Tower (597 meters); the first standard of Xiongan New Area - Xiongan Citizen Service Center; the largest single electronic clean plant in China - Chuzhou Huike main plant; the largest single public hospital in China - the new site of Tianjin No. 1 Central Hospital and Wuhan Vulcan Hill Hospital. There is a large number of other high-end business card projects with large volume, high technological content and far-reaching social impact.

② Always striving for excellence and development. After the establishment of the company, we put forward the high-quality development idea of "doing well first, then getting stronger, then getting bigger". The first project undertaken after its establishment was the joint plant of Coca-Cola Wuhan, which set two records for the shortest construction period and fastest production among large joint ventures and foreign-funded enterprises in Wuhan and won the Luban Award. Afterwards, the company undertook a large number of landmark buildings in Wuhan. After gaining a firm foothold in Hubei, the company explored Beijing, Zhengzhou, Shandong and other regions, and in three years' time crossed the platform of one billion contract volume and one billion business income, smoothly stepped into the first square of the Engineering Bureau, and in 2011 crossed the platform of ten billion contract volume and ten billion business income development, and its comprehensive strength ranked in the forefront of the directly-operated companies of the Engineering Bureau of China Construction Group for many years in a row. In October 2020, the fourth party congress of the company put forward the short- and medium-term goal of "striving to be the leader of

high-quality development of CECC Group and the leader of excellence in China's construction industry" and the long-term strategic goal of "the most value-creating comprehensive construction service provider". The company is actively implementing the development strategy of "two centers and one base" and has started a new journey of "one best and two first".

③ Practicing the concept of "three products" and demonstrating our commitment. The company has always kept in mind its original mission, reformed and innovated, and actively delivered talents and contributed value to the Group. The company has integrated six bureau units (road and bridge company, equipment leasing company, installation company, materials and tools company, construction technology company and Jiangxi manager department of the second company). They completed the acceptance of the relevant projects, units and personnel of the former Forth Bureau Corporation, cultivated and incubated four Bureau-affiliated secondary units (Bureau Beijing Company, Southwest Company, Real Estate Company and Infrastructure Construction Investment Company) and one Bureau-level unit (China Construction Commercial Concrete, which later became the backbone of China Construction Western Construction). The company has won the Luban Award and the National Quality Engineering Award for 44 projects and has been awarded the National Civilized Unit for four consecutive terms. It has also won 137 provincial and ministerial-level honors, including the National May Day Labor Certificate, the National Customer Satisfaction Enterprise, the Advanced Grassroots Party Organisation of Central Enterprises, the Advanced Collective of Central Enterprises, and the Advanced Collective of Central Enterprises in the Fight against the New Coronary Pneumonia Epidemic.

## Corporate Culture

Dare to be the first, always strive to be the first

### Major honors in the Past Three Years



National Civilized Unit



National Youth Civilization



Advanced grass-roots party organizations  
in central enterprises



Advanced group of central enterprises  
in the fight against the new crown epidemic

## Employee Data

The company employs more than 8,000 people, of whom 13% are women.



# LABOR PRACTICES



The labor practices of an enterprise include all policies and practices related to the work carried out by the enterprise itself, entrusted or on its behalf, including subcontracted work. These include employment and Labor relations, working conditions and social protection, democratic management and collective bargaining, occupational health and safety, human development and training in the workplace. Providing employment and paying wages and other remuneration for Labor are the most important economic and social contributions of businesses. Labor practices have a significant impact on respect for the rule of law and social fairness, and whether they are responsible for the society is directly related to social justice, stability and harmony.



# People First CMEC is Committed to Improving Employee Care in Remote Areas

◇ China Machinery and Equipment Engineering Co., Ltd.

## Introduction

During the installation of the project construction of Angola Soyo Combined Cycle Power Station process, in the face of project, is to rely on medical services and remote employees often encounter a tropical disease and the threat of poisonous snake ants, The initiative to build a comprehensive employee health care system, and continue to extend occupational health services, effectively protect the health and safety of employees, owners and local communities and other stakeholders.





## SDGs

 Goal No.3	<p>We attach importance to and pay attention to the health of all employees and related communities, build an integrated employee health security system, continuously extend occupational health services, and effectively guarantee the safety and health of employees, owners, communities and other stakeholders.</p>	 Goal No.4	<p>Donate “Great Wall Comprehensive School” to improve the local educational conditions.</p>
 Goal No.6	<p>Donating 1,000 sets of household water purification units to improve local drinking water sanitation and help Soyo fight the cholera epidemic.</p>	 Goal No.10	<p>Under the background of being in the remote areas, the health of the employees being threatened with no credible medical service, it actively builds comprehensive employee health security system and integration of international SOS and other resources to provide health care support services, establish a project site clinic, for employees, owners, and community residents to provide medical services, reduce the health inequality of the distribution of data and services.</p>
 Goal No.17	<p>Integrate international SOS resources, provide health and medical support services, and jointly protect the life and health safety of employees, owners and local community residents.</p>		

## CSR

 Human Rights	<p>Adhere to the purpose of “people-oriented care for life”, attach importance to and pay attention to the health of all employees and related communities, to ensure life health and safety.</p>	 Labor Practices	<p>Establish a comprehensive employee care and security system, the HSE system with full participation, carry out a series of activities to relieve the anxiety of employees, hold regular health and occupational safety training lectures, and comprehensively protect the occupational health and safety of employees.</p>
 Community Participation and Development	<p>Pay attention to the health and safety of the local community, the project site clinic is open to the local community residents free of charge, to provide them with help within their ability; To donate the “Great Wall Comprehensive School”, household water purification equipment, etc.</p> <p>To contribute to the local community by improving local education and drinking water sanitation.</p>		

## 1. Case Overview

China mechanical equipment engineering co., LTD. (hereinafter referred to as CMEC) general contracting construction of Angola's line about combined cycle power plant construction and installation project is located in the remote, is to rely on local health services, and often meet with tropical diseases such as malaria, yellow fever, cholera, and the threat of poisonous snake ants, employees health and safety life under severe challenges. As a responsible international enterprise, CMEC always adheres to the development concept of "people-oriented", attaches great importance to and cares about the health of all employees and related communities, and has built a project integrated employee health security system. In 2018, CMEC received the "Best Remote Care Award" from SOS International for its outstanding performance in employee care obligations.

This project can be said to be an epitome of CMEC's "employee care". Adhering to CMEC's social responsibility concept of "contributing to the world, accompanied by responsibility", this project vividly explains CMEC's purpose of "people-oriented, caring for life". It is always committed to promoting the physical and mental health of employees, continuously extending occupational health services, and expanding staff responsibilities. It spares no efforts to save the lives of sub-



Aerial View of the Soyo Combined Cycle Power Plant Construction and Installation Project in Angola

contractors' employees, and effectively protect the safety and health of employees, owners, communities and other stakeholders.

## 2. Case Background

Angola Soyo Combined Cycle Power Station Construction and Installation Project (hereinafter referred to as "Soyo Power Station Project"), with an amount of US \$985 million, is planned to build 4 sets of 125MW gas-fired generating units and 2 sets of 125MW combined cycle generating units with a total installed capacity of 750MW, which is the largest power energy project undertaken by CMEC in Angola. It was also the largest gas-fired power station project in Angola and even Africa at that time. As the largest energy project under construction in Angola at that time, the Angolan government attached great importance to it.

Like most of CMEC's projects around the world, the project is located in a remote location, with no reliable local medical services, and the area where the project is located is often confronted with tropical diseases and adverse environment, such as malaria, yellow fever, cholera, and poisonous snakes and ants. The life and health safety of the staff is seriously challenged. How to protect the project construction personnel from disease and protect the life and health safety of employees is in front of the CMEC project department.

## 3. Responsibility Actions

As a leading enterprise in the international engineering contracting industry, CMEC always adheres to the concept of people-oriented development, attaches great importance to the welfare and health of all employees and related communities. CMEC has designed a perfect employee care and guarantee program for Soyo combined cycle power plant project in Angola.

(1) Establish a comprehensive employee health insurance system

“Making Ideas Come True” is the corporate culture that CMEC has always championed, demonstrating our firm commitment to improving the talent and well-being of every employee. In the face of the challenges faced by the employees of Soyo Combined Cycle Power Station Project in Angola, CMEC made timely decisions, made full use of internal and external resources of the company, and established a comprehensive employee care and security system. After detailed comparison and analysis of various schemes, the HSE system led by CMEC and the health and medical service support provided by international SOS integrating various medical resources were selected before the official construction of Soyo combined cycle power station to form an integrated employee care and security system of the project. With the support of SOS International, the CMEC Soyo Combined Cycle Plant project has set up an on-site clinic, which not only provides daily medical services, but also maintains a 24-hour link with SOS South Africa Assistance Center. The on-site clinic has established a medical and health record for each CMEC expatriate employee. By collecting health data, it can systematically focus on high-risk personnel and provide them with ongoing medical services and advice.

The on-site clinic established by CMEC’s Power Station Project Department is free of charge for all CMEC staff, subcontractor expatriate staff, project supervisors, GE engineers, local employees and residents of the surrounding communities to provide assistance within their capacity. International SOS physicians deployed to the site



The CMEC Soyo On-site Clinic Provides Medical Services to Local People

treated and treated malaria-infected local workers on several occasions without any human injuries or environmental complaints from the owners or local residents.

On January 7, 2017, in Angola about power station project department work of a male the subcontractor employees on the abdomen severe pain to come to the camp clinic, rope around the site clinic international SOS medical officer of physicians for found that patients with acute disease countenance and comprehensive inspection and professional experience, to determine the patient is seriously ill, immediately call the international SOS assistance center in South Africa, And immediately report to CMEC to activate the On-site Medical Transport Emergency Plan (MERP). In the face of poor cell phone signal, CMEC made a decisive decision to immediately send the patient to the designated local clinic according to the on-site medical transport emergency plan, and made efforts to contact the international SOS rescue center for support. After the diagnosis of inferior myocardial infarction, SOS International South Africa immediately supported Dr. Zhang in the initial treatment of the patient and communicated with the management staff in Beijing and CMEC to determine the emergency transport plan. CMEC made a decisive decision in a short period of time: authorized the air ambulance of SOS International South Africa to transfer the patient to a local hospital in Johannesburg, South Africa for emergency treatment. The on-site medical officer Dr. Zhang monitored the patient at night for emergency treatment such as sudden ventricular fibrillation. Through the air ambulance, the patient was safely transported to SUNNINGHILL Hospital in Johannesburg, South Africa, where cardiology experts took over the treatment. After treatment, the patient finally recovered and returned to China for further treatment on January 16, 2017. For an acute patient with sudden myocardial infarction, time is of the essence. CMEC coordinated with multiple parties, from the patient’s reception to the decision on

the transport plan to the patient's boarding on the plane, all the way was a green channel. The ambulance drove directly to the airport tarmac until the local hospital in Johannesburg, South Africa, for treatment. The whole process took 13 hours, which bought valuable time for the successful rescue of life.



CEMC Soyo Project to Rescue Angola Myocardial Infarction Patients, Charter Transport to South Africa

*“When I was dying, it was CMEC who transferred me to South Africa and gave me a second life. Now I have returned to work and am working in China. I don’t know how to express my gratitude.”*

———A Chinese worker who had been transferred to South Africa by the Soyo Combined Cycle Power Plant on-site clinic for emergency treatment Yang Yuanguo

## (2) Develop a series of activities to build confidence

According to the investigation of their employees on the spot, they feel anxiety is one of the largest in the remote lands, especially in illness or emergency, often feel helpless and uncomfortable situation, rope about combined cycle power plant project site HSE team collaborative SOS doctor carried out a series of activities, to help expats relieving anxiety and build confidence, including:

At the end of each month, a major health inspection is conducted in the camp dining hall and living areas, and the inspection reports are collected and sent to the logistics team for rectification and

improvement.

Actively conduct emergency preparedness exercises, each in conjunction with South Africa's SOS Assistance Center, to ensure coordination and response, and to assure field workers that there are robust systems in place to ensure their health and safety.

Conduct regular field surveys aimed at identifying risk sources and corresponding solutions, and, based on the results, continually invest in the field clinic: The range of drugs and medical devices expanded to more than 100, including multivalent antivenom that requires a full cold-chain import to treat deadly bites from venomous snakes that are common in the field and have long been one of the biggest concerns for field employees.

Under the cooperation of on-site international SOS doctors and HSE management team, regular medical health and occupational safety training lectures will be held around disease prevention, medical health knowledge popularization, first aid ability training, work-related injury prevention and environmental protection. After the training, the on-site employees have improved their awareness of health and occupational safety, and are able to identify potential hazard sources more actively and



CMEC Soyo On-site Health Presentation - First aid Training



CMEC Soyo Onsite Health Promotion

#### 4. Effect of Responsibility Fulfillment

(1)The project staff care and security program has achieved remarkable results

The employee care and guarantee program of CMEC Sawyer combined cycle power Station project has achieved remarkable results. Take 2017 as an example: In January 2017, the Soyo Power Station Project site clinic, in collaboration with SOS South Africa Assistance Center, safely transferred a patient with an acute heart obstruction to a hospital in Johannesburg, South Africa, by air ambulance in just 13 hours, successfully saving the patient's life. In 2017, a cholera epidemic broke out in Angola, with 828 confirmed infections and 43 confirmed deaths. The infection rate and mortality rate at the Soyo Combined Cycle power Plant site were 0. In 2017, Angola had a malaria outbreak, with more than 3.87 million people infected and more than 10,000 deaths. In 2018, 4.4 million people were infected and 9,599 people died. However, the number of infections at Soyo Combined Cycle power Station site was only 3 and 18 cases, far below the regional average in Angola. The on-site clinic in Angola resulted in zero serious injuries or deaths among project personnel and a minor injury rate of less than 3 per thousand.

*"The on-site Project Department has established a set of effective employee care system and made every effort to provide convenience and security for our employees in work and life. Although we work in Angola, where medical conditions are very backward, we feel very stable and at ease."*

——Staff of Combined Cycle Power Station Project Department, Soyo Fang Rui

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——Manager of Combined Cycle Power Station Project Department, Soyo Xiong Jun

#### (2) The project won the international award

In 2018, CMEC, with its outstanding performance in the Soyo Joint Power Station project in Angola, stood out from 13 companies in the world and won the Best Remote Area Medical Award of the 2018 Global Enterprise "Employee Care Obligation Award" issued by International SOS.



CMEC was Awarded the "Employee Care Obligation Award" -- the Best Remote Area Medical Care Award by International SOS

#### 5. Future Outlook

While accelerating the pace of "going global", CMEC not only focuses on business development, but also pays more attention to the health and safety of expatriate employees, and better integrates the obligation and responsibility of caring for

employees into business continuity and good sustainable development practice. Angola's line about combined cycle power plant construction and installation project is CMEC on "employee caring about" a microcosm, uphold the CMEC "contribution to the global, liability company" social responsibility view, vivid interpretation of CMEC the tenet of "people-oriented, love life", has always been committed to promoting the staff's physical and mental health, and constantly extends the occupational health service, Expand employee responsibility, spare no efforts to save the lives of subcontractors' employees, and effectively protect the safety and health of employees, owners, communities and other stakeholders.

While pursuing the integration of economic, environmental and social benefits, CMEC is also committed to contributing what it can to local communities. On August 18, 2017, CMEC cable to cable around the city about power station project department in the "school" on September 17 in the school held a ground-breaking ceremony, to the local government donated 1000 sets of household water purification equipment, designed to improve project area education conditions and improve the local drinking water hygiene, helping somalia about city against cholera outbreak. The governor of Zaire Province, the deputy governor of Zaire vince, the Angolan Minister of Education and the Mayor of Soyo attended the ceremony. The Governor of Zaire thanked CMEC for the donation and highly praised CMEC for its social responsibility in a time of greatest need. On February 1, 2019, CMEC officially handed over the donated "Great Wall Comprehensive School" to Angola. Soyo Great Wall School is a comprehensive school that CMEC built and donated to the local city during the implementation of Soyo Power Station project, adhering to the social responsibility concept and development concept of "global responsibility accompanied by contribution". Ambassador Cui Aimin, Governor Pedro and student representa-

tives spoke in different languages and in different forms, praising the friendship between China and Angola and the contribution CMEC has made to

*Of "the Great Wall a rope around the children provides a good learning environment, when the testimony of friendship between the people, appreciate CMEC for Zaire province and cable today about the city's economic and social development and improvement of the education career efforts, hope the teacher and the students take good care of school facilities, beautiful campus and when people's friendship for generations together."*

——stadholder of Angola, Pedro



CMEC Donated 1,000 Household Water Purification Units to Soyo City Government



CMEC Donates Soyo Great Wall School to Angola

the local community.

In the future, CMEC will give full play to its core advantages and work with stakeholders such as shareholders, investors, employees, government,

customers, industry and partners to provide innovative solutions to economic, social and environmental problems, and strive to achieve a harmonious coexistence between the enterprise, society and environment.

## 6. Deposition From Stakeholders

The work of CMEC Sawyer Power Station project has been highly appraised by stakeholders, which fully demonstrates the concept, management, practice and effectiveness of CMEC's adherence to responsible operation.

*“The successful completion and commissioning of the Soyo combined cycle power station and its supporting power transmission and transformation network will further improve the level of power supply in Anzan and inject new strong impetus into the economic development of Anzan and the improvement of people’s lives.”*

——Then Angola’s Minister of Energy and Water, Borges

*“The completion of the power station and the power transmission and transformation project will effectively improve the power shortage in Angola and provide a solid energy guarantee for the long-term and healthy development of its economy and society. “China is willing to deepen cooperation with Angola in energy infrastructure and other fields to push bilateral economic and trade cooperation to a new level.”*

——Cui Aimin, Chinese ambassador to Angola at the time

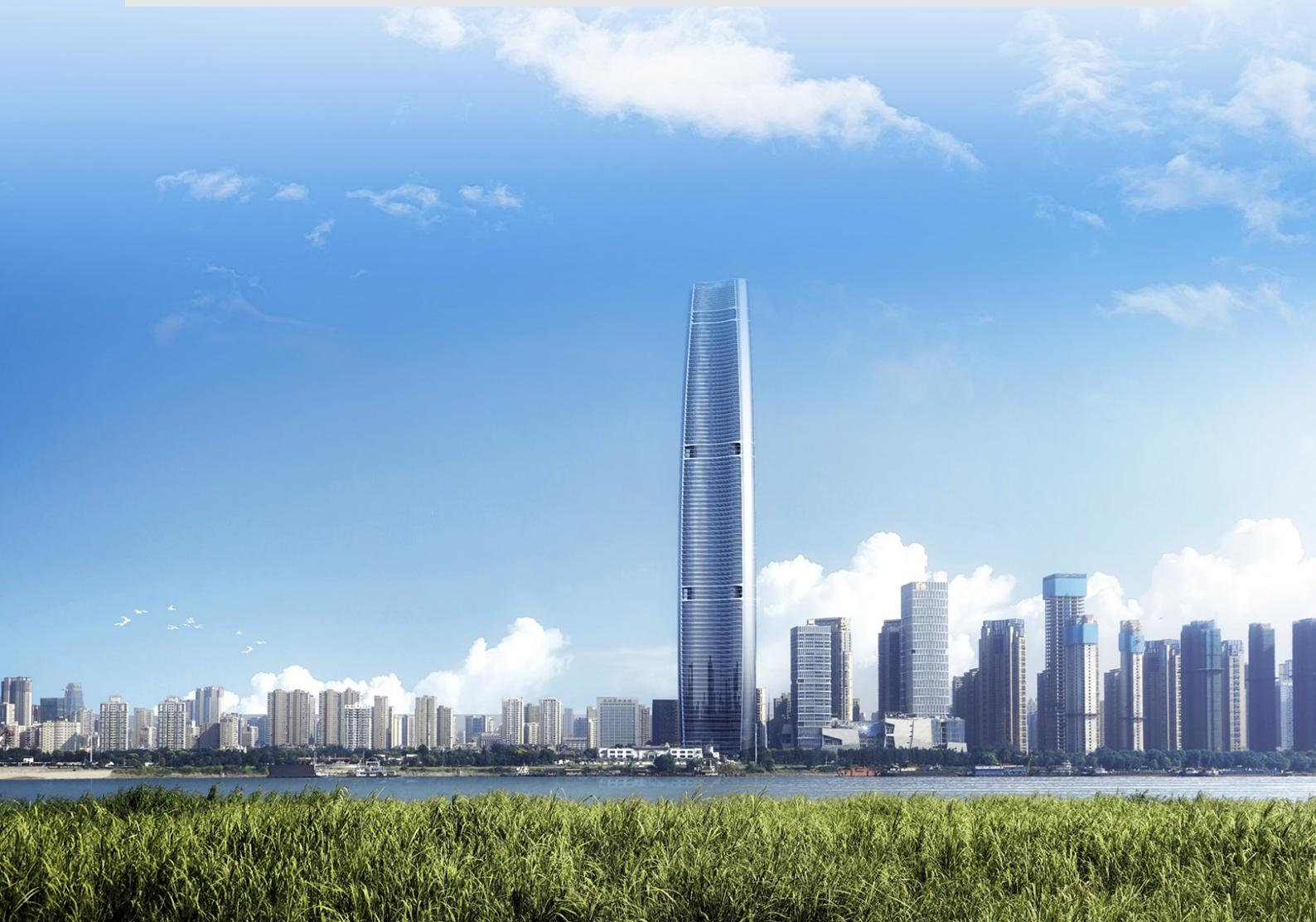


# Strengthen Responsibility to Build Demonstration Projects

❖ The Second Construction Co., Ltd of China Construction Third Engineering Bureau

## Introduction

In the construction of Wuhan Greenland Center project, the Second Construction Engineering Co., Ltd. of China Construction Bureau No. 3 has fully fulfilled the social responsibility of the construction industry and built a demonstration project of social responsibility by strengthening quality management, adhering to innovative development, paying close attention to safe production, promoting green construction and other measures.



## SDGs

 Goal No.3	<p>We have improved free medical services for migrant workers and purchase work-related injury insurance to protect their health.</p>	 Goal No.9	<p>Adhere to innovation and development, and apply BIM technology and Beidou satellite space precision positioning technology to the project</p>
 Goal No.12	<p>In the process of project construction, we should pay attention to environmental protection, promote green construction, and achieve the effect of energy saving, consumption reduction and emission reduction.</p>	 Goal No.13	<p>The brick machine is used to treat the construction waste at the project site, which increases the recycling of construction waste and reduces the carbon emissions generated by the transportation process of construction waste.</p>

## CSR

 Fundamental Responsibility	<p>Establish “three full quality management” covering all employees, the whole process and all aspects to ensure project quality; BIM technology and Beidou satellite space precision positioning technology are applied to the project to drive innovation and development.</p>	 Labor Practices	<p>We provide training, pay attention to the health of migrant workers, and purchase injury insurance for migrant workers to fully protect the rights and interests of migrant workers.</p>
 Environment	<p>The effects of environmental protection, consumption reduction and emission reduction are realized by adopting measures such as fabricated components and prefabricated construction, construction waste resource utilization, energy saving and material saving technology and groundwater recovery.</p>		

## 1. Case Overview

Greenland International City A01-1 Plot I project is located in Wuchang Binjiang Business District, west of the Yangtze River, is a collection of business office, business services, cultural entertainment, high-grade residential as one of the super high-rise urban complex. As an important fulcrum on the “main axis of the Yangtze River”, the project will enter the international vision together with the “Yangtze River era” and become a new name card of the city image. The total construction area of the project is 694,500 m<sup>2</sup>, and the construction cost is 10.5 billion yuan. The project was started on September 19, 2011 and delivered to the owner in September 2021. With “high, large, new, sharp, special” five characteristics, construction difficulty is quite high.

The Second Construction Engineering Co., LTD of China Construction Bureau No. 3 is the main contractor of the project. As a social responsibility pilot project of the company, the project team strives to fully fulfill the corporate social responsibility of the construction industry in the aspects of project quality management, green construction, digital management and scientific and technological innovation, staff development and occupational health. The project has won many honors in China and Hubei Province for its innovative technology research and development and excellent engineering quality, and was awarded the fourth batch of national Construction Industry Green Construction Demonstration Projects by China Construction Industry Association. The project was evaluated by the social responsibility experts of Beijing ZhongJianXie Certification Center as the outstanding presentation of project quality, and fully fulfilled the social responsibility in the aspects of project quality, production safety, innovation and development, law and compliance, enterprise credit, community participation and so on.



## 2. Case Background

Wuhan Greenland Center, the tallest building in Central China, the second tallest building in China and the third tallest building in the world, is located in Greenland International City of Wuchang Binjiang Business District. The project consists of a super high-rise main building, an office annex, a SOHO building and a podium building. Among them, the super high-rise main building has 6 floors underground, 101 floors above ground structure, 39 floors above office auxiliary building, 31 floors above SOHO building, and 8 floors above podium building. This project by Wuhan green riverside professional co., LTD., AS the construction unit, the United States AS + GG and east China architectural design and research institute AS the design units, the Shanghai construction engineering supervision co., LTD AS a supervisor, build three innings group co., LTD., AS the construction unit, build three innings second construction engineering co., LTD AS the main construction units to implement. After the completion of the project,

it will become a super high-rise urban complex integrating super five-star hotels, high-end shopping malls, top office buildings and high-end apartments. As a business platform gathering domestic enterprise headquarters, international top brand groups and financial services, it will form the core area of the integrated Wuhan Binjiang CBD.

The project has the five characteristics of “high, large, new, sharp and special”. “High” that is, the building height is high, the building height is high, the concrete strength grade is high, the technical content is high, the construction accuracy is high; “Big” means large engineering volume, large space, large equipment, steel bar diameter up to 50mm, and large engineering influence; “New” means novel design, new technology, new process, new material; “Sharp” refers to the construction technology leading in China, such as foundation pit, top mould and steel structure dome. “Special” refers to the special geographical location and unique construction site shape. None of these features poses engineering challenges. The second company of China Construction Bureau No. 3 meets the challenge with a positive attitude, takes the project as a pilot project of social responsibility, fully performs social responsibility in all stages of project construction, and builds a demonstration project of social responsibility.

### 3. Responsibility Actions

The second company of China Construction Third Engineering Bureau has strengthened the construction of quality management standardization system, established a three-dimensional management network from vertical to all levels and horizontal to all units, and adopted control measures such as lean planning, lean quality, full professional integration, permanent and permanent combination, and new technology to promote the improvement of quality management. In order to ensure the quality of the project and fulfill the social responsibility in the whole process of the project con-

struction, the project has established the “three whole quality management” covering the whole staff, the whole process and all aspects.

#### (1) Three whole quality management

##### ① The overall management

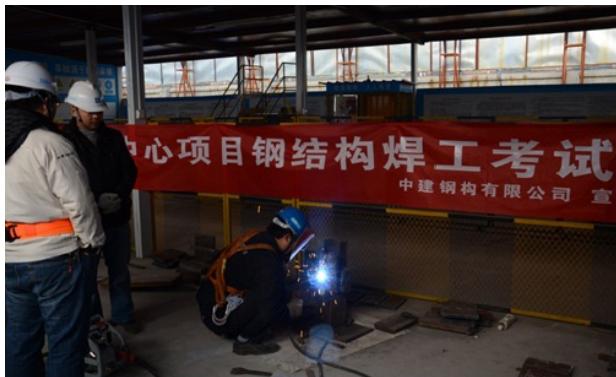
For the implementation of the ministry of construction “much starker choices-and graver consequences-in planning” action plan for improve the quality and safety of engineering, the practice of Chinese building the core values of “quality guarantee, the value creation”, guarantee the quality level of engineering construction, construction co.,

LTD in China the several opinions on further enhance quality management, It clearly lists the main quality responsibility decomposition reference of each post in the Project Department and sub-suppliers. During the implementation of this project, the project manager and each position have signed the quality responsibility letter, the general contractor and each subcontractor have also signed the “Project Quality Management Agreement”; At the same time, the project carries out a quarterly employee assessment, and the assessment results are linked to the bonus. Star-rated employees and star-rated departments are selected once a quarter and awarded.

##### ② Whole process management

The project has established quality management covering the whole process of planning, scheme optimization, assessment disclosure, process control, review and verification. In the planning stage, it is required to complete all kinds of planning documents at the beginning of the project construction, and make timely adjustments according to the actual situation in the implementation process; In the scheme optimization stage, the project is further designed based on the planning documents at the initial stage of construction, and BIM is applied for simulation, node deepening and comprehensive arrangement. In the assess-

ment and disclosure stage, the planning scheme shall be assessed and disclosed, and the technical disclosure meeting of the project shall be held to communicate the technical scheme in the form of visual communication. Meanwhile, construction workers shall take the relevant skills examination, and qualified employees can take the post. During the construction process, the engineer shall carry out strict process control and inspection on the project. In the review and verification stage, each part of the project is reviewed and verified, and multi-level control is carried out.



The project manager will sign the quality responsibility letter with each position



Structure Welder Examination

### ③ All round inspection

During the implementation of the project, the company shall conduct a comprehensive verification of the process capacity of materials and semi-finished products on the supply side. Every quarter, the project evaluates the suppliers.

### (2)Developing green creation

Green construction is the core of this project.

The project adopts prefabricated components and prefabricated construction technology, non-waste site management, energy-saving and water-saving construction technology and spraying dust control system, so as to achieve environmental protection, consumption reduction, low emission and other effects.



Supplier Assessment

### ① Factory prefabrication and pre-processing

The project used ready-mixed mortar and ready-mixed concrete, prefabricated steel structural members, steel truss panels, prefabricated curtain wall panels, prefabricated air ducts, prefabricated pipes and other prefabricated components. To improve the accuracy of prefabrication figure and production of prefabricated processing efficiency, deepen the extent of the duct precast factory and project introduced five wire duct automatic production line, total length of 24 meters, average daily production of about 2000 square meters, can finish the bundle of rolled plate by flat, leveling roll gap, embossing, die cutting, precise displacement joint bite, bending, etc. Series of working procedure, All processing procedures have CNC



Air Duct Prefabrication Production Line

control system, only by 4 people to monitor the operation, compared with the traditional handicraft to improve the efficiency of 15-20 times, the material utilization rate is as high as 99%, the quality is also compared with the original manual handicraft production has been greatly improved, to achieve a variety of specifications of air duct processing modular, intelligent, standardized, efficient.

## ② Turn waste into treasure -- on-site recycling of construction waste

In order to save energy and environmental protection, reduce cost and increase efficiency, the project department introduced a brick machine costing only 80,000 yuan. The 90,000 of construction waste residue be fully utilized, without external transport, can be turned into 10 million building bricks, the economic benefit is expected to reach 11 million yuan. The brick making machine is composed of three parts: batching system, mixing system and forming system. In the process of operation, the concrete waste slag, cement, sand and other materials are poured into the brick making machine according to a strict ratio to break and stir, and the mortar bricks are made after pressing and forming. The strength and quality are up to the standard. This green construction “sharp tool”, can be the site of rubble slag, residual material recycling, 10 minutes can produce 26 gray sand brick, basically achieve “zero emissions”. At present, the bricks made by the brick machine are about 5cm thick, and there are two models: large and small. Semi-automated production has been realized on the brick production line. Two workers can produce a version of gray sand bricks (26 pieces) in 10 minutes, with a daily output of 1,500 to 2,000 pieces. The strength and quality are up to standard by laboratory test. The recycled bricks are not only used in the construction of temporary barriers, temporary walls and foundations ,but also exported to other projects of the company, creating good economic benefits.

Xu Gang, manager of the project protection de-

partment, introduced that the traditional construction waste residue is mostly used in engineering backfilling, transported to the quarry landfill or transported to the brick factory, which not only has high transportation cost, but also pollute the environment. Due to the large volume of the project after the completion of Wuhan Greenland Center, it is estimated that 90,000 tons of construction waste residue will be generated after the completion of the project. If all construction waste residue is shipped out, the transportation cost will be about 9 million yuan, calculated as 20 yuan per cubic meter for 1 kilometer. The use of brick-making machine enables the project to realize efficient on-site construction waste treatment and recycling, which not only saves the cost of materials and transportation, but also increases the recycling of construction materials and reduces emissions from the transportation of construction waste.



The Brick Maker is in Operation

## ③ Energy saving and material saving

The project adopts the third-generation overhead mold system independently developed by China Construction Third Engineering Bureau, also known as the “skyscraper building machine”. The system consists of support and lifting system, steel platform system, template system, hanger and auxiliary facilities system, and innovatively integrates a ZSL380 tower crane on the top mold platform, which lifts synchronously with the top mold platform, so that the top mold and tower crane are integrated into one, improving efficiency. With a top lift of more than 4,000 tons, it can make construction work at a height of more than 1,000 meters

and smoothly proceed in force 8 winds. The construction speed of one floor in four days is amazing at home and abroad, showing China's super tall building construction technology and leading position in the world. Initially, the system's platform covers an area of about 1,330 square meters and weighs 2,010 tons. The first demolition and renovation was completed in October 2016, reducing 295.6 tons of weight. In March 2017, the second demolition and transformation began. After the completion of the transformation, 180.4 tons of weight was reduced, and the platform area became 633 square meters. In terms of frame lightweight, the project adopts aluminum mold instead of the traditional steel mold, which greatly reduces the weight of the frame. At the same time, in the construction stage, the hanger system is adopted, which is suspended on the lower sliding beam of the steel platform and rises synchronously with the jacking frame. Compared with the ordinary steel frame structure, 200 tons of steel is saved while ensuring the construction quality and reducing the energy consumption during the construction process.



Skyscraper Building Machine

#### ④ Basement precipitation recovery

This project is located at the edge of the Yangtze River and has rich groundwater resources.



Groundwater Recovery System

Rock-socketing ground wall is used as the foundation pit enclosure in the construction stage to cut off the surrounding groundwater and effectively re-

duce the precipitation pressure. At the same time, the underground water inside the foundation pit is collected through the dewatering well and stored in the recyclable steel catchment pool for spray maintenance of giant columns and steel plate shear walls, blasting spray dust removal, spray dust removal and cooling in office and living areas, etc., so as to achieve water saving in the project.

### (3) Adhere to Innovative Development

#### ① BIM comprehensive information management platform

In order to fully apply BIM technology to site management, in-depth design, business settlement and other aspects, the project establishes a BIM professional team and develops a 5D digital collaborative information management platform (hereinafter referred to as the platform) integrating civil engineering, mechanical and electrical engineering, steel structure, curtain wall and other professionals to strengthen the deep influence of general contract management. The platform organically integrates BIM technology, construction comprehensive drawing and information sharing application functions, including ten work modules such as BIM planning, BIM standard management and plan management. It focuses on the technological deepening and optimization before construction, and adopts digital simulation construction method. Form instructive 3D model and derive executable construction drawings and written construction process (process coordination process and planning and scheduling process) to effectively guide construction and solve construction problems. This technology can be used in scheme optimization, in-depth design, collision inspection, process management, 4D demonstration, data compilation, labor monitoring and other aspects, the information volume reaches 150GB,

and has won the first prize of the fifth Longtu Cup National BIM Competition and the second China Construction Engineering BIM Competition.

At the same time, BIM integrated information management platform also realizes two-dimensional code material management based on BIM technology. The function of two-dimensional code management system for materials is to directly read and write the database, from production, transportation, warehousing, warehousing and installation of traceability management; In the later stage, data interaction with BIM is carried out to realize full digital property operation and maintenance management.



Two-Dimensional Code Material Management Platform  
Based on BIM Technology

② Research and development and application technology of monorail multi - cage cycle construction elevator

In order to solve the problems of low utilization rate of elevator guide rails and insufficient vertical transport capacity in the construction of super high-rise buildings, China Construction Third Engineering Bureau has the courage to break the convention of "one ladder and two cages", and independently developed the world's first technology of "single guide rail and multi-cage cycle operation construction elevator", which has been applied for the first time in this project. By setting

a rotating rail changing device on the guide rail, the elevator cage can rotate and change the track at high altitude and run in a cycle, so as to realize the cycle running of several or even dozens of ladder cages on a single guide rail. The operation principle of the recycle elevator to single rail rack, some of the upward trajectory of ladder cage from the side of the upward climb, arriving at a particular location, the in the rotation of the special device in rail place of 180 °, transform to the other side of the downward track, run to the bottom and then spin 180 ° transformation to the upward path, in order to realize single guide frame running 6 ~ 10 ladder, the purpose of the cage It can not only meet the requirements of vertical transport capacity of super high-rise building construction, but also greatly reduce the occupation of curtain wall construction plane, and minimize the impact on the construction period caused by curtain wall closure after the removal of elevator. The elevator is divided into 25m underground, 575m above ground, a total of 600m; A total of 8 ladder cages were put in, and the basement was used as the warehouse and maintenance room for the ladder cages. A total of 8 rotating joints are installed, and the ladder cage can be rotated at the rotating joints. It can greatly improve the efficiency of vertical transportation and save the construction period of super high-rise curtain wall closing in the later period.



Monorail Multi - Cage Cycle Construction Elevator



### ③ Precise positioning technology of Beidou satellite

The project starts from “developing the application of BDS in the field of construction”, and creates the Global Navigation Satellite System (GNSS) measurement technology combining BDS and GPS. By combining the advantages of BDS and GPS, and through data analysis, the measurement accuracy reaches the millimeter level in the military field. Satellite positioning without sighting, no cumulative error, almost not influenced by the weather, etc., has a good applicability in ultra-high measurement, has been in the core barrel and end frame column good application in the measurement control, and through correction factor research, have solve the problem of normal vertical deflection, precision of millimeter, correspond with the traditional measurement of retest results.

### ④ Escape high tech

In order to ensure safe escape in the process of construction, the project USES the independent research and development by building three escape “black” of science and technology, magnetic slow down tall escape device, its design principle is developed according to lenz’s law, by manned device with high strength magnets and non ferromagnetic escape orbit of guide rail and building facades parallel and perpendicular to the ground, is aluminum tube material. In case of emergency, the personnel involved in danger can escape at a steady and safe speed through the track with the help of manned devices. The device does not need electric energy, relying on magnetic force to achieve uniform sliding; Simple operation, no need for professional training; Guide rail attached to the building erected, escape height is not limited; Can enter at any floor, descent speed adjustable, controllable, high escape efficiency.

### (4) Protection of Employee Rights

Adhering to the tenet of “building a home is building a project”, CSCB Wuhan Greenland Center

general Contracting project actively explores, makes overall planning, makes scientific policies and pushes forward in an orderly manner, focuses on exploring the standardization, uniqueness and branding of “one-stop” staff service construction work, and accelerates the transformation and upgrading of farmers’ union work. This project provides training, free medical treatment and other services for migrant workers, so that the occupational health and safety of migrant workers are guaranteed.

#### ① Training and promotion for migrant workers

In order to improve the quality of workers and focus on building a learning organization, Wuhan Greenland Center project actively carries out night reading and learning activities for migrant workers. Courses include personal safety protection, mechanical equipment, electrical circuits and other professional knowledge and skills. The project department will send the class schedule to the corresponding team in advance, so that workers can arrange learning according to their own time, which greatly improves the flexibility of learning.

#### ② Health of migrant workers

The project department insisted on the blood pressure measurement of all workers, and monitored workers with high blood pressure every day. Professional doctors were also invited to review such workers to ensure their healthy work and life. In the free clinic activity site, the project department also distributed more than 350 copies of safety manuals, hypertension knowledge and healthy lifestyle education manuals, which explained the knowledge of how to carry out first aid in terms of the most likely accidental casualties on the construction site. The whole health examination service is tailored to the occupational diseases and safety hazards that may exist in the construction process of migrant workers, including blood pres-

sure measurement, health education, electrocardiogram and color Doppler ultrasound, and personal health records are established for migrant workers. Medical personnel according to the result of individual physical examination, to find out the problems put forward reasonable Suggestions, guidance should be how to prevent or how to carry out relevant examination and treatment, and to emphasize the importance of a healthy diet and regular exercise, so that you develop good habits and customs, with the joyful mood and healthy body into life and work.

③ Worker's injury insurance for migrant workers  
In order to ensure that the work of industrial injury insurance in the construction industry is implemented and effectively protect the rights and interests of migrant workers in construction enterprises, China Construction Third Bureau attaches great importance to the work of promoting industrial injury insurance in the construction industry. Lv Zhongmei, Resident deputy Director of Committee of Social and Legal Affairs of the CPPCC National Committee, led the national government and research team to visit the construction site of Wuhan Greenland Center project to learn about the project safety measures and unique safety experience management. Walk into the living area of migrant workers, check the living environment of migrant workers and the construction of supporting facilities such as migrant workers' service stations. Among them, LV Zhongmei spoke highly of the implementation of industrial injury insurance in CCB after conducting field research on the project, listening to the report of CCB on Promoting Industrial Injury Insurance in Construction Industry by Li Yongzuo, deputy general manager of CCB, and the report of labor subcontracting representative units of CCB. She pointed out that CSCB's strong measures to ensure the safety of migrant workers

are worth promoting and learning from. She hoped that CSCB would work hard to improve the industrial injury insurance system for construction enterprises, effectively protect the rights and interests of migrant workers, and benefit more workers.

There are two main ways to participate in the insurance for migrant workers of CCB 3 project. One is the industrial injury insurance within the scope of social insurance required by Article 103; Accident insurance, another traditional commercial insurance, is mainly paid by the labor enterprise and is usually purchased in a group way. According to the preliminary statistics in 2015, China Construction Third Engineering Bureau has paid for 330 work-related injury insurance projects for migrant workers, with an amount of 80 million yuan, involving 150,000 migrant workers. It paid for 591 accidental injury insurance projects for migrant workers, with an amount of 90 million yuan, involving 170,000 migrant workers. Industrial injury insurance valuation method and premium rate are often very different because of local differences. The valuation base is mainly calculated with the total cost of the project, the total amount of labor and wages as the base. The rate is roughly 1%- 2% of the total cost of the project.

#### 4. Effect of Responsibility Fulfillment

Since the commencement of the project, the project has won many honors in all stages of the whole Hubei Province and even the whole country. In terms of quality management, Wuhan Greenland Center project has won 8 awards such as the first prize of the 2017 Annual Excellent Quality Management Group of Engineering Construction by China Construction Enterprise Management Association and the first prize of the National Excellent



QC Group of Engineering Construction by China Construction Industry Association. In terms of scientific and technological innovation, the project has obtained 9 software Copyrights, edited 1 Hubei provincial local standard, 4 provincial science and technology progress awards, 15 provincial construction methods, 13 invention patents, 20 utility model patents, and published 23 papers in the national core journal "Construction Technology". It has won 4 demonstration projects, including National Green Construction Demonstration Project of Construction industry, Hubei Science and Technology Demonstration Project, Hubei energy-saving Demonstration Project, and BIM Demonstration Project of CSCC. The scientific and technological achievements have reached the "international advanced level" as a whole by evaluation organized by Hubei Technology Exchange. In terms of green construction, Wuhan Greenland Center Project was awarded the fourth batch of national Construction Industry Green Construction Demonstration projects by China Construction Industry Association in 2014. In addition, the project has been awarded as safe and civilized construction demonstration site and excellent unit by Wuhan City and Hubei Province.

As a social responsibility pilot project, the project has been assessed by social responsibility experts of Beijing ZhongJianXie Certification Center as: excellent presentation of project quality, comprehensive implementation of project quality, innovation and development, safety production, compliance with the law, enterprise credit and social participation and other social responsibilities.

During the construction process, the second company of China Construction Third Engineering Bureau created a number of best: In the field of

domestic housing construction, the deepest and highest bearing engineering pile, the deepest continuous wall, the highest steel plate shear wall, the reinforced concrete bottom plate with the largest forming area, the breathing glass curtain wall, the robot that can clean the window, the "air building machine" known as the "great power", more than 30 innovative green and energy-saving technologies... The project has been featured in the mainstream media such as CCTV's "Great Powers", CCTV's "In-depth Finance", and Xinhua News Agency's "Dream of the Yangtze River". The Ministry of Foreign Affairs has also promoted the Wuhan plane crash to the world.

Due to the excellent BIM technology applied in the project construction and management, during the project construction, China Construction Third Engineering Bureau hosted the national Internet +BIM technology application and Wuhan Greenland Center super high-rise project observation meeting. More than 700 experts and scholars of building technology and BIM technology related research units from all provinces and cities in China attended the observation meeting.

## 5. Future Outlook

The project department plans to continue the previous idea, on the basis of green construction and green construction, adopt the operation mode of energy saving and environmental protection, and expand the project into a full life cycle green building. In addition, the project will actively prepare for the acceptance of the science and technology demonstration project and the application of the Luban Award project, so as to draw a successful end to the project.

In the future, the company will continue to

strengthen social responsibility management, effectively improve the level of social responsibility management and practical ability, and adhere to lean construction and quality performance; Adhering to the concept of openness, inclusiveness and sharing; Expand diversified and core competitive development models, and innovate and develop in emerging fields such as water environmental protection, super high-rise buildings, advanced hospitals and laboratories, and intelligent logistics plants.

At the same time, the company actively fulfill the social responsibility of state-owned enterprises. Adhere to people-oriented, equal communication, strengthen the cultivation of talent team; Continue to establish rules and regulations, promote standardized management; Continue to provide favorable conditions for the working environment and occupational health, medical care and insurance protection of migrant workers.

## 6. Deposition of Stakeholders

*“Since 2016, the project team has maintained the excellence of stone, reflecting the construction skills and excellent management quality of Chong Gao. Active mobilization of superior resources in management, linkage up and down, multi-party cooperation, successfully completed the major project nodes: the main tower completed the first Dingmo transformation, the structure broke through the 400-meter mark, the office building and SOHO building were topped, and the mechanical and electrical installation, curtain wall and fine decoration projects were orderly advanced. In order to further establish social popularity and reputation of engineering, your bureau made a bright spot on the intelligent construction, green construction and breakthrough, using intelligent environmental protection means such as brick making machine, welding robot, upgrade the size of the duct processing plant and equipment, to attract leaders at all levels and industry experts to visit learning, gained widespread recognition of the project.”*

——Wuhan Real Estate Division of Greenland Holding Group (Project Owner), Letter of Praise to the General Contracting Project of Wuhan Greenland Center of China Construction Third Bureau

on December 9, 2016



## Attachment: Enterprise Related Information



Company Name: The Second Construction  
Co., Ltd of China Construction  
Third Engineering Bureau

Company Address :Wuhan,Hubei province  
Company Website :<https://zj32.cscec.com/>

### Company Profile

The Second Construction Engineering Co., Ltd. is one of the important backbone enterprises of the world's top 500 China State Construction Co., LTD. Founded in April 1954, the company formerly known as "state southwest second construction engineering company", later renamed "China building third construction bureau second building installation engineering co., LTD", in December 2002, the overall restructuring for co., LTD., later renamed the "build three innings second construction engineering co., LTD.", registered capital of 1 billion yuan, The net value of fixed assets reached 870,117,800 yuan.

The company has two special qualifications for general contracting of construction engineering and municipal public works; First-class qualification of general contracting of mechanical and electrical engineering construction; Steel structure engineering, foundation engineering, fire protection facilities engineering, waterproof anticorrosion and heat preservation engineering, building decoration and decoration engineering, building mechanical and electrical installation engineering, building curtain wall engineering and environmental protection engineering eight professional contracting qualification; Power engineering and petrochemical engineering construction general contracting qualification; Bridge engineering and tunnel engineering professional contracting qualification; Professional contract qualification of formwork scaffolding (regardless of grade); Municipal industry, construction industry (construction engineering, air defense engineering) Class A design qualification, with a complete qualification system.

The company has 29076 employees, including 1 expert enjoying government special allowance, 74 national excellent project managers, 274 national registered construction engineers (including 236 first-level construction engineers). It has 429 sets (sets) of advanced mechanical equipment with a total power of 12072 kW. The construction team is



distributed in 31 provinces (municipalities directly under the Central Government, autonomous regions and special administrative regions) and 10 countries, with an annual construction production capacity of more than 24 billion yuan and a contract value of more than 40 billion yuan. It has been rated as a key taxpayer in Wuhan City for many years, and its comprehensive strength has been ranked among the top five number companies of China Construction System for many years.

The company's existing 37 projects have won the Luban Award (National Quality Engineering Award); 5 projects were awarded Zhan Tianyou Award; Five projects were evaluated as national green construction demonstration projects, and 17 projects were approved as national green construction demonstration projects. It has won 1 national science and technology award and 45 provincial science and technology awards. Obtained 309 national patents, including 30 invention patents; It has won 8 national construction methods.

In recent years, the company strives for reality, takes "construction + investment" as a two-wheel drive, takes "high-end housing construction + infrastructure + overseas" as a three-carriage, and focuses on the development of real estate development, large-scale installation, overseas business,

equipment management, and architectural design. It has reached the domestic and international advanced level in the construction of super high-rise buildings, the installation of complex space steel structure buildings, the precise construction of industrial buildings, and the high-quality construction of mechanical and electrical buildings. It has unique advantages in extra-large bridge construction, ecological restoration and environmental governance construction, general contracting and construction of modern hospital projects, smart communities and green construction.

The company has established a standardized, standard and scientific total quality management, safety production management and environmental management system, and issued a comprehensive management system document; According to "Internet +" thinking and "cloud + + network end" architecture, strive to build "online office, business statistics automatically calculate, see" evaluation system of information management system, has constructed the collaborative work platform, project integration system, enterprise WeChat mobile terminal such as information management platform, has the advanced modern enterprise management level.

# ENVIRONMENTAL PROTECTION

Environmental responsibility is an important aspect of corporate social responsibility, and the core theme of environment is closely related to other core themes and issues of social responsibility. No matter where a business is located, its decisions and activities inevitably have an impact on the environment. These impacts may involve the use of resources, the places where companies operate, the generation of pollutants and waste, and the impact on natural habitats. In order to reduce the impact on the environment, enterprises should adopt a comprehensive, systematic and holistic approach to deal with problems. It mainly includes four topics: pollution prevention, sustainable use of resources, mitigation and adaptation to climate change, biodiversity and natural habitat restoration.



# Building a Beautiful Home for Sustainable Development and Expanding New Space for High-Quality Urban Development

◇ BCEG Resources Recycling Co., Ltd

## Introduction

BCEG Resources Recycling Co., Ltd. dared to be the "first crab eater". In the construction waste disposal project of Beijing Universal Theme Park, it put forward the idea of "in-situ disposal", realized the transformation of 2.7 million cubic meters of miscellaneous fill into wealth by technological innovation, created the first example of miscellaneous fill and construction waste recycling disposal in China, and opened a new chapter in China's construction waste recycling disposal industry.





## SDGs

 Goal No.9	Independent research and development process equipment, completely solve the problem of construction waste removal; Research and development of corresponding technology to reach the world advanced level; Develop and apply recycled products to realize the transformation of construction waste into treasure.	 Goal No.12	Customized a special program for Universal Studios -- in situ disposal, realizing the resource utilization of construction waste and waste, avoiding the traditional treatment method to occupy a lot of land, water resources and air pollution and other environmental problems.
 Goal No.13	The on-site resource disposal of construction waste and solid waste avoids carbon emissions caused by external transportation.		

## CSR

 Fundamental Responsibility	By means of comparative experiments and professional testing conducted by a third party authoritative organization, materials up to standard are selected to meet the high standard construction requirements of the universal theme park; Independent research and development process equipment, completely solve the problem of construction waste removal; Research and development of corresponding technology to reach the world advanced level; Develop and apply recycled products to realize the transformation of construction waste into treasure; Compile relevant standards and lead the development of the industry	 Environment	The idea of “in situ disposal” is adopted to carry out the resource disposal of construction waste and solid waste on the spot, which not only avoids the carbon emission and garbage scattered caused by external transportation, but also separates less debris that can be used for incineration and power generation. Research and development of recycled products to realize the utilization of construction waste resources. This customized solution also avoids the large amount of land occupied by traditional treatment methods, which brings environmental problems such as water and air pollution.
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## 1. Case Overview

In Tongzhou District of Beijing, the world's largest Universal theme park stands tall, super fantasy big park, cool lifelike high-tech, Universal Studios has become a new landmark of Beijing culture and tourism. But once here, after the demolition work was over, a large number of construction waste and domestic waste were mixed underground to be treated urgently, which also became a problem that troubled the builders of the park. Two years, 10 sets of independent research and development of China's manufacturing management system, a number of national invention patent, BCEG Resources Recycling Co., Ltd. has achieved the miracle of "deformation" of earthwork in the Universal Theme Park, turning 2.7 million cubic meters of miscellaneous fill into wealth, creating the first example of recycling disposal of miscellaneous fill and construction waste in China, reaching the international advanced level and filling the gap in the Chinese industry. And starting from this, it opened a new chapter in the recycling disposal industry of construction waste in China.

## 2. Case Background

The Earth's resources are not inexhaustable. We are using the equivalent of 1.6 earths to sustain our current production needs. Global warming, the spread of acid rain, the collapse of biodiversity, solid waste pollution... Huge waste, excessive exploitation, plunder, wanton use of natural resources without restraint, let the earth infinite "overdraft", will produce immeasurable "side effect", protect the ecological environment, improve the efficiency of resource use, use recycled regenerate products instead of natural resources, avoid over-exploitation of natural resources, is a green, low-carbon path of sustainable development.

China's urbanization process, in the world is rare, and construction waste as the inevitable outcome of urban renewal, with the accelerating urbaniza-

tion process, residents relocation, village renovation, road construction, building expansion and so on, its production increased year by year, according to the "China association of urban environmental sanitation construction waste management and resource recovery committee" data analysis. The annual production of construction waste is about more than 2 billion tons, which is the solid waste with the largest single type, the largest carbon emission and the most concentrated among China's municipal garbage. If these construction waste is dumped and piled up at will, it will cause great pollution to the surrounding environment. The community property said that it "affects the image", the sanitation department said that it "dumps hidden", and the driver of transportation said that it "has nowhere to place" ... It not only threatens the ecological status of the urban environment, but also hinders the healthy development of urban low-carbon emission reduction and urban construction to a certain extent. The problem of construction waste resource utilization has received higher attention from all sectors of society.

If the simple way of traditional landfill and open stacking is used to dispose of construction waste, on the one hand, it takes up a lot of land and causes waste of land resources, on the other hand, it also poses a threat to the safety of groundwater and soil, and there is a serious potential risk of environmental pollution. With the increasing production of construction waste and the gradual saturation of consumption places, construction waste is facing nowhere to go, which has also become a problem to be solved in urban fine management.

## 3. Responsibility Actions

BCEG Resources Recycling Co., Ltd. was founded in 2014, the specialty is engaged in the construction waste recycling of use of the whole industry chain services, for eight years, the company always adhere to the strategic orientation of technology first, market first, and continuously promote

the transformation of scientific and technological research and development and the achievement, construction waste recycling industry from scratch, to gradually establish a system, standards, and mature business model, The company has also grown from an immature enterprise to a leading enterprise in China's construction waste resource disposal industry.

### (1) The first example of miscellaneous landfill disposal in China, and the first person to eat crabs

As early as 2015, Beijing Universal Studios, which attracted worldwide attention, officially started the construction of basic projects. However, at the beginning of the construction, a huge problem was encountered. Universal studios are located, once the factories and farms, after the demolition, the structure of the soil is loose, and mixed with a large number of underground construction waste and life rubbish, such as soil conditions can't meet Beijing universal theme park in bearing capacity of the field, total settlement, compaction degree and so on high standard construction requirements, if in the above construction directly, such as subsidence, cracking, dumping a series of hidden dangers.

According to the traditional disposal method, these miscellaneous filled soil should be cleaned, transported and buried. But the 4-square-kilometer Universal Studios will generate 2.7 million cubic meters of clutter and construction waste, and it will take 200,000 muck trucks to carry it all away, and then fill the space of 37 standard football fields 10 meters high. In this way, it not only takes up a



lot of land, which brings environmental problems such as water and air pollution, but also purchases a large amount of natural soil for backfilling, which is expensive and difficult to solve. A series of problems have delayed the construction of Universal Studios.

“The miscellaneous filled soil will be disposed of as resources and recycled.” BCEG Resources Recycling Co., Ltd. came up with a customized solution and became the first to eat crabs. At that time, China was almost blank in this field, and there was no mature case. Moreover, it was facing such a big project as the largest theme park in the world, and the difficulty could be imagined. The technical team of the resource company conducted a solid preliminary investigation. They picked up, classified, weighed, recorded and analyzed little by little in countless dirty and messy garbage pits, and finally formed a large database of construction waste components to thoroughly find out the true details of construction waste and conduct a comprehensive assessment. A special program for Universal Studios - *in situ* disposal: The miscellaneous filled soil is not transported outside, and the assembly and disposal production line is assembled on the spot. The miscellaneous filled soil mixed with construction waste and solid waste is disposed of as resources. After two-stage crushing, three-stage screening and multi-stage sorting, the high-quality recycled aggregate and high-quality reduced soil produced are directly used for earth backfilling in the site. Avoids miscellaneous fill outbound traces of carbon emissions, waste and caused by traffic pressure and so on questions, a few sundry, isolated and packaged to living garbage incinerators, used for incineration power generation, harmless disposal, truly achieve the miscellaneous fill from the “miscellaneous” to the “net” transformation, this way can save hundreds of millions of money, a few months time limit for a project owner.

However, this is a program that has never been

implemented, no successful cases have been seen, and it is doubtful that the goal will be achieved. To reassure the owner concerns, construction resources company decided to set up the “experimental field”, in the universal studios, on the north side of the excavation of the five holes compared experiments, respectively bolus, reduction of natural soil, recycled aggregates and reduction of 1:1 soil, etc., with 5 different material bolus, rolling, at the same time, please the third party professional testing authority, with the data. After nearly two months of the experiment, the final test data show that the recycled aggregates and reduction of 1:1 soil bolus plot for maximum pressure and resist the pressure of 32 tons per square meter, and 160000 mpa pressure requirements, is in 1 square meters of land, and stacking stand 4, 5 adult elephants, at the same time, the indicators are better than that of natural soil, It fully meets the high standard construction requirements of global theme parks



Carrying Capacity Test was Carried Out

The key to turning miscellaneous landfill and construction waste into treasure in situ is equipment and technology. China's rapid urban development is unprecedented, the composition of construction waste is complex, imported equipment “soil and water” can not be disposed of, China's domestic sorting equipment is not applicable, completely rely on independent research and development. The project team implements the most stringent technical standards, and the process plan is improved almost every day. The size of the screen, the shape and thickness of the screen are all carefully studied. Finally, 8 sets of pre-treatment systems and 2 sets of construction waste disposal

systems work together, with a daily treatment capacity of more than 20,000 square meters, which fully meets the construction schedule.

## (2)Regional comprehensive governance, creating a new model of urban fine management

Taking the Universal Theme Park landfill resource project as an opportunity, the resource company based on Tongzhou, radiating Beijing and looking at China, established the whole life cycle management solution of buildings, and took the overall management of urban solid waste as the breakthrough point, focusing on the city cycle. Combined with trans-regional and multi-project operation experience and technology development results, a regional comprehensive solution based on multi-business model, multi-technology path, multi-application path and multi-disposal object is proposed. For different types, different size, different characteristics of garbage, such as stationary, in situ type, modular more than 10 kinds of independent research and development core technology, can use multiple projects together way and the nine categories more than 20 kinds of regeneration product line of organic combination, realize regional level height collocation, and combination of construction waste resource utilization, achieve the goal of the top-level design, overall management.

At present, it has built a number of regional construction waste comprehensive treatment models such as “N+1+1” comprehensive disposal in Beijing Haidian District, multi-project joint disposal in Pinggu District, and the whole life cycle management of decoration waste in Shanghai Baoshan District, and created and implemented the “receive-transport-disposal” integrated management business model in Shanghai and Jiangsu Province. It has realized the “full coverage” of the source of decoration waste and the “high resource” disposal, which provides a new solution for solving the “high carbon” problem of construction waste, urban organic renewal and low carbon emission reduction.



### (3)Independent research and development process equipment to fill the technical gap in the industry

In the process of equipment research and development and process development, BCEG Resources Recycling Co., Ltd. gives full play to independent innovation ability to solve common difficulties in the industry. According to construction waste impurity rate is high, the characteristics of conventional mining equipment cannot apply, Beijing construction company independent research and development of resources including wind vibration separator, high precision separator, composite separator, hammer crusher, and other core for decoration waste sorting equipment, fill in the pieces of blank for construction waste sorting equipment industry in China, The problem of removing miscellaneous construction waste is completely solved, and the “non-picky food” disposal of construction waste is realized.

Core technology has its own equipment, for the disposal of process development provides a higher degree of freedom, to solve the problem of diversification demand of construction waste disposal, based on China construction and decoration garbage composition characteristics, the Beijing construction resources, ongoing technological innovation and optimization of the technological process, has developed the comprehensive construction waste disposal technology, the modular construction waste disposal technology, Decorate garbage vertical, compact and disposal process, decorate gradient disposal process and garbage compost sieve disposal process and so on more than 10 kinds of core technology, realize the construction waste recycling rate more than 95%, decorate a garbage recycling rate more than 85%, in the true sense realize construction and decoration of garbage disposal of high utilization rate, reached the international first-class utilization level.

Among them, the construction waste in situ disposal of complete sets of technology research and

application of the modular construction waste treatment technology by the Beijing municipal councils expert appraisal, achieves the international advanced level, modular design to achieve the international leading level, two technologies are included in the ecological environment of the first “no waste city” advanced suitable technology; “Research and Application of Complete set of Technology for comprehensive Disposal of urban decoration Waste” has been identified by the academician and expert team of China Circular Economy Association, which has reached the “international advanced” level as a whole, and the comprehensive technology of composite sorting has reached the “international leading” level.

### (4)R & D and application of recycled products to promote the integration of resource recycling and ecological environmental protection

The promotion and utilization of recycled products is the last link in the resource disposal of construction waste, and it is also a key step to turn construction waste into treasure and play the role of “urban mineral”. The recycled aggregate of BCEG Resources Recycling Co., Ltd. has achieved an ultra-low impurity rate of 3‰, which is far lower than the industry standard of 1%. However, for a long time, recycled products are not accepted by the market and few people pay attention to them. If we can't overcome the difficulties in the promotion of recycled products, so that construction waste can be truly recycled and reused, it will be an empty talk.

Seeing is believing. BCEG Resources Recycling Co., Ltd. uses objective and rigorous tests, professional and convincing conclusions to open the market of recycled products step by step. In 2017, in order to verify the recycled bricks used way of inorganic material performance and application effect of long-term durability, in chaoyang river construction waste recycling of project, using recycled brick all kind of inorganic material, according to

the secondary highway overload transportation design standards laid a length of 140 m, width is 6 m test road, after paving, rolling and curing test, All the performance indexes of the test road can meet the design parameters. After the test road was put into use, an average of 94 vehicles per day and an average bicycle weight of 74 tons were passed. After 4 years of continuous tracking and monitoring, the road was in good condition, and no cracks, grooves and ruts occurred. 194 complete road core samples were successfully removed, and the strength of regenerated brick and tile inorganic materials continued to grow. Practice has proved that the recycled brick and tile inorganic material base has good bearing capacity and stability, excellent long-term road performance, can withstand the test of heavy traffic load and natural environment, and can be fully applied to the secondary and below highways, urban secondary trunk roads and below grade road base.

Over the years, BCEG Resources Recycling Co., Ltd. expanded renewable products category, created a comprehensive product system covering nine categories and more than 20 kinds of renewable products, introduced the recycled aggregates, regeneration, regeneration inorganic mixture imitation stone municipal brick, renewable water purification filter material, premixed flow filling material such as a variety of renewable products, performance indexes can reach the national standard of natural material products. It can be applied to wetland park, sponge city construction, municipal infrastructure, water treatment, garden landscaping and other fields. It has been applied to more than 1000 projects, among which the application amount of recycled cement products exceeds 8 million square meters, and the length of recycled brick and concrete inorganic material paving is the highest in the country, exceeding 350 kilometers.

While continuously improving the quality of its own products, BCEG Resources Recycling Co.,

Ltd. has also actively promoted the standardization and standardization of the use of renewable products. It has led and participated in the compilation of 16 industrial standards for products. Among them, the Technical Regulations for the Application of Building Waste Recycling Products, which it took the lead in editing, is the first local standard for building waste recycling products in Beijing.

#### 4. Effect of Responsibility Fulfillment

BCEG Resources Recycling Co., Ltd. was recognized as a national high-tech enterprise in 2018, and passed the “quality, environment, occupational health and safety” management system certification in 2020. In 2021, it was approved as Beijing Enterprise Technology Center and passed the intellectual property management system certification. In 2022, it was selected as the “Science and Technology Reform Demonstration Enterprise” of The State Council. Awarded Beijing “specialized and special New” enterprise.

At present, 35 projects have been launched in Beijing, Shanghai, Jiangsu, Hebei and other places in China. Construction waste disposal services cover 10 administrative regions in Beijing, with a total annual disposal capacity of 19 million tons, which is equivalent to saving the land area of nearly two Beihai parks every year, and reducing carbon emissions by about 1.1 million tons every year. The completed projects have achieved 100% continuous and stable operation and production, and it is currently the enterprise with the largest annual disposal volume of construction waste in China. It has built China's first miscellaneous filling and construction waste resource disposal project, China's first shed renovation site construction waste in situ disposal project, China's first decoration waste disposal project with high resource rate, China's first diversified collaborative disposal project in the field of construction waste, and other national demonstration projects. Developed by the nine cat-



egories of more than 20 kinds of renewable products have been applied to the construction of city wetland park, sponge, water treatment, municipal foundation form a complete set, landscape gardening, and other fields, has been applied in more than 1000 engineering construction, the recycled cement products are more than 8 million square meters, renewable brick paving length for the whole of China highest inorganic material, has more than 350 kilometers, An effective closed loop from construction waste generation, resource disposal and recycling product return application is realized.

## 5. Future Outlook

The continuous improvement of resource utilization rate is the inevitable trend of the future development of construction waste resource disposal. Urban management and operation management need to be improved simultaneously to form an intelligent operation mode and closed-loop governance of urban solid waste.

In the future, the resource company will aim to become the most valuable comprehensive service provider of urban resource recycling and utilization, continuously promote the upgrading and expansion of existing technol-

ogies, and continuously increase the development efforts and R&D investment in the field of new technologies. Explore the comprehensive treatment technology of engineering mud and river sediment such as “source control and pollution interception, garbage cleaning, mud and water separation, tail water purification”, as well as the recycling and sorting technology of renewable resources and the new technology of resource disposal of community-level kitchen waste, to provide more solid waste solutions for city managers. Taking the lead in applying BIM technology to the construction design and construction management of construction waste resource treatment projects, from design and construction to simulation operation, greatly improving the integration degree of engineering information; To explore and build an intelligent platform integrating intelligent sorting, intelligent control, and intelligent operation and maintenance, improve the energy efficiency of project operation and maintenance control, promote the deep integration of artificial intelligence (AI), Internet technology and other technologies with urban solid waste comprehensive treatment, and promote the development of industry information, digitalization and intelligence.

## 6. Deposition From Stakeholders

*“Your construction waste resource recycling is a real ‘carbon emission reduction’, is a very good model! It is worth promoting nationwide!”*

——Academician of Chinese Academy of Engineering, chief expert of China State Construction Corporation, professor of Tongji University

*“Thank you for undertaking this project!”*

——Representative of US

## Attachment: Enterprise Related Information



Company Name: BCEG Resources Recycling Co., Ltd.  
Company Address: Haidian, Beijing  
Company Website :<http://bcerr.bcegc.com/>

### Company Profile

Beijing Construction Engineering Resources Recycling Co., LTD. (hereinafter referred to as Beijing Construction Engineering Resources Co., LTD.) is a state-owned enterprise in Beijing and a holding subsidiary of Beijing Construction Engineering Group Co., LTD., one of the world's 250 largest international engineering contractors. Founded in 2014, it was recognized as a national high-tech enterprise in September 2018. In December 2020, it passed the "Quality, environment, occupational health and safety" management system certification, was approved as Beijing Enterprise Technol-

ogy Center and passed the intellectual property management system certification in 2021, was selected as the "Science and Technology Reform Demonstration Enterprise" of The State Council in 2022, and was rated as Beijing "specialized and Special New" enterprise.

Company's core main business service for construction waste recycling of use of the whole industry chain, professional provide including "project prophase research and evaluation - planning and plan - the business model and management policy consultation process design and equipment integration - investment, construction and opera-





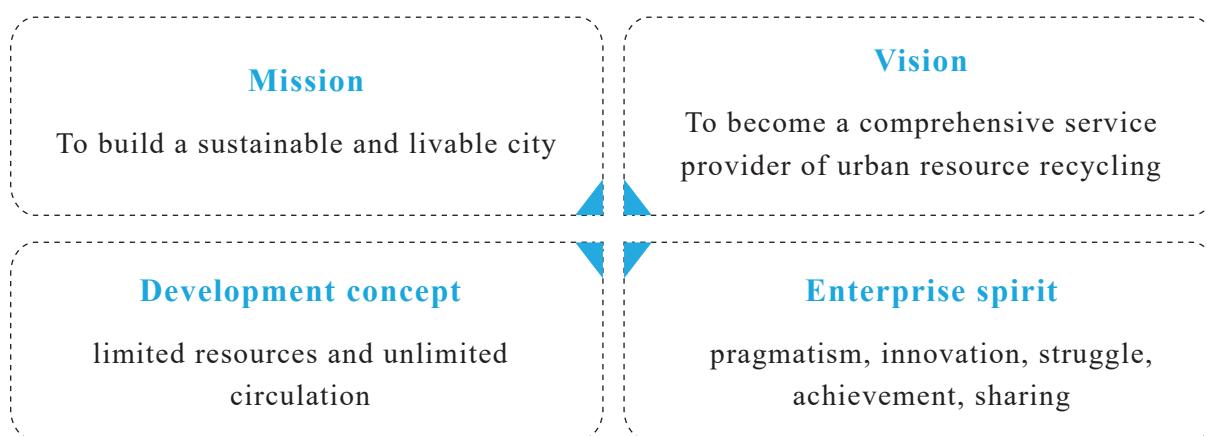
tion management - product production and reuse" one-stop service and comprehensive solutions, to building demolition waste and recycling of solid waste disposal is given priority to decorate, at the same time carry out informal landfill site management, slag treatment, sludge disposal, river sediment management, big rubbish disposal, eat hutch waste disposal and recycling garbage sorting and other diversified business, to create "2 + N" solid waste comprehensive disposal of business system. In China since 2016, Beijing, Shanghai, Jiangsu, Hebei and other places have more than 30 projects fall to the ground, construction waste disposal services covering 10 administrative areas in Beijing, total disposal capacity of 19 million tons, has completed the project to achieve 100% continuous stable operation of production, is the Chinese biggest enterprise in domestic construction waste disposal.

Adhering to the tenet of innovation-based, market-oriented, customer-centered and service-oriented, the company has carried out research on the composition of urban solid waste in Beijing, Shanghai, Shenzhen, Wuxi and other key cities, forming a large data-

base of urban solid waste composition to fill the gap in the domestic industry. Carry out the research and development and innovation work of process scheme, core equipment and recycling products, and explore the mature construction and decoration waste resource disposal technology suitable for our country's national conditions; Summarize the experience of multi-mode project operation and management, and establish an operation big data management platform.

As practitioners and reusing resources for the sustainable development of green industry leader, the company with "limited resources circulation is infinite" for the idea, to build the sustainable development of human livable city for long-term strategic target, determined to become a diversified business model, the types of business diversification and business diversification in the field of composite industry leader, Make outstanding contributions to promote the high-quality development of the industry.

## Corporate Culture



## Major honors in the Past Three Years



Intellectual property management system certification



Beijing National Collaborative Innovation Center for Energy Conservation and Emission Reduction and Urban and Rural Sustainable Development



National high-tech enterprises



Ten new technologies will be built in 2021



China Patent Excellence Award (a small modular treatment system for construction waste)



Zhongguancun high-tech enterprise



Beijing New Technology New product (service) certificate - High precision sorting machine



Beijing New Technology New Product (service) Certificate - Compound sorting machine



Beijing New Technology New Product (service) Certificate - Vibration air selection machine



Beijing New Technology New Product (Service) Certificate - construction waste recycling cement stable inorganic mixture



Quality management system certification



Beijing New Technology New Product (Service) Certificate - Small modular disposal service of construction waste



Occupational health and safety management system certification



Environment Management System Certification



Typical demonstration cases of smart sanitation in China in 2020



Annual Beijing Intellectual Property Pilot Unit From 2020-2022



Beijing New Technology New Product (Service) Certificate - Construction waste disposal service in situ



2019 National Smart enterprise construction innovation practice cases



“Pioneer Leadership” award



Science and Technology Award of  
China Circular Economy Association



2018-2019 National Best Demon-  
stration Enterprise of Construction  
Solid Waste Recycling (BP)

“Specialized special new” enterprise

“Science and Technology Reform Demonstration Enterprise” of SASAC of The State Council

The first batch of ten ESOP pilot enterprises in Beijing approved by the SASAC of The State Council

## Employee Data

Beijing Construction Engineering Resources Recycling Investment Co., LTD., the total number of employees is 372, including 294 males and 78 females, the male to female ratio is 49:13; Female employees accounted for 23.5 percent of middle and senior managers, and 57 percent of senior managers.



# Eliminate the “Rust” of the City, Help the “Embroidery” of Management, and Achieve the Beauty of life

◇ BCEG Resources Recycling Co., Ltd.

## Introduction

BCEG Resources Recycling Co., Ltd. has given full play to its independent innovation ability, created the first high resource rate decoration waste disposal project in China and the first diversified collaborative disposal project in the field of construction waste in China, realized the high resource rate disposal of decoration waste, improved the level of urban refined management, and made the city more beautiful and better.



## SDGs

 <p>Goal No.9</p>	<p>Give full play to independent innovation ability, promote equipment research and development, apply BIM technology to process design and construction management, integrate “intelligent sorting technology” and “traditional construction waste solid waste disposal technology” to solve common problems in the industry; Develop recycled products to turn construction waste into treasure.</p>	 <p>Goal No.12</p>	<p>Through independent innovation, the high resource rate of decoration waste disposal is realized, and the decoration waste is “turned into treasure”, avoiding the waste of land resources and pollution problems such as groundwater and soil caused by traditional disposal methods.</p>
 <p>Goal No.13</p>	<p>The prefabricated + passive ultra-low energy consumption green building is adopted to make full use of renewable energy, improve overall environmental comfort and reduce carbon emissions with less energy consumption.</p>		

## CSR

 <p>Fundamental Responsibility</p>	<p>Give full play to independent innovation ability, promote equipment research and development, apply BIM technology to process design and construction management, integrate “intelligent sorting technology” and “traditional construction waste solid waste disposal technology” to solve common problems in the industry; Develop recycled products to turn construction waste into treasure; Compiling relevant standards, leading the standardization and standardized development of the industry.</p>	 <p>Environment</p>	<p>Realize the high resource rate disposal of decoration waste, improve the utilization rate of resources, and avoid the waste of land resources and pollution problems such as groundwater and soil caused by traditional disposal methods. The prefabricated + passive ultra-low energy consumption green building is adopted to make full use of renewable energy, improve overall environmental comfort and reduce carbon emissions with less energy consumption; The dust removal process and noise reduction measures combined with front-end micron dry fog dust suppression and end bag dust removal phase are adopted to ensure that there is no secondary pollution to the surrounding environment during operation.</p>
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## 1. Case Overview

China's urbanization process, in the world is rare, with the continuous development of city, the construction, in the old village transformation, Peng-Gai demolition, housing quality promotion "rust" aging in the process of construction, building interiors in being washed out gradually, in the construction and decoration of the waste generated in upgrading has become the city's new "rust", and how to wipe away the "rust" to make cities "brighter"? BCEG Resources Recycling Co., Ltd. gives an innovative answer. China's first decoration waste disposal project with high resource rate -- Decoration waste resource disposal project in Baoshan District, Shanghai; China's first diversified collaborative disposal project in the field of construction waste -- Huacao Recycling Resource Utilization Center project in Minhang District, Shanghai; BIM technology is applied to the construction waste resource treatment project, and the organic integration of "intelligent sorting technology" and "traditional construction waste solid waste disposal technology"... BCEG Resources Recycling Co., Ltd. has realized the high resource disposal rate of decoration waste, "turning waste into treasure", erasing the new "rust" generated in the urban renewal, and improving the city's fine management with "embroidery kung fu", so that the city is more "show" and life is more beautiful.

## 2. Case Background

The Earth's resources are not inexhaustable. We are using the equivalent of 1.6 earths to sustain our current production needs. Global warming, the spread of acid rain, the collapse of biodiversity, solid waste pollution... Huge waste, excessive exploitation, plunder, wanton use of natural resources without restraint, let the earth infinite "overdraft", will produce immeasurable "side effect", protect the ecological environment, improve the efficiency of resource use, use recycled regenerate products instead of natural resources, avoid

over-exploitation of natural resources, is a green, low-carbon path of sustainable development.

As an inevitable product of urban renewal, construction waste is divided into five categories: engineering muck, engineering mud, engineering waste, demolition waste and decoration waste. With the accelerating process of urbanization, the amount of construction waste is increasing year by year. According to the data analysis of the "Construction Waste Management and Resource Utilization Committee of China Urban Environmental Health Association", the annual amount of construction waste is about more than 2 billion tons. It is the solid waste with the largest single type, the largest carbon emission and the most concentrated in China's municipal garbage. If the simple way of traditional landfill and open stacking is used to dispose of construction waste, on the one hand, it takes up a lot of land and causes waste of land resources, on the other hand, it also poses a threat to the safety of groundwater and soil, and there is a serious potential risk of environmental pollution. With the increasing production of construction waste and the gradual saturation of consumption places, construction waste is facing nowhere to go.

At present, in terms of technical difficulty and the blank of large cities, decoration waste is the most difficult to solve. With the gradual improvement of urban living standards, the production of decoration waste is also increasing year by year. Its dispersed sources, wide variety, complex composition, coupled with difficult treatment and high technical requirements, have always been a difficult point in the disposal of construction waste.

## 3. Responsibility Actions

BCEG Resources Recycling Co., Ltd. was founded in 2014, the specialty is engaged in the construction waste recycling of use of the whole industry chain services, for eight years, the company always adhere to the strategic orientation

of technology first, market first, and continuously promote the transformation of scientific and technological research and development and the achievement, construction waste recycling industry from scratch, to gradually establish a system, standards, and mature business model, The company has also grown from an immature enterprise to a leading enterprise in China's construction waste resource disposal industry.

(1)Pay attention to the difficulties of urban governance, and improve the fine management of cities with "embroidery skills"

With the continuous improvement of the living environment requirements of the general public, the frequency of new construction, renovation, decoration and decoration is also getting higher and higher, and the amount of decoration waste is increasing. Taking Baoshan District of Shanghai as an example, the amount of decoration waste produced every year reaches 280,000 to 300,000 tons. Land resources are limited but the disposal needs are very urgent, and the contradiction between people and land in first-and second-tier cities is becoming more and more prominent. To crack decoration garbage disposal problem, in 2018, BCEG Resources Recycling Co., Ltd., provides a new solution, in baoshan district of Shanghai Jiang Yang north road built the Baoshan district of Shanghai to decorate the garbage recycling of project, the project for the country's first high uti-



The first decoration waste disposal project with high resource utilization rate in China

lization rate of garbage disposal project, decorate design in disposal of rubbish scale of up to 300000 tons, resource recovery rate more than 85%, The operation period is 10 years.

"Crossing the river by feeling the stones", creating a new model of fine management of urban decoration waste. Due to the lack of any mature and successful cases that can be used for reference in China, the operation management mode, project design and construction work are no more than "crossing the river by feeling the stones". In the early stage of the project, the research team of BCEG Resources Recycling Co., Ltd. conducted a survey on the composition of decoration garbage in Shanghai's garbage transfer stations and terminals for nearly 2 years and more than 20 times in a row, and formed a large database to fill the industry gap, and gradually formed a package solution of decoration garbage "collection", "transportation" and "place". Village residents, after waste generated decorate unified investment set up near garbage dumps, focus on a regular basis to garbage HuanWeiSuo decorate, the big trash, waste, etc. After a preliminary sorting, then to decorate fine disposition of garbage recycling of terminal, eventually translate into high quality recycled aggregates regression application and urban construction.

"Do a doodle in the shell of a snail", build a decoration waste resource disposal project full of science and technology. The production area of the project, including raw material and product storage area, is only 16 mu, and the site is very small. The composition of decoration waste is complex. Compared with Beijing's temporary waste dismantling project, its resource recycling process equipment has longer process lines and more equipment. How can so much equipment be packed into a workshop that is 66 meters long, 24 meters wide and 21 meters high? Technical team according to the requirements of project disposal field situation and site, the project workshop covers an area of small,

highly limited conditions, adjustment process repeatedly, project construction team with high temperature in an office, and installation workers to eat together, live together, every link rot, focus on every detail, even if a screw is not wrong. From civil construction to the steel structure to the device from the disposal of the line construction and installation debugging, from production operation to the recycled product sales, they overcame all kinds of the total project construction period and operation problem, eventually forming a limited space, vertical, compact decoration waste comprehensive disposal process, disposal technology of the complex “stack up”, highly “enrichment” in a fully enclosed factory room, it is like “packing” into a “box” to ensure that the resource disposal task is completed in a compact layout, and the overall construction of the project is completed in only 7 months. The project is also equipped with an automatic weighing and measurement management system independently developed by BCEG Resources Recycling Co., Ltd., which realizes information sharing and intelligent management with government departments by identifying trans-



Extremely limited space, three-dimensional, compact decoration waste comprehensive disposal process

port vehicles, positioning and weighing, collecting, storing, analyzing and uploading information, and sending it back to the big data cloud platform in real time.

At present, the project has been used as urban infrastructure to dispose more than 600,000 tons of decoration waste for Baoshan District, opening the closed loop of resource disposal of decoration waste, and becoming an innovative act to improve the “embroidery” of urban fine management.

(2)Comprehensive and collaborative governance will add the wings of artificial intelligence to urban solid waste disposal

To meet the demolition of garbage, and part of the town center, Minhang district of Shanghai to decorate garbage, mud and river sediment engineering construction waste waste recycling of demand, improve the quality of human settlements, the comprehensive construction in ecological and cultural modernization, Beijing construction company in Minhang district of Shanghai to build the hua cao renewable resources recycling use center project, The project is the first diversified collaborative disposal project in the field of construction waste in China.

Green environmental protection, to create a “high appearance level” model project. The project adopted the prefabricated + passive low green building energy consumption, make full use of renewable energy, with less energy consumption to improve the overall environmental comfort, reduce carbon emissions, the front end micron grade dry fog dust suppression + terminal phase of bag-type dust collector and supplemented by the combination of spray water dust removal process and noise reduction measures, to ensure that the operation of will not cause secondary pollution to the environment. At the same time, the integrated workshop is deindustrialized, and the environmental friendliness is obtained through beautification of the facade, greening landscaping, roof garden and other

ways. The concept of green environmental protection runs through the whole life cycle of project design, construction and operation, and achieves dynamic balance with the surrounding ecosystem, and continuously expands the green space of the project and the city.



China's First Diversified Collaborative Disposal Project in the Field of Construction Waste

Multiple collaboration, the project design displays “space magic”. Huatao Recycling Resource Utilization Center project covers a total area of 70 unit, and the disposal area is narrow and long, the narrowest part is less than 60 meters, and the widest part is only 130 meters. BCEG Resources Recycling Co., Ltd. has customized a coordinated comprehensive disposal plan for construction waste. The production line includes a comprehensive disposal line for demolition waste, with an annual disposal scale of 350,000 tons. A comprehensive disposal line for decoration waste, with an annual disposal scale of 350,000 tons; An engineering mud disposal production line with an annual disposal scale of 200,000 tons; A river sediment disposal line with an annual disposal scale of 60,000 cubic meters, the project is also equipped with a recycled cement product production line with an annual production scale of 500,000 square meters. In order to be able to in the limited space inside decorate 5 production lines, project process design adopt vertical compact layout, repeatedly has carried on the horizontal and vertical layout optimization, material storage area is located in the workshop outside to facilitate material handling into the factory, set aside the vertical penetration

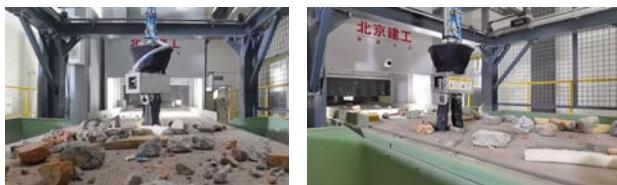
maintenance lifting channel convenient for daily maintenance and equipment overhaul technology adoption, The effect of reducing the occupation area, clear functional division, smooth traffic organization in the field, and sufficient maintenance space is obtained, which makes the space and function movement line in the field more reasonable and creates an efficient space layout.



The Inner Part of China's first Diversified Collaborative Disposal Project in the Field of Construction Waste

Scientific and technological innovation, project construction highlights “science and technology model”. The project will breakthrough BIM technology is applied to process design and construction management, construction personnel on 3 d visualization clarificaiton, for simulating device, platform construction and the collision detection, preclude the collision interference problems in the construction, to optimize the construction drawing and improve the quality of construction, speed up the construction speed, saving the cost of construction and management. At the same time, in this project, the “intelligent sorting technology” and “traditional construction waste solid waste disposal technology” are organically integrated, which can effectively replace manual sorting. The recognition model of the intelligent sorting robot can understand the human brain, the visual system is equivalent to the human eyes, and the grasping actuator is equivalent to the human limbs. The training and learning of the robot needs to be from simple to complex. The actual different working conditions are simulated by manual feeding, a large number of images are collected and labeled to help the ro-

bot learn, and the performance improvement and test feedback are carried out in batches and stages. At present, the effective mark images have been close to 10000 pieces, the average recognition rate reached 97.63%, the components of the monomer model under the condition of low speed mode, for all kinds of target sundry crawl rate up to 91.5% on average, and continue to iterate research work, the monomer model under high speed mode and stack model material recognition rate and expand the crawl rate.



Intelligent Sorting Robot

### (3)Independent research and development, key core technology achievements “rust removal” expert

Decoration waste is the most complex type of construction waste. Compared with general construction waste, its impurity content is higher, and the requirements for resource disposal technology are higher. In the process of equipment research and development and process development, BCEG Resources Recycling Co., Ltd. gives full play to independent innovation ability, solves common difficult problems in the industry, and does a good job of “rustproof” work in the city on the basis of technological innovation.

According to the characteristics of high impurity content of construction waste and inapplicability of conventional mining equipment, BCEG Resources Recycling Co., Ltd. independently developed a variety of core sorting equipment, including vibrating wind separator, high-precision separator, composite separator, special hammer crusher for decoration waste, which filled in the gaps in the industry of special sorting equipment for construction waste in China and thoroughly solved the problem of impurity removal of construction

waste, realizing the “no pickiness” disposal of construction waste.

Core technology has its own equipment, for the disposal of process development provides a higher degree of freedom, to solve the problem of diversification demand of construction waste disposal. Based on China construction and decoration garbage composition characteristics, BCEG Resources Recycling Co., Ltd. has continuously carried out technical innovation and process optimization. It has successively developed more than ten core process routes, including comprehensive disposal process of construction waste, modular disposal process of construction waste, three-dimensional and compact disposal process of decoration waste, gradient disposal process of decoration waste and mixed waste screening disposal process, to achieve a recycling rate of more than 95% of construction waste and more than 85% of decoration waste. In a real sense, we has achieved a high recycling rate of construction and decoration waste disposal and reached the world-class recycling level.

Among them, the construction waste in situ disposal of complete sets of technology research and application of the modular construction waste treatment technology by the Beijing municipal councils expert appraisal, achieves the international advanced level, modular design to achieve the international leading level, two technologies are included in the ecological environment of the first “no waste city” advanced suitable technology; “Research and Application of Complete set of Technology for comprehensive Disposal of urban decoration Waste” has been identified by the academician and expert team of China Circular Economy Association, which has reached the “international advanced” level as a whole, and the comprehensive technology of composite sorting has reached the “international leading” level.

### (4) R&D and application of recycled products to promote the integrated development of resource recycling and

## ecological environmental protection

The promotion and utilization of recycled products is the last link in the resource disposal of construction waste, and it is also a key step to turn construction waste into treasure and play the role of “urban mineral”. The recycled aggregate of BCEG Resources Recycling Co., Ltd. has achieved an ultra-low impurity rate of 3%, which is far lower than the industry standard of 1%. However, for a long time, recycled products are not accepted by the market and few people pay attention to them. If we can not overcome the difficulties in the promotion of recycled products, so that construction waste can be truly recycled and reused, it will be an empty talk.

Over the years, BCEG Resources Recycling Co., Ltd. has continued to expand the variety of renewable products, created a comprehensive product system covering nine categories and more than 20 kinds of renewable products, and introduced a variety of renewable products, including recycled aggregate, recycled inorganic mixture, recycled stone like municipal bricks, recycled water purification filter materials, premixed fluid filling materials, etc. The performance indicators can meet the national standards for natural material products, and can be applied to the construction of wetland parks, sponge cities The municipal infrastructure, water treatment, landscaping and other fields have been used in more than 1000 projects, among which the application of recycled cement products has exceeded 8 million square meters, and the paving length of recycled brick concrete inorganic materials is the highest in China, exceeding 350 kilometers.

While continuously improving the quality of its own products, BCEG Resources Recycling Co., Ltd. has also actively promoted the standardization and standardization of the use of renewable products. It has led and participated in the compilation of 16 industrial standards for products. Among

them, the Technical Regulations for the Application of Building Waste Recycling Products, which it took the lead in editing, is the first local standard for building waste recycling products in Beijing.

## 4. Effect of Responsibility Fulfillment

BCEG Resources Recycling Co., Ltd. was recognized as a national high-tech enterprise in 2018, and passed the “quality, environment, occupational health and safety” management system certification in 2020. In 2021, it was approved as Beijing Enterprise Technology Center and passed the intellectual property management system certification. In 2022, it was selected as the “Science and Technology Reform Demonstration Enterprise” of The State Council. Awarded Beijing “specialized and special New” enterprise.

At present, 35 projects have been launched in Beijing, Shanghai, Jiangsu, Hebei and other places in China. Construction waste disposal services cover 10 administrative regions in Beijing, with a total annual disposal capacity of 19 million tons, which is equivalent to saving the land area of nearly two Beihai parks every year, and reducing carbon emissions by about 1.1 million tons every year. The completed projects have achieved 100% continuous and stable operation and production, and it is currently the enterprise with the largest annual disposal volume of construction waste in China. It has built China's first miscellaneous filling and construction waste resource disposal project, China's first shed renovation site construction waste in situ disposal project, China's first decoration waste disposal project with high resource rate, China's first diversified collaborative disposal project in the field of construction waste, and other national demonstration projects. Developed by the nine categories of more than 20 kinds of renewable products have been applied to the construction of city wetland park, sponge, water treatment, municipal foundation form a complete set, landscape



gardening, and other fields, has been applied in more than 1000 engineering construction, the recycled cement products are more than 8 million square meters, renewable brick paving length for the whole of China highest inorganic material, has more than 350 kilometers, An effective closed loop from construction waste generation, resource disposal and recycling product return application is realized.

## 5. Future Outlook

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## 6. Deposition of Stakeholders

*“Your construction waste resource recycling is a real ‘carbon emission reduction’, is a very good model! It is worth promoting nationwide!”*

——Academician of Chinese Academy of Engineering, chief expert of China State Construction Corporation, professor of Tongji University Xiao Xuwen

*“This is the best garbage disposal project I've ever seen. They do it very carefully and very well.”*

——Professor of Peking University Jijie

# Defining the Nature of Development with Green, Drawing a Safe Living Environment Together

◇ Beijing Oriental Yuhong Waterproof Technology Co., Ltd.

## Introduction

Beijing Oriental Yuhong Waterproofing Technology Co., Ltd. upholds the concept of carbon neutrality, and has made comprehensive deployments in the areas of business layout, production sites and product innovation, increasing the research and development and application of green technologies, promoting clean production, providing green services, creating green buildings, and making every effort to explore the road to low-carbon, which has strongly contributed to the transformation and low-carbon development of the building materials industry.





## SDGs

 Goal No. 7	<p>The roof-mounted solar photovoltaic power generation system was developed and applied in a number of projects in the automotive, new energy and electronic communications industries. The clean energy was applied in the production and R&amp;D logistics base in Puyang, Henan Province.</p>	 Goal No. 9	<p>With technological innovation as the base, it helps to develop green building materials and build energy-efficient buildings.</p>
 Goal No. 13	<p>Set up a carbon asset management company to fully co-ordinate the management of carbon assets within the company; increase investment in environmental protection, develop and utilize clean energy, create near-zero energy buildings, etc. to promote energy conservation and emission reduction.</p>	 Goal No. 17	<p>Work with stakeholders to create a cross-border “green circle of friends” to promote low-carbon development.</p>

## CSR

 Fundamental Responsibility	<p>Adhere to the innovation drive, research and development of green technology, to create green building materials, green energy-saving buildings, etc.; increase investment in safety production to ensure safe production.</p>	 Environment	<p>Increase investment in environmental protection, research and develop green technology, apply clean energy, create green building materials and green energy-saving buildings; set up a carbon asset management company, strengthen the management of carbon assets and actively respond to climate change.</p>
 Fair Operation Practices	<p>Work with stakeholders to promote cross-border cooperation and development, create a “green circle of friends”, and drive partners along the value chain to jointly fulfil their social responsibility.</p>		

## 1. Case Overview

Since China announced the “Double Carbon Goals”—“Carbon Peak by 2030” and “Carbon Neutrality by 2060”—in 2020, Oriental Yuhong, as a building material systems service provider, has been incorporating the low carbon and sustainable development concepts into its core, accelerating its exploration and innovation processes, and fully pushing forward the resource-saving and environmental friendly models of enterprise development.

Established in 1995, Oriental Yuhong has grown into an outstanding building material systems service provider in the past two decades by providing high-quality and complete system solutions for tens of thousands of important infrastructure construction projects, industrial buildings, civil buildings and commercial buildings. The company’s business development path is also its path to exploring low carbon development in practice. In accordance with the guiding principles of carbon neutrality, Oriental Yuhong has taken actions in the following fields: research and development (R&D), production, and construction. In the field of R&D, the company has expanded its input to promote the development and application of green technology. In the field of production, the company has continued to advance clean production at the R&D logistics bases throughout the country. On the construction sites, the company has developed green construction services through standardized and intelligent construction and created green buildings through developing various green technologies. Through resource saving and emissions reduction at the production end, Oriental Yuhong has also enabled green product consumption. The company is fully dedicated to contributing to the low-carbon retrofitting of all types of buildings and infrastructure, and leading the decarbonization of buildings and construction materials.

## 2. Case Background

Carbon neutrality goals have both presented opportunities and posed challenges for the development of buildings and construction materials industries. Factors such as the international environment becoming complicated and volatile, the COVID-19 crises, and the price fluctuations in raw materials put significant stress onto the buildings and construction materials industries. Meanwhile, factors such as the stable and improving domestic economy, the expansion of infrastructural development investment, and the renewal and retrofitting of the urban environment have presented opportunities to the construction industry. However, as people’s standards for the quality of life and living environment have increased, environmentally friendly, healthy buildings have become necessities. Therefore, the building and construction material enterprises also need to undergo a green transition.

The relevant national policies came in “perfect timing” for the green transition of construction industries. The “Opinions on Deepening the Reform of the Compensation System for Ecological Protection,” issued by the General Office of the CPC Central Committee and the State Council, proposed that the development of green technological innovation, green building materials and green buildings need to be supported. The “Action Plans for the Digital Transformation of Industry Intelligent Manufacturing,” issued by Ministry of Industry and Information Technology, suggested that the industrial transition mode, structural adjustment, and motivation force need to be promoted in order to speed up high quality development. The “Implementation Plan for Carbon Peak in Urban and Rural Development,” issued by the Ministry of Housing and Urban Development, advocates for low carbon urban and rural development. The National Development and Reform Commission also



established a working group on carbon emissions accounting, which includes the Building Materials Industry Association.

Oriental Yuhong is dedicated to become the most valuable enterprise in the construction and construction materials industry around the globe and deeply believes in creating a safe and long-lasting environment for humans and the society. The scope of the company's business focuses on waterproofing and extended its scope to the upstream and downstream and relevant industrial chains. It has developed a building material service system consisting of diversified business segments, such as building waterproofing, civil construction materials, architectural coating, specialized mortar, energy saving and heat preservation, building renovation, non-woven fabrics, and specialized film. In all business segments, the company adheres to the human-centric approach and aims to facilitate green transitions in more buildings.

### 3. Responsibility Actions

Oriental Yuhong has always believed that low carbon development is a long term and systematic project. The practitioners may constantly run into challenges, especially when taking pioneer actions without previous experiences that one can learn from. However, Oriental Yuhong is strongly dedicated to putting sustainable development in practice in its business layout, production process, and product innovation, and it was prepared for any challenges ahead.

#### (1) Paving the Path to Low Carbon Development

At the top-level, in November, 2021, Oriental Yuhong has established the first carbon asset management firm in the construction industry—The Oriental Yuhong (Tianjin) Carbon Asset Management Co., Ltd.—which comprehensively manages and coordinates the carbon assets of the entire company.

In addition, Oriental Yuhong is actively building a network between various stakeholders within the industry to promote low carbon development together. For example, in Guangzhou, the company has co-hosted the “2021 Guangzhou Application and Development of Green and Functional Construction Materials Industry” with entities such as the Guangzhou Municipal Housing and Urban-Rural Development Bureau, and has initiated the launch of the association of Guangzhou Green and Functional Construction Materials Industry. IN Wuxi, the company has co-established the “Yi'an Meng Public Welfare Foundation Special Fund for Carbon Neutrality Demonstration Project” with entities such as the Wuxi Construction Industry Association and the YiAn Holdings Jiangsu Construction Co., Ltd., to help promote the R&D of green construction materials and build energy-efficient buildings, with technological innovation as the fundamental approach.

Besides collaborations with stakeholders within the same industry, Oriental Yuhong has also developed cross-industry collaboration network, or a “green friend circle.” The company has collaborated with photovoltaic energy enterprises such as China Green Energy, Ruihe, Jingri Technology, JA Solar, XYG, and Huafu New Energy and signed a strategic collaboration agreement with the Jinshan Guangfu Association to promote technological innovation and business expansion. In addition, Oriental Yuhong has collaborated with JA solar to create the Yuhong JA New Energy Technology Co., Ltd. and comprehensively layout the “photovoltaic + waterproofing” market structure. Especially because Oriental Yuhong has shown noticeable advantage in the aging resistance, corrosion resistance and energy efficiency of its TPO waterproofing membrane, its specialty matches well with the service life of photovoltaic modules and serves as the optimal waterproofing membrane materials for photovoltaic roofs. Combining the photovoltaic technology with waterproofing technology can help one take full advantage of roofing resources

of production plants, which promotes the green and low-carbon transformation in the automotive industry.

## (2) Making the Production Process Green and Environmental-Conscious

Oriental Yuhong pays special attention to the impact of its production and operation activities on the environment; therefore, the company continues to expand its resource input into environmental protection and safe production. In 2021, Oriental Yuhong has spent 62.4594 million Chinese Yuan on environmental protection (solid waste management, climate protection, water and noise management, etc.) and 47.7235 million Chinese Yuan on safety management (equipment upgrading, maintenance, emergency rescue, and the “four new” objectives) in factories.



Oriental Yuhong Qingdao Production  
and R&D Logistics Base

For example, at the production and R&D logistics base in Huizhou, Guangzhou, the company has replaced the original twin screw air compressor with a permanent magnet frequency conversion air compressor, installed the flow monitoring device and enhanced the pneumatic device at the production line. The enhanced equipment would decrease the air pressure of compressed in the production base without interrupting its usage at the production site. As a result, the air compressor power can be reduced from 121 KW to 77KW, and the air compressor pressure can be reduced from 0.70

Mpa to 0.6 Mpa. This can save 390,000 kWh of electricity usage every year.

In the production and R&D logistics base in Puyang, Oriental Yuhong is also applying clean energy. Since February 25th, 2022, the rooftop photovoltaic power station project has been officially connected to the power grid. The project takes up a total area of 40,000 square meters and has a total installed capacity of about 3.9 MW. After the grid has been connected, the power station can generate around 4.34 million kWh of clean energy per year. In the 25-year cycle of continuous power generation, the power station will generate around 110.75 million kWh of clean energy to the local area, which can replace around 44,000 tons of standard coal, reduce carbon dioxide emissions by 110,000 tons, and reduce sulfur dioxide by about 1,329 tons (when converting to standard coal, use the equivalent of 1 kWh of electricity to 0.4 kg of standard coal).

## (3) Pioneering the Development of Green Products

Since buildings are massive physical structures, the decarbonization of buildings also involves green transition of various types of construction materials. Oriental Yuhong has actively responded to the call for a green transition of buildings, given full play to the company's relative advantage in technology and innovation, and contributed to the development of new, eco-friendly buildings in diverse fields. This better fulfills the demand for green and eco-friendly buildings from different players in the society.

### Highlight 1: Green Roofing

In the field of green roofing, Oriental Yuhong has developed the solar photovoltaic green generation system, which has been successfully applied in many automotive, new energy, and digital communication projects, including the Chery Jaguar Land Rover, the Beehive Energy Power Battery Project of Great Wall Motor CO., Ltd., the China

Mobile (Hohhot) Data Center Phase II, and Tencent Huailai Data Center. Furthermore, the company developed the planted roofing system, which can turn the downward growth of the roots of the plants into parallel growth, ensure plant growth and long-term water proofing, and become the classic choice for urban roof-top gardens. Additionally, the company developed the “space fort” waterproofing system, which reduces the damage caused ultraviolet radiation with the space radiation resistance technology; this lowers the surface temperature of buildings in the summer (20—30 °C) and reduces the “heated island effect” in the cities. During the high temperature period (calculated by 100 days) in the summer, the system can reduce energy used in indoor cooling system by 15%--20%, which reduces electricity usage by 6,000kWh-8,000kWh for every 1000 meters squared. Calculating based on 0.997KG of carbon dioxide reduced by every 1 kWh of electricity saved, the system can reduce CO2 emissions by 2982—7976 kg.



Oriental Yuhong's Classic Project—Waterproofing of Chery Jaguar Land Rover Engine Workshop

## Highlight 2: New Prefabricated Buildings

In the field of prefabricated buildings, Oriental Yuhong developed the EDDE roofing system for industrialized prefabricated buildings, which embodies the characteristics of waterproofing, sound thermal insulation, wind resistant, solid protection, and landscape views. Furthermore, the company developed the modified silicone (MS) sealants for

domestic prefabricated buildings, which are formaldehyde free, non-polluting, and easy-to-apply in construction. The subsidiary company, Woniushan Energy-Efficient Insulation, has developed an indoor prefabricated decorations system (internal wall, flooring, suspended ceiling, kitchen and bathrooms), which is suitable for both new buildings and existing building renovations under various climates.



At the Site of Prefabricated Building Construction

## Highlight 3: Nearly Zero-Energy Building

Oriental Yuhong's subsidiary company—Woniushan Nearly Zero-Energy Building Design and Research Institute has gradually expanded its business scope from nearly zero energy consultation, design and development to many directions such as nearly zero-energy building, low carbon communities, zero-carbon communities, carbon sinks, carbon footprints, carbon labeling, carbon assets,



Classic Case in Nearly Zero-Energy Project--Harbin Vanke Smart Future City Passive Box

carbon standards and many other directions. This contributed to the iteration and development of systematic EPC solutions of ultra-low energy consumption buildings and nearly zero-energy buildings. For example, in Harbin's first near-zero energy public building "Harbin Vanke Smart Future City Passive Box", the first challenge that Woniushan faced was the frigid climate. To address this challenge, the company adopted innovative use of constant temperature construction, indoor construction and other means to successfully cope with the extreme weather of minus 25 degrees. In the specification of near-zero energy public buildings, the heat transfer coefficient of the external window is required to be less than  $1.2\text{W}/\text{m}^2\text{K}$ , but in the extremely cold climate of Harbin, the ordinary passive external window is far from meeting the energy-saving requirements of the design. Woniushan innovatively used a new glass curtain wall system with a heat transfer coefficient of  $0.46/\text{m}^2\text{K}$ , which met the energy-saving requirements without large-scale modification to the original façade design of the building.

At the same time, in order to cope with the extremely low temperature in Harbin's climate, Woniushan adopted a new type of jet enthalpy ultra-low temperature heating pump: combining EVI jet enthalpy increase technology with smart and highly efficient program algorithms. Compared to the traditional ambient frequency jet enthalpy increase technology, low-temperature heat pump can increase heat production by 20%, which allows normal functioning in the ultra-low temperature of  $-38^\circ\text{C}$ .

After a winter and summer, it was attested that the building's actual energy emissions was much lower than the amount designed. The building has obtained certificates of "Nearly Zero-Energy Building Evaluation and Certification" from CCIA and the DENA certificate from the German Energy Agency. This project provides a successful example for the implementing the nearly zero-energy

building concept in extreme cold weathers.

#### 4. Effect of Responsibility Fulfillment

At the production end, Oriental Yuhong has received certificates for certifications in quality, environment, and occupational health and safety management systems in 20+ production and R&D logistics bases in cities such as Shanghai, Yueyang, Jinzhou, and Xuzhou, 12 of which have obtained certificates for energy management system certification. The company as a whole has received 102 certificates for China Environmental Labeling Certification (10 Ring Certification) within which the bases in Tangshan, Jinzhou, Huizhou, Kunming have been selected as the green production demonstration sites by the Ministry of Industry and Information Technology. The Xianyang, Puyang and Tangshan bases received Grade A in the environmental performance evaluation for major national environmental protection areas—these are the first enterprises to receive Grade A in the waterproofing industry. Oriental Yuhong also led the way in energy efficiency and emissions reduction with its green and environmentally friendly factories; in 2021, the annual unit energy consumption per output value (tce/million yuan) has decreased by 49.2% compared to the previous year, and the output value emissions  $\text{t}(\text{CO}_2)/\text{million yuan}$  decreased by 21.5% compared to the previous year.

On the consumer side, taking the nearly zero-energy buildings system as an example, Oriental Yuhong has participated constructing 171.61 million square meters of nearly zero-energy consumption buildings, which makes up 15% of the entire market. Compared to the 65 domestic energy-efficient standard buildings, the nearly zero-energy buildings can save 60.0648 million kWh of electricity and 18019.45 tons of coal per year, which can reduce carbon dioxide emissions by 48652.51 tons. Oriental Yuhong's progress in promoting carbon

neutrality has also received wide recognitions from the society. Some highlights include: obtaining China's first "Certificate of Green Building Materials Certification" from the China Building Material Test & Certification Group; appearing on the 2021 list for good practices in smart production of the Ministry of Industry and Information Technology; and receiving 14 gold metals and 8 silver metals from the Waterproofing Industry Science and Technology Awards—Engineering Technology award since 2014. In addition, the subsidiary company, Guangzhou FUDA Thermal Insulation Mate-



Certificate of Recognition and Appreciation for Valuable Contributions and Efforts in Protecting the Ozone Layers

rials Co., Ltd., has been recognized for "Valuable Contributions and Efforts in Protecting the Ozone Layers" by the UN as a part of the Montreal Protocol.

## 6. Deposition from Stakeholders

*"On the path to sustainable development, Oriental Yuhong has always adhered to 'the truth, the good and the beautiful' in its approach. As a front-line worker on its production line, I have deeply felt the true impacts of its management philosophy. The garden-like work environment, to friendly interactions with surrounding communities and the constant praises from visiting partners and collaborators are the best affirmations for our effort in low-carbon and sustainable development."*

——A front line worker at Oriental Yuhong

## Attachment: Enterprise Related Information



Company Name: Beijing Oriental Yuhong Waterproof Technology Co., Ltd.

Company Address: Beijing

Company website: <http://www.yuhong.com.cn/>

### Company Profile

Founded in 1995, Oriental Yuhong has been providing high-quality system solutions for tens of thousands of major infrastructures, industrial, residential and commercial buildings for more than 20 years, and has become a premium building materials system service provider. In 2008, the company went public, and its revenue exceeded RMB 31.9 billion in 2021, representing a 44-fold increase in performance from 2008 to 2021. Some of the company's products have successively passed the EU CE certification, Germany EC1 certification and many other domestic and international certifica-

tions, and won the 17th "National Quality Award", "National Quality Benchmark" in 2017, "National Technology Innovation Demonstration Enterprise" and other honors. The company has been listed on the Fortune 500 list of China's listed companies.

The company pursues high quality and steady development, extending upstream and downstream and related industrial chains with its main waterproofing business as the core, forming a system of building materials services with the synergy of business segments such as building waterproofing, civil building materials, non-woven fabrics, architectural coatings, building repair, energy saving





and heat preservation, mortar and powder, and special films.

Oriental Yuhong has taken the initiative to assume social responsibility, create value for society and play the role of a responsible “corporate citizen”. At present, the total number of employees has exceeded 13,000. At the same time, the company has set up the “Oriental Yuhong Vocational Skills Training School”, which is the first vocational skills training school in the industry to have a private school license from the People’s Republic of China. The company has also established the “Oriental Yuhong Vocational Skills Training School”, the first vocational skills training school in the industry with a private school license from the People’s Republic of China.

Oriental Yuhong relentlessly pursues sustainable development, promoting scale development with technological advancement, product excellence, service satisfaction and safety and environmental protection. The company has been approved to build the National Key Laboratory of Special Functional Waterproofing Materials and has a state-recognized enterprise technology center and a post-doctoral research station. The R&D system is becoming more and more complete, forming four major R&D centers for product development, production technology and equipment, application technology and engineering construction technology. The company has also set up a vocational and technical institute, aiming to improve standardized construction service skills and to train globally competitive industrial workers. In order to bring R&D in line with international standards, a global center of excellence for waterproof coatings has

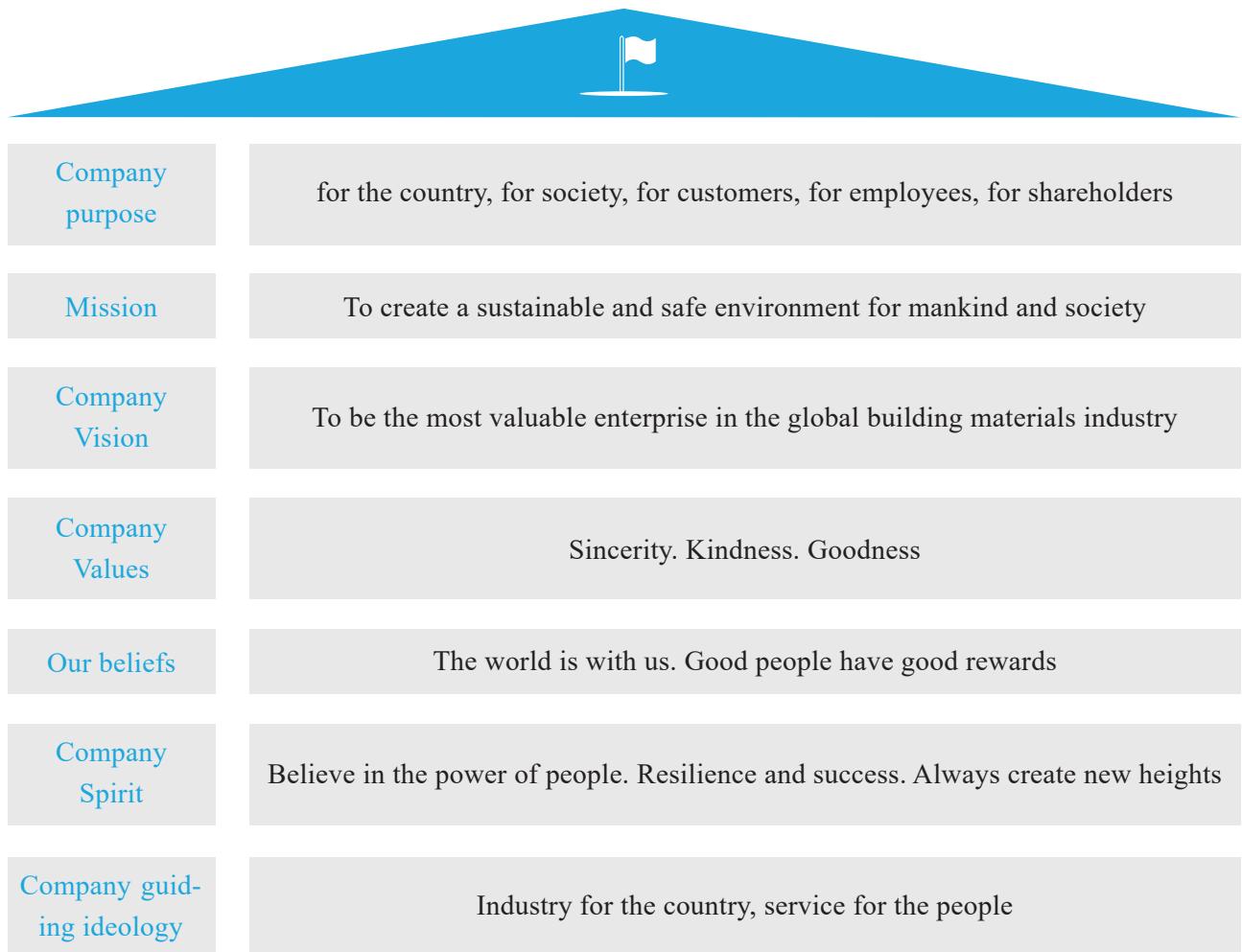
been established in the USA.

As a provider of building materials systems, Oriental Yuhong has successfully applied its excellent products and professional services in many fields such as housing construction, highways, urban roads and bridges, metro and urban railways, high-speed railways, airports and water conservancy facilities. These include the Great Hall of the People, the Bird’s Nest and the Water Cube, and other 2008 Beijing Olympic venues, as well as major national infrastructure projects such as the Beijing-Shanghai High Speed Railway and the Beijing Metro. The company has established long-term, friendly and stable strategic partnerships with more than 400 real estate developers and large corporate groups such as Vanke, Greenland and Poly, and has entered thousands of homes through nearly 3,000 larger home improvement companies and building material markets such as Ye Zhifeng, City Home, Huaxun and Quanzhu.

With the full implementation of Oriental Yuhong’s internationalization strategy, the company’s quality products are exported to over 100 countries and regions, including Germany, Brazil, Australia, the United States, Canada, Russia, Japan, Singapore, South Korea, Central Africa and South Africa.

Their dream is to contribute to the construction of a harmonious habitat, and to fully implement the corporate mission of “creating a lasting and safe environment for mankind and society”. Oriental Yuhong has been on its way.

## Corporate Culture



## Major honors in the Past Three Years



2021 "Employer of the Year"



Top 500 Chinese manufacturing  
companies in 2020



2020 ONA Award for Social Responsibility in Poverty Alleviation



Second Prize of the National Science and Technology Progress Award for the project of complete set of technology and engineering application of high-performance multi-layer polymer coil for waterproofing and protection in underground space



People's Artisan Brand Award 2019



Green Pioneer Company of the Year 2019



Quality Benchmark of the Year in the "Light of Quality" Public Awards 2019



Outstanding Enterprise Award



China's Good Company



Best Investor Relations Award for Listed Companies in China



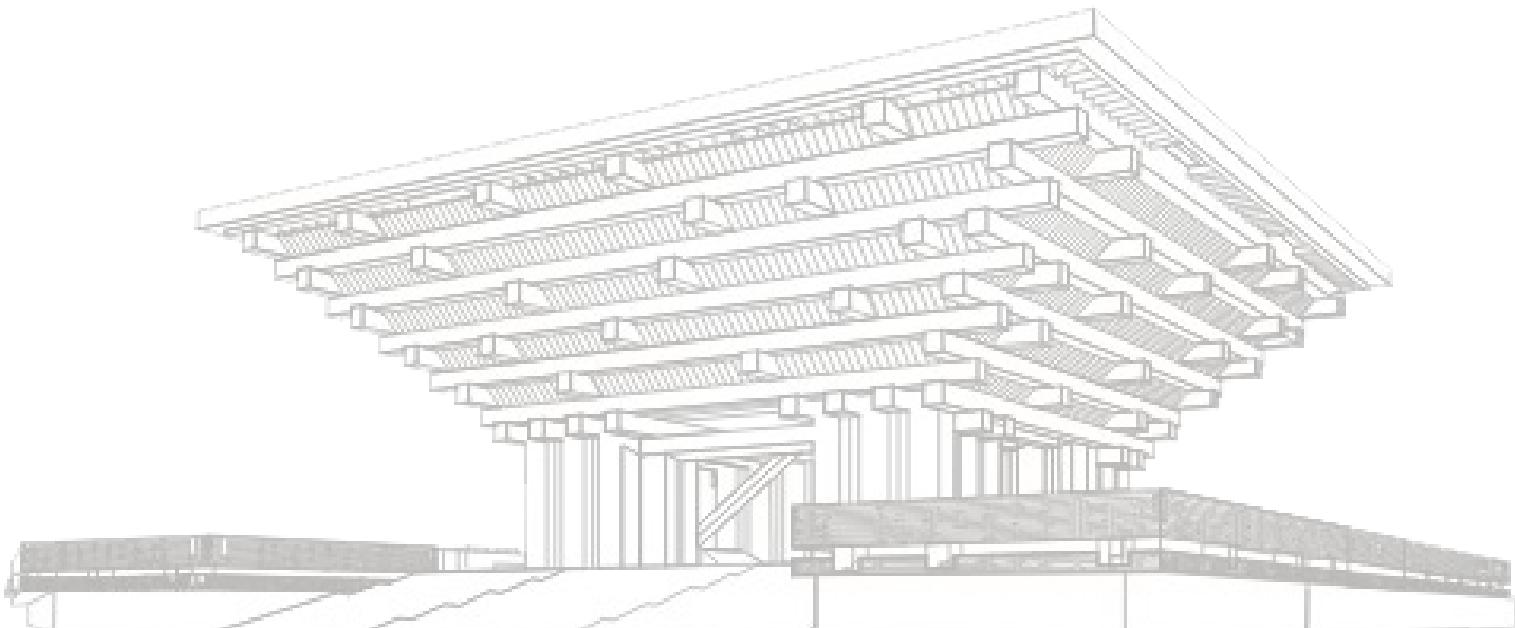
Single Champion Incubatees in Manufacturing

## Employee Data

Index	Performance in 2021
Total number of staff	13630
Labor contract signing rate	100%
Social insurance coverage	100%
Number of female employees	3039
Percentage of women in management	22.66%
Number of ethnic minority employees	790
Staff satisfaction	100%

## Performance Data for the Past Three Years

Index	Unit(RMB)	2019	2020	2021
Total Assets	billion	22.416	27.847	49.733
Operating Income	billion	18.154	21.730	31.934
Total Profits	billion	2.592	4.155	5.100



# Construction of Green “New Gate”: Beijing Daxing International Airport Eastern Airline Base Project Phase II, Section II (Core Work Area F-06-02)

❖ The Second Construction Co., Ltd. of China Construction Third Engineering Bureau

## // Introduction

The Second Construction Co., Ltd. of China Construction Third Engineering Bureau has actively applied a number of new technologies and green construction techniques in the construction of the second stage of the second section of the Eastern Airlines Base Project of Beijing Daxing International Airport, achieving good results in energy, material and water conservation and waste control, and realizing the unification of economic, social and environmental benefits.



## SDGs

 Goal No.9	Apply the composite liquid fluid recycled material technology, mix the recycled material made from solid construction waste recycling with cement and other materials in a certain ratio, instead of traditional backfill materials such as ash and concrete, and it becomes a major highlight of the project implementation of green construction.	 Goal No.12	Apply a number of new technologies and green construction techniques to create green projects and achieve good economic, social and environmental benefits.
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## CSR

 Fundamental Responsibility	Strengthen process and quality control to ensure project quality and create high-quality projects; adhere to innovation and development, independent innovation of composite liquid fluid recycling material technology, and actively apply a number of new technologies, and won a number of honors.	 Environment	Actively apply a number of green construction techniques, promote energy and material conservation, adopt green energy, increase the recycling of construction waste, etc., and achieve good environmental benefits through a number of measures.
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## Case Overview

Section II of the second phase of Beijing Daxing International Airport Eastern Airline Base Project actively implemented and applied many new technologies and green construction techniques issued by the Ministry of Housing and Construction, Beijing and the Company. Through the use of new energy sources such as air energy and solar energy, intelligent electrical switches, automatic water-saving appliances, groundwater and rainwater recycling, office production waste recycling, reuse of steel formwork and concrete residues, standardized safety production protection facilities, the project has achieved good results in terms of energy saving, water saving, material saving and waste control. It has achieved the set objectives of the project, with significant ecological, economic and social benefits. The project has been recognized by all parties in the community and has accomplished the project's target of achieving excellence. During the backfilling construction of the foundation pit fat trench, the project independently innovated and applied the technology of composite liquid fluid recycled material, using recycled material made from solid construction waste to mix with cement and other materials in a certain ratio, replacing traditional backfilling materials such as grey soil and concrete, with high construction efficiency, good implementation effect, material saving and green environmental protection, which was recognized by all parties of the construction and became a highlight of the project's implementation of green construction.

## 2. Case Background

The Beijing Eastern Airlines Base Project is located in the Daxing International Airport area of Beijing, with a total construction area of approximately 78,200 square meters and is a supporting project for the Daxing International Airport. The undertaking of this project has enhanced the company's brand influence in the construction industry

in the capital region and further improved the supporting infrastructure service system of Daxing International Airport, which has far-reaching significance in promoting the collaborative development of Beijing, Tianjin and Hebei and the high-quality development of the region.

Beijing Daxing International Airport Eastern Airlines Base Project Phase II Project Section II (core work area F-06-02 plot) is located in the red line of Daxing International Airport, Daxing District, Beijing, the southeast area of the intersection of Yuanjing East Road and Tianxing Second Street. The construction unit is China Eastern Airlines Company Limited, and the supervision unit is Beijing Zhongjing Hengji Engineering Management Co., Ltd. The project has a total construction area of 78,185m<sup>2</sup>, of which 51,541m<sup>2</sup> is above ground and 26,644m<sup>2</sup> is underground, including 1# logistics building, 2# operation building, 3# and 4# comprehensive business building, and an underground garage with 2 underground floors and 9 above ground floors and a building height of 40m. The project lasts from May 8, 2020, to September 26, 2022, spending a total of 872 days.

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### 3. Responsibility Actions

(1) Composite liquid fluid recycled material for green construction applications

#### ① Process features

The perimeter of the fat trench of this project is about 560m. There are two main forms of support, one is full height support pile and the other is half height support pile + soil nail wall. The width of the fertilizer trench is 0.8 m. And the composite liquid fluid recycled material is used for backfilling in the area of the supporting piles.

Use of waste and conservation of resources:

The coarse and fine aggregates used in the composite liquid fluid recycled material are crushed from solid construction waste such as bricks and concrete, effectively reducing construction waste. And it is used for fertilizer tank backfill instead of ash and concrete, saving a lot of construction materials such as sand, stone, soil and lime.

No dust on site:

The composite liquid fluid recycled material is produced off-site in a professional production base, mechanically mixed according to a uniform ratio and transported directly to the construction site by concrete mixer trucks.

Simple, efficient and time-saving process:

The composite liquid recycled material has high fluidity and can be pumped or self-levelled when backfilling the fertilizer tank, without the need for rolling and tamping. It can be backfilled 2m at a time, mainly mechanically and with less labor. In contrast to traditional grey soil backfilling, manual paving and tamping is inefficient, the thickness of the layers is small, each layer needs to be sampled and retested, and can only complete 1.5m of backfill height per day.

High strength of fluid composite for good construction results:

The composite liquid fluid recycled material is similar in nature to concrete and is self-compacting, with high early strength, up to 3MPa after setting, effectively eliminating the settlement problems of traditional backfill.

#### ② Material performance

It is mainly made of cement, water, admixture and recycled aggregate (made by crushing concrete blocks, bricks, etc.), and its strength is about 3MPa after solidification, and the collapse degree can be controlled at about 200mm.

The recycled material is divided into four particle sizes: 0-5mm, 5-10mm, 10-25mm and 25-31.5mm, depending on the crushed particle size.

The fluid recycled resource compound is made of 0-5mm, 5-10mm and 10-25mm recycled materials mixed in a reasonable ratio.

#### ③ Process and quality control

Material preparation → fertilizer tank cleaning acceptance → retaining wall masonry → concrete pump and pipe installation in place → pouring composite liquid fluid regeneration material →

sampling retest → backfill maintenance on site → pouring the next layer. For the first time, the compound liquid fluid recycled material should be used to match the ratio, and the original material should be identified and provided with the test data and trial test report.

The composite liquid fluid recycled material should be tested for cubic compressive strength and should meet the design requirements. The finished surface should meet the design elevation requirements and the error should not be greater than  $\pm 2\text{cm}$ .

## (2) Construction material savings

### ① Promoting the use of new technologies

The project applied a total of 9 major items and 20 minor items from the Ministry of Housing and Construction's "10 New Technologies for the Construction Industry (2017 Edition)", 14 items from the "Promoted and Prohibited Technologies for the Construction Industry in the Eleventh Five-Year Plan (First Batch)", 19 items from Beijing's 100 Key Promotional Projects in the Construction Field (2006), and 9 items from the company's scientific and technological achievements. The company has made 9 scientific and technological achievements and 2 new technological innovations.

The use of high-strength rebar HRB400E and HPB300 with seismic performance to replace low-performing rebar can reduce the amount of rebar by about 12% to 18% on average, which has a very good effect of material saving.

All reinforcement bars  $\geq 18\text{mm}$  in diameter are connected with straight threaded sleeves to reduce the amount of lapped reinforcement.

They use coil buckle scaffolding as formwork support frame. Compared with steel pipe fastening formwork support frame, the spacing between steel pipes is reduced and the amount of steel pipes

is saved.



New technology application for material saving

② The lighting system, fire-fighting system and staircase railing of the construction site are combined with permanent proximity, and formal equipment is installed in advance instead of temporary equipment during the construction stage to reduce material input.

③ The office room of the project adopts box-type room, and the workers' living area adopts color steel plate room. The toilets, bathrooms and janitorial rooms use integral container rooms, and the fire pump rooms, and standard maintenance rooms use integrated integral box-type rooms, which can be reused many times.

④ Concrete remnants are used to make secondary structural precast blocks and overbeams, formwork remnants are used to make structural corner guards, and reinforcement remnants are used to make ladder bars, positioning bars, catch basin covers, drainage gutter grates and on-site test block maintenance cages.

⑤ Establish geotechnical-structural finite element model. Through calculation of foundation settlement and differential settlement, foundation and anti-floating measures are adjusted to achieve the elimination of settlement post-cast zone. By changing from double construction joints to single construction joints in the post-cast zone, the material of water-stopping steel plates and the material input of independent support in the post-cast zone are saved.

## (3) Green energy applications

The daily hot water supply for washing in the living area adopts air energy water heaters. One Finecz KV18 water heater is used in the workers' living area, with a heat production capacity of 19.5kW and a heating power of 5.33kW, and two Finecz PASHW010-200LD-T water heaters are used in the managers' living area, with a heat production capacity of 2.4kW and a heating power of 0.63kW.

Outdoor lighting in the living area is provided by 20 100W solar streetlamps. Indoor lighting in the living area is provided by 18W LED lamps. Outdoor lighting in the construction site is provided by 1kW LED lamps. Indoor lighting in the construction site is provided by LED strips and 28W fluorescent lamps. Infrared induction delay switches are installed in the corridor of the living area, and remote intelligent switches are installed in the construction site, fire pump and living area air-conditioning power supply lines.

Water-saving appliances such as infrared automatic induction urinals and dual-position squatting tanks were adopted in the toilets of the office area. The standard maintenance room on site adopts constant temperature and humidity automatic control system and atomized humidifier to save energy and water. A three-stage sedimentation tank is set up for vehicle washing to recycle washing water. On-site collection of pit drainage and rainwater is used for road cleaning and greening irrigation.



Recycled water utilization

## (4) Construction waste recycling

Construction waste from the construction site is sorted and disposed of. Separate piles of

waste formwork wood and steel are set up and professional companies are arranged to recycle them. Waste toner cartridges, ink cartridges, wastepaper cartons and plastic products generated from office life are sorted and recycled.

Steel plate roads and construction recycled material gravel floors are used at construction sites instead of concrete hardened floors to achieve recycling and reduce waste.

Standard steel pallets or wooden pallets are used for packaging and transportation of materials and equipment such as plate buckle frames and blocks to achieve 100% recycling.

The safety and protection facilities of the project are all products of the company's standardized atlas and can be recycled, including the processing yard protection shed, external frame mesh and safety channels.

The floor equipment foundation reinforcement and the ground pouring layer reinforcement are pre-deployed by deepening in advance to avoid subsequent implantation of reinforcement, reducing costs and improving efficiency.

Full professional BIM application to solve the problem of pipeline collision and structure collision, determine the deepening of pre-set holes and control the standard height of pipe



BIM application results



lines. Complete the comprehensive layout of the plant room, simulate the layout and construction plan, and improve the accuracy of construction. Simulate the effect of decoration and realize the program visualization.

## 4. Effect of Responsibility Fulfillment

### (1) Ecological benefits

This project has a total backfill of 2850m<sup>3</sup> of composite liquid fluid recycled material, with a density of approximately 1800kg/m<sup>3</sup>. According to its matching ratio, a total of approximately 4.1 tons of recycled material is used. In comparison with other materials backfilling, 2,850m<sup>3</sup> of ash can be saved.

Table 1 Compound liquid fluid recycled material mix ratio

Index	Cement	Water	Recycled Powder	Recycled Aggregate	Water Reducers
Quantity per Cubic Meter(kg)	180	182	1020	505	6.2
Amount per Tray(kg)	540	546	3060	1515	18.6
Content(%)	9.5%	9.6%	53.9%	26.7%	0.3%

### (2) Economic benefits

The average work efficiency of this project is about 285m<sup>3</sup>/day for backfilling with composite liquid fluid recycled material and about 90m<sup>3</sup>/day for backfilling with grey soil. Backfilling of composite liquid fluid recycled material is 2850m<sup>3</sup>. A total of 22 days were saved.

Compared to using concrete to backfill the fertilizer tank, the cost can be reduced by about 940,000 RMB.

The air energy system can save 425kW·h of elec-

tricity per day and the solar energy system can save 20kW·h of electricity per day, resulting in a total saving of 327,000kW·h of electricity.

The coil buckle scaffolding replaces the steel pipe fastener formwork support frame, saving about 203.7 tons of steel pipe.

### (3) Social benefits

The traditional process of backfilling the fertilizer tank of the foundation pit uses plain soil or gray soil backfill, and the width of the fertilizer tank of the deep foundation pit project is generally small, and there are generally problems such as low mechanical usage rate, low work efficiency and insufficient compaction of the backfilled soil. Ultimately, this will cause the soil within the backfill to settle, resulting in loose water settlement rupture, outdoor ground stubble exposure, basement exterior waterproofing membrane breakage, and even affect the construction quality of municipal pipelines.

And in the use of composite liquid fluid recycling material, because the material itself can be solidified and has a certain strength, the above hidden problems can be effectively avoided. Although the cost of construction has increased slightly, the overall quality of construction has improved considerably. The project has worked well to date and all parties have expressed satisfaction.

### (4) Honors received

The project has passed the re-inspection of Beijing Great Wall Cup of Structure and has been awarded the title of Beijing Green Safety Model Site. It has also passed the green construction level process evaluation of the Beijing ZhongJianXie, with an overall score of 87.5, reaching the level of a two-star project, and was awarded the green construction standardized model site by the China Construction Third Bureau.

As a key element of the green construction of this project, the construction of the compound liquid recycled material backfill fertilizer tank has been well received by the expert group, and has played a role in promoting the lightness, standardization and greening of the construction industry. It has a strong promotion significance and broad market prospect in the field of building construction.

The project's BIM results have been awarded 5 awards in various BIM competitions, including the Beijing Construction Industry Federation's Beijing BIM Competition for Comprehensive Applications II, the China Survey and Design

Association's 12th Innovation Cup Building Information Modeling (BIM) Application Competition for Special BIM Applications in Engineering Construction, Second class prize of China Association of Graphology's 10th Longtu Cup National BIM Competition, the second prize of the Second Engineering Construction Industry BIM Competition of China Construction Industry Enterprises Association (comprehensive application category of construction engineering), and the third prize of BIM technology innovation application competition of China Construction Third Bureau No.2 Company.



2021 Beijing Engineering Construction BIM Achievement Certificate Comprehensive Application Achievement Class II



Second-class results of the Second Engineering Construction Industry BIM Competition of CSCA (Construction Engineering Comprehensive Application Category)



Third-class results of BIM application for engineering construction in the 12th "Innovation Cup" Building Information Modeling (BIM) Application Competition



Second Prize in the Construction Group of the 10th National BIM Competition of Longtu Cup



Third Prize in the 2021 BIM Technology Innovation Application Competition of China Construction Third Bureau Second Company

The project has completed 2 patents, 2 papers and 2 work method declarations. The two patents are "A multi-functional enclosure with integrated pipeline" and "A transferable box-type integrated

fire pump room". The two papers are "Construction Technology of Anchor Rods for Complex Underground Facilities in Airports" and "Optimization of Post Casting Strip - Practical Application of



Expansion Reinforcement Strip". The 2 works are "Construction method of fluid regenerative resources composite material" and "Construction method of multifunctional enclosure with integrated pipeline".

The QC results of "Improving the one-time pass-



Class I Achievements of Beijing Engineering Construction Quality Management Group in 2021

ing rate of CFG pile construction" compiled by the project won the third prize of Class I QC results of Beijing Engineering Construction Quality Management Group and the third prize of 2021 Annual Engineering Construction Quality Management Group Activity of China Construction Industry Enterprises Association.



2021 Third Prize for Engineering Construction Quality Management Team Activities



Utility model patent certificate



Publication of papers

## 5. Future Outlook

The use of recycled materials can alleviate the huge environmental and land pressures that Beijing is currently facing. The use of environmentally friendly recycled materials that meet construction requirements is in line with the relevant national industrial policy of developing energy-efficient and waste-friendly new building materials.

With the development of urban construction, the consumption of large quantities of building mate-

rials has exacerbated the consumption of energy for extraction and transportation. China's per capita mineral resources are only half of the world average, and the per capita area of land and arable land is a quarter of the world average. Considering from the perspective of circular economy, the bricks, stones and concrete blocks in construction waste (accounting for more than 80% of construction waste) are resourcefully utilized by directly crushing construction waste into recycled coarse and fine aggregates instead of natural sand and

gravel materials, or by using the characteristics of each component in construction waste to produce new building material products. The resource utilization of construction waste is an important measure to solve the problem of high energy consumption, high pollution, high emission and low efficiency. It is an important way to save land and resources, an important measure to develop circular economy, build an environment-friendly and resource-saving society, and an inevitable requirement to implement the scientific concept of development, achieve sustainable development and protect the environment.

In the future, the company will take practical action to implement the concept of efficient, low-carbon and environmentally friendly construction, and continue to be the practitioner of ecological protection. We will expand and strengthen our green engineering product line, deepen and develop ecological restoration and water pollution treatment projects, optimize the layout of clean energy fields, practice green construction, create green buildings, and promote green and low-carbon development.

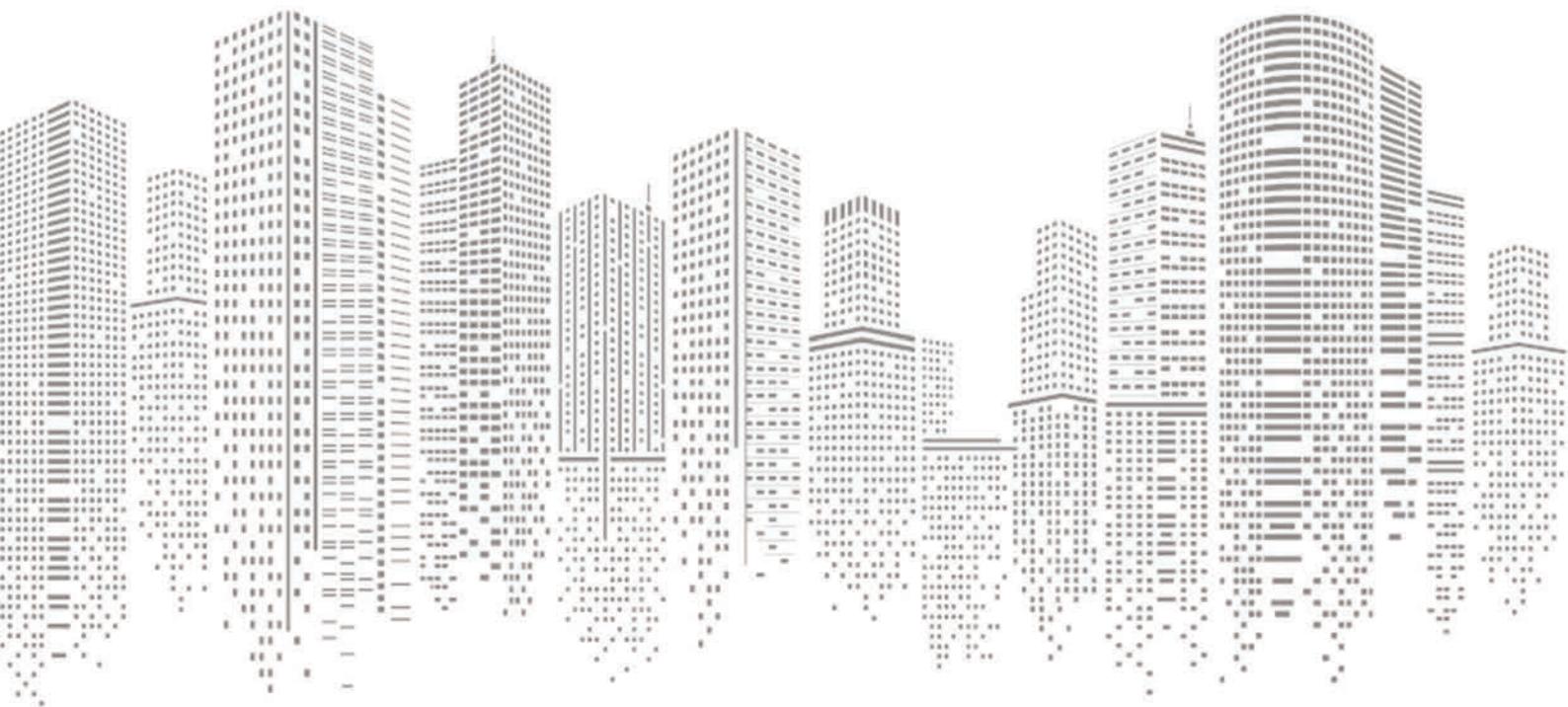
## 6. Deposition from Stakeholders

*“During the construction process, we saw the great importance your company attached to this project. During the critical period of construction, we faced many unfavorable factors such as repeated epidemics, site restrictions and complex surrounding environment. The leaders of your company visited the site many times to guide the work, actively coordinating all parties, solving technical problems and organizing the allocation of labor resources. At the same time, the entire project department rose to the challenge and brought into play the spirit of perseverance, thus successfully achieving the plan of theme topping. At the same time, in the face of the large number of professional subcontractors, your company fully demonstrated the management ability of the general contractor, actively coordinating and solving the problems of all parties, cooperating with us to put the work, and strictly controlling the quality and safety while following up the progress. It successfully passed the acceptance of the Structural Great Wall Cup and Green Safety Model Site, which is a benchmark for all participating units.”*

——China Eastern Airlines Co., Ltd., 15 July 2021

# COMMUNITY PAR- TICIPATION AND DEVELOPMENT

Community Participation and community development are both important components of sustainable development. To enhance the civic value of construction industry enterprises, enterprises should actively support their communities and contribute to community development. It mainly includes seven topics: community engagement, education and culture, job creation and skills development, technology development and access, wealth and income generation, health, and social investment.



# Actively Promote the Belt&Road Initiative, Build Model Project with Partner in Harmonious Way

❖ Yellow River Co., Ltd.

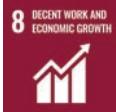
## Introduction

During the construction of the Kafue Gorge Lower Hydro-power Project, Yellow River Co., Ltd. wholeheartedly focused on technology innovation, quality management, green construction, and localized management. The company brought Zambia and the entire southern Africa clean energy and laid a good foundation for social and economic development there. The Kafue Gorge Lower Hydro-power Project is the “No.1 Project” of the cooperation between China and Zambia.





## SDGs

 Goal No.1	Increased energy supply in Zambia and provided a foundation for its economic growth.	 Goal No.4	Established a training school to provide for local residents high-quality education and job opportunities.
 Goal No.7	Constructed a hydro-power system to increase the supply of clean energy in southern Africa, and popularized the use of clean energy.	 Goal No.8	Emphasized localized management, providing numbers of job opportunities.
 Goal No.9	Facilitated the construction of safe and quality infrastructure, creating a power center for the power pool in southern Africa.	 Goal No.10	Released the energy shortage problem in southern Africa, bridging the regional development gap globally.
 Goal No.13	Developed renewable energy and reduced greenhouse gas emission.	 Goal No.15	Managed the project with detailed control and high sense of responsibility to ensure the implementation of low-carbon principle. Realized green construction in the process of construction.
 Goal No.17	Played a role in the Belt and Road Initiative, improving the cooperation between China and Africa.		

## CSR

	Fundamental Responsibility	<p>During the construction of the Kafue Gorge Lower Hydro-power Project, Yellow River Co., Ltd. focused on quality management and technology innovation to ensure safety in production and to carry out fundamental responsibility as a construction enterprise from various aspects.</p>		Labor Practices	<p>In the process of constructing the project, Yellow River Co., Ltd. established a training school for local workers to improve their construction, operation, and management skills. With better career development prospect and stricter safety requirements, every worker was offered proper career protection.</p>
	Environment	<p>Yellow River Co.,Ltd. adopted digital design, exploration modeling, and key technology of green construction, proposed green industry chain supply technology while developing and using clean energy to reduce the impact of the project on the environment, and promoted eco-friendly and green construction of the hydro-power projects.</p>		Community Participation and Development	<p>Besides project construction, the Yellow River Co.,Ltd. also actively participated in local public welfare activities and construction, providing public health materials for local people.</p>



## 1. Case Overview

As an important development strategy of China, the “Belt and Road Initiative” has played a major role in bridging the regional economy divide and promoting social harmony among related countries, which has made great differences in many areas of social production and life, including the power industry. Compared with the domestic power supply, which has met the needs, the relative backward regions in Africa are seriously inadequate in power supply. In order to adapt the “Belt and Road Initiative” to the international environment, Power Construction Corporation of China (POWERCHINA) has increased its efforts in developing the African regional market and signed a contract with the Zambian government for the Kafue Gorge Lower Hydropower Project. The project has been organized and implemented by Yellow River Co., Ltd. (the Company). Being acclaimed as a model project in the Belt and Road countries and the “No.1 Project” of cooperation between China and Zambia, the completed power plant was designed to increase the power supply capacity of Zambia by 38%, as the core power supply point to stabilize the power pool in southern Africa. It is a pillar of Zambia.

## 2. Case Background

As people pay more attention to energy, zero-pollution energy (hydroelectric power or wind power) is more and more popular, and it has been widely recognized by people for its renewability. In recent years, the technology development of domestic hydro resources utilization is changing rapidly, while some overseas developing regions with rich water resources have not been tapped into yet. Therefore, with the opportunity provided by the “Belt and Road Initiative”, the company successfully explored the market in Africa.

Yellow River Co., Ltd., formerly known as Yellow River Sanmenxia Engineering Bureau, was

established in 1955. It is the first mechanized hydropower construction team approved by the State Council after the founding of People’s Republic of China, and is known as the “cradle of hydropower in New China”. The company is now a wholly-owned subsidiary of POWERCHINA, and has the qualifications of national water conservancy and hydropower construction general contracting, construction construction general contracting, water conservancy industry design grade A, construction industry design grade A, municipal public works construction general contracting grade A, and import and export trade qualification. It is a state-owned large-scale integrated construction and operation enterprise integrating construction, survey and design, investment and financing, and trade services. The company entered the Zambian market in 1999 under the brand of China Hydropower of POWERCHINA, and the projects completed and under construction as of the end of 2014 involve hydropower stations, power transmission lines, roads and other fields. Zambia is an important partner of China in Africa. The country is rich in water resources, containing a power generation capacity of 6,000 MW, with an installed capacity of only 2,203 MW in 2014, which has a great potential for development.

In recent years, Africa’s emerging economies have significantly increased their investment in infrastructure development. The priority areas of action in the African Union’s 2012-2020 infrastructure development plan involve energy, transportation, water resources, communications, with a total estimated investment scale of \$67.9 billion, including energy investment of up to \$40.3 billion.

In May 2015, China proposed to take the Asian periphery and Africa as the main direction of cooperation in the near future, and promoted the “Going Global” of key industries such as railroad, electric power and construction machinery. Under this circumstance, Chinese enterprises were increasingly plunging into the African market and China Hydro

International, a subsidiary of POWERCHINA, signed a contract for the largest hydro-power plant in Zambia worth \$1.566 billion (about RMB 10 billion).

In addition to POWERCHINA, China Railway Construction Corporation Limited, China Energy Engineering Corporation Limited and other enterprises also participated in various projects in Africa. Recently, Chinese enterprises are accelerating their expansion overseas by way of outward investment and engineering contracting. According to official data, from January to October this year, China's foreign contract engineer business signed new contracts amounting to RMB 921.53 billion, showing an increase of 18.3% year-on-year.

Zambia has long faced power shortage, as only about 25% of the country's urban population and about 3% of the rural population have access to stable electricity supply. Meanwhile, considering the country's rich water resources, Zambian people has long been expecting to turn the water into electricity. The Kafue Gorge lower hydro-power plant, constructed by Power Construction Corporation of China (POWERCHINA), plan to install five mixed-flow generating units with a total installed capacity of 750 MW. After all five units are connected to the grid, it can increase Zambia's power supply capacity by about 38%.



Kafue Gorge Lower Hydropower Station (Dam)

### 3. Responsibility Actions

As the world's largest power construction group,

POWERCHINA has made rapid development in the international engineering field by actively responding to the “Belt and Road Initiative” and the strategy of “Going Global”. Since 2003, the Company has built the Taishir HPP Project in Mongolia, the Chalillo Hydroelectric Dam Plant and the Vaca Hydroelectric Facilities in Belize, the Chucas and St. Paul Hydroelectric Station in Costa Rica, the Patuca and Arena Hydro-power Station in Honduras. In 2015, it won the bid for the largest overseas EPC project in the company's history, the Kafue Gorge Lower Hydropower Station in Zambia. At present, three generating units have been put in use, and the installation of all units is expected to be completed by the end of 2022. The Kafue Gorge Lower Hydropower Station project in Zambia faces numbers of challenges such as optimization of scheme under environmental and space constraints, realization of fine green construction, building on thin industrial base and high operational risks. Related team has systematically researched key technologies, such as foundation forming adaptive excavation, overall reinforcement and stability evaluation of extra-high dams, through a comprehensive approach consisted of theory analysis, experimenting, numerical analysis, field production testing and monitoring feedback, and has achieved a series of original results.

#### (1) Apply compact layout by designing scientifically

Before the development of the project, the Company studied the limited conditions of the natural environment, rock conditions and the geographic location of the upstream and downstream reservoirs that might have ill effects on the dam site of the Kafue Gorge Lower Hydropower Station and the arrangement of the hydraulic structures. After that, the most suitable survey techniques were applied and a 3D geological model was constructed to ensure that the dam line, dam type, above-ground and underground hydraulic structures were accurate and adapted to the complex adverse geology.

The company developed the digital mapping and drawing process to generate the overall 3D realistic map and contour lines of the project area with the help of the automated processing tool of UAV plus aerial photography. The self-developed cell phone software that involves pre-planning, front-end acquisition, ItasCAD modeling, and engineering analysis obtained software copyright as it realized a fully electronic recording, combining field data collection with indoor data analysis and review and 3D mapping. The composition, amount and distribution range, and boundary of the reservoir area were all accurately revealed. Considerations also included the adverse impacts of geological bodies such as wedges, landslides, regional faults, and combined blocks on the safety and stability of the pivot building in the dam site area. With a comprehensive understanding of the spatial location and mechanical effects, guidelines on the adaptive arrangement of above-ground and underground hydraulic structures and compact layout methods were proposed. Specifically, the water inlet was arranged in a tributary of the Kafue River, the water diversion cavern was put along the ridge, the long diversion cavern was combined with ground plants (replacing the underground plant), and a long tail water cavern was used to achieve a compact arrangement. In this way, the coupling effect of adverse geological structures and hydraulic structure buildings was eliminated.

## (2) Strengthen localized management by training local workers

Dam construction faced many problems as it demanded highly specialized knowledge and large number of workers, while it was cooperating with a limited number of unskilled local constructors. In response to these situations, the Company have taken initiative to establish their own training school, facilitate school-enterprise cooperation, trained in line with the reality and standardized the teaching and training process. Workers finished training their courses can be issued a vocational

training certificate recognized by the Zambian Ministry of Education. Therefore, a large number of Zambian technical workers and management personnel can be prepared to fit in the positions provided by the Kafue Gorge Lower Hydropower Station. Since the establishment of the training school, a total of 6 classes have been held and 328 local employees have been trained.



Training school inaugurated by On-site worker training Zambian President



On-site worker training

## (3) Ensure the project quality by intensifying inspection

During the project, local workers and local college students were responsible for most construction and on-site management. The number of Chinese personnel during the peak construction period was 583, while the peak number of local employees was 4,262. The total number of local college students and management personnel was about 126, accounting for about 1/30 of the total number of local employees. Female employees accounted for

1/40 of the total number of local employees.

Local staff gradually mastered the key points of construction and site management through continuous training, so they directly participated in meetings with the owner and consulting engineers, so as to ensure that the construction is regulated according to the requirements and to pay close attention to the construction quality of the project.

The project adopts British Standard, American Standard and other specifications, classifying constructions according to materials such as cement, fly ash, aggregate, external admixture and RCC. Test specifications included BS EN 196: Methods of testing cement, BS-197: Composition, specifications and conformity criteria for common cements, ASTM C 204-00: Standard Test Method for Fineness of Hydraulic Cement by Air-Permeability Apparatus, ASTM C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete1, etc. Compacted concrete construction specifications included BS EN 480-1,12350-7: Admixtures for concrete, mortar and grout-test methods part1. Reference concrete and reference mortar for testing, ASTM C1170/ C1170M: Standard Test Methods for Determining Consistency and Density of Roller-Compacted Concrete Using a Vibrating Table, ASTM C566: Standard Test Method for Total Evaporable Moisture Content, etc. The above specifications were all used to strictly control the project quality, among which the quality of metamorphic concrete construction was especially well controlled: the excellent quality rate of metamorphic concrete of RCC dam was improved, which

won the first prize of Henan Engineering Construction Association in 2021 through QC activities; the quality rate of metamorphic concrete of the dam was improved, which also won the third prize of China Construction Enterprise Management Association in 2021.

After the dam was impounded, Malcolm Dunstan, winner of the International Committee on Dams Lifetime Achievement Award and an international expert in RCC, gave high recognition to the quality of the dam. He said that the quality of the compacted concrete construction of the dam was excellent and reached the international leading level.



International RCC expert inspecting project quality

(4) Create a international brand by improving the consciousness of contract

POWERCHINA and YELLOW RIVER CO.,LTD. has been committed to the service of Kafue Hydropower Station in Zambia, to achieve the goals of contract management, schedule management, quality management and safety management, and to improve the performance mechanism as a way of enhancing corporate reputation and promoting the sustainable and healthy development of the project.

Contract management: As soon as the contract was signed, experts were organized to make analysis and evaluation, then to formulate specific measures for the risks in the contract, subsequently to decompose the contract and emphasize risks to be



Honor certificates

paid attention to during the construction process. Experts also reported relevant information to consulting engineers and the owner in a timely manner as the basis for risk control in the process.

**Schedule management:** The total project schedule was formulated before the start of construction, so that important node targets are determined, detailed the schedule to annual, quarterly and monthly level. Each month, the related team have been analyzing the completion of the monthly plan, and necessary catch-up measures have been taken for the schedule lagging behind to ensure the schedule is controllable.

**Quality management:** Attention was placed on key control parts and processes in project construction; quality plan was formulated before the start of construction; according to that, quality control measures were planned before the start of each individual project, including quality key points, control parts and testing frequency, etc; monthly quality inspection was carried out, and requirements that needed to be met quickly were issued in the form of quality rectification notices for problems arose during the inspection; the principles of “first piece approval” and “sample first” were implemented for prefabricated parts, concrete construction, steel structure and other products’ processing procedure to ensure reliable construction quality.

**Safety management:** Related team identified and evaluated safety risks and major hazards of the project before the start of construction, and have constantly updated and supplemented safety risks and hazards as the project progressed. During the construction period, safety inspection was conducted once a month and a monthly discussion on problems was held to ensure the effectiveness of safety measures through the project. Additionally, there was a safety production responsibility system including an administrative management system charged by the project manager, a technical support system charged by the chief engineer, a

production implementation system charged by the production manager and a production supervision system charged by the safety director. The full coverage of the responsibility system has ensured the safe production of the project.

At the same time, it fulfilled its social responsibility as a central state-owned enterprise, actively



The scene of a ceremony to donate anti-cholera supplies to the Zambian government



The project department donated epidemic prevention materials to the Chikankata District Health Department



participated in local public welfare activities and construction, and established a good image, so that the brand of POWERCHINA was again recognized by the local government in Zambia. Enhancing the popularity of POWERCHINA in Zambia and the African region, the cooperation saw large development potential there.

#### 4. Effect of Responsibility Fulfillment

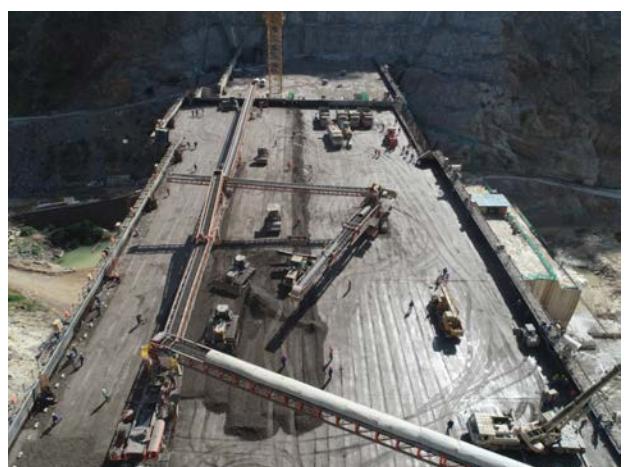
##### (1) Solve key technology problems to deepen technology innovation

The project development faced challenges such as restricted space and environment, complex regional environment, limited resource supply, weak industrial infrastructure and high operational risks. Therefore, comprehensive tools were used, namely, aerial survey, theoretical analysis, indoor tests, numerical analysis, field production tests and monitoring feedback. Constructing in such environmentally and spatially limited condition, hub construction were systematically studied from various aspects such as accurate survey, dynamic design, construction equipment process innovation, green and refined construction, etc. A series of innovative results have been obtained as follows:

① Strict planning and flexible design. With the most advanced scientific results as the basis for project implementation, the design of the powerstation was precise, scientific, optimal and environmental friendly: the accurate engineering design based on 3D geological model was supported by the comprehensive technology of accurate survey combined with aerial survey and in-situ test by UAV; the design of adaptive treatment of typical unfavorable geological structure in restricted space was instructed by the damage mechanics law and parameters of gneiss body; the dynamic optimization design method was supported by the design guidelines, based on engineering stability, for the control of rock stability in the site area and

the adaptive arrangement of hydraulic buildings, and was supported by the evaluation and acceptance criteria for the dynamic optimization design of rock excavation and reinforcement under space and environmental constraints; the RCC material with ultra-long age and high fly ash mixture was developed to save cost and optimize the design of temperature-controlled anti-cracking measures.

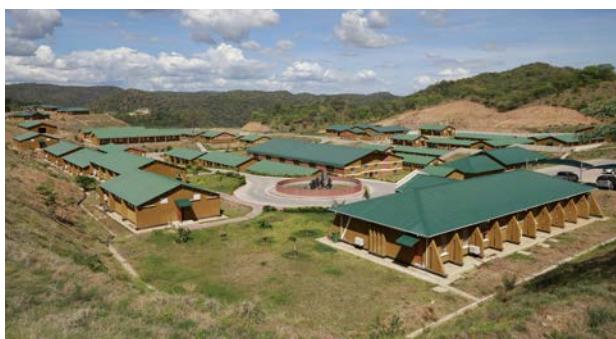
② Innovative methods and optimal arrangement. With the most reliable technology as the guarantee for project implementation, the construction realized fast, efficient and quality construction of hydropower hubs: In order to lay the foundation for fast and high quality dam construction of RCC, the new structures such as full-face quasi-three-graded dam partition and rectangular dam body corridor with performance were applied, the criteria for examining and handling the cracks of the crushed layer based on the maturity analysis were proposed, and the treatment method and process of cement paste in intermittent layer were developed. The technology of mechanized adaptation of belt conveyor was developed, which enabled the machine to work in high efficiency to convey, place and continuous raise bins, which realized the high efficiency of fast entry of RCC and full belt transportation and placing. The process of adding slurry to the bottom of metamorphic concrete and the quality assessment method were innovated, which



The technology of continuous bin raising belt conveyor system

ensured the construction quality and great appearance of metamorphic concrete. Moreover, the innovative design and construction of a 2000m<sup>2</sup> level pressure regulating well became the world's largest span pressure regulating well.

③ Low-carbon principle and precise control. With the most responsible management concept as a guide for the implementation of the project, the construction team has achieved ecological and environmental protection and green construction of hydropower engineering: The adaptive treatment method targeting at minimizing the impact of typical unfavorable geological structure reflected the saving concept of less excavation and less disturbance; the key green construction technology of strong protection, less excavation and more utilization made it possible to shorten the construction period while guaranteeing the quality of the project; the key technology of using pressure regulating wells to precisely control construction realized the fast and high-quality construction of “seven holes with one well”; the green and refined zoning, transportation and filtering technology realized the low-carbon production of aggregates in view of the constraint relationship between sand and gravel aggregate supply and quarry mining construction; the green industry chain supply technology created a green camp combining “construction and transportation”.



Green camp of the project department

The achievements of the project's scientific and technological innovation are as follows: As a model project of “the Belt and Road”, the Kafue

Gorge Lower Hydropower Station project's key technology of the quality and efficient RCC dam was awarded the first prize by POWERCHINA in 2021 and the second prize by China Construction Enterprise Management Association. The Model Project's technology of rock utilization in restricted space won the second prize of Chinese Society for Rock Mechanics and Engineering in 2021. The quality and efficient dam construction technology of Kafue Gorge Lower Dam in Zambia won the first prize of POWERCHINA Mass Innovation and Efficiency Achievement in 2021. The whole working team gained three national patents authorization, and twelve national utility model patents authorization. The project camp was awarded the title of Outstanding Camp of China Overseas Engineering in 2018.

(2) Complete construction efficiently to improve local living condition

In July 2021, the first generation unit was successfully connected to the grid under the design and construction joint venture model of the Yellow River Co.,Ltd., a subsidiary of POWERCHINA, and Northwest Engineering Cooperation Limited. As the largest hydro-power plant in Zambia, the project has been in the limelight since the day the contract was signed. During the construction period, reports from foreign famous media and various Chinese mainstream media such as CCTV, China Daily, CCTV-4, CCTV-13, Dragon Television and Phoenix TV, gave positive comments on the project construction.



Close shot of the dam



Close shot of the construction site

Through the construction and implementation of the project, the popularity of POWERCHINA in the African market has been greatly enhanced, strengthening its market competitiveness, and at the same time promoting Zambia's economic growth. During the implementation of the project, it created more than 20,000 jobs for local workers, trained a number of excellent technical workers, drove the national export of 1.15 billion yuan, increased the power supply capacity of Zambia by 38%, guaranteed power supply in Southern Africa by building the power plant a national pillar.

The President of Zambia spoke highly of "The Belt and Road Initiative" and the contribution of POWERCHINA in the implementation of the project. Chinese Ambassador to Zambia, Li Jie, expressed his hope that the Chinese and Zambian builders would insist on both production and epidemic prevention to promote the full handover of the project and create another model of practical cooperation between the two countries. The Times of Zambia highly praised Chinese effort for improving the survival skills of Zambian youth, and



Reports in the Times of Zambia

it featured the results of China Hydropower Training Institute established in Zambia.



Ribbon-cutting ceremony of the first generating unit (Zambian President and Chinese Ambassador to Zambia)

## 5. Future Outlook

In recent years, the pace of hydropower development has been steady and the resilience has been increasing. Hydropower generation does not consume fossil fuels, so the development of hydropower is conducive to reducing greenhouse gas emissions, protecting the ecological environment, optimizing the use of resources, and improving the comprehensive interests of the economy and society. In the context of carbon neutrality, the development prospects of the hydropower industry remain positive in the long term. Hydropower is not only a clean energy source, producing neither carbon emissions nor pollution, but also a renewable energy source, which is friendly to the environment and can also participate in carbon emission peak regulation. Hydropower is one of the best sources of power to achieve carbon neutrality. In the long run, hydropower will continue to play an important role in promoting the goal of "carbon peaking and carbon neutrality goals".

Targeting the problem that the southern region of Africa has abundant water resources but insufficient development capacity, POWERCHINA and the YELLOW RIVER CO.,LTD. will further explore the market. The Julius Nyerere Hydropower



Project in Tanzania, which is currently under construction, was signed as a “Belt and Road” project, and the first unit is scheduled to generate electricity in 2023. The company hopes to seize the opportunity of this project to further enhance its market competitiveness and develop more clean, non-polluting, low-carbon and environmentally friendly hydropower projects. Meanwhile, the company is following up on the largest hydropower station on Victoria Falls at the border of Zambia and Zimbabwe and the Lesotho Hydropower Station in South Africa. These have achieved preliminary intention to cooperate and are waiting for the clients’ further plan.

Hydropower is one of the best energy sources to achieve carbon neutrality. Giving full play to the positive role of hydropower in “carbon peaking and carbon neutrality goals”, especially integrating artificial intelligence, big data, cloud computing, industrial Internet and other technologies into

the whole industrial chain of hydropower energy development, production, transportation and use, can not only improve the management capacity and power generation efficiency, help enterprises improve efficiency and reduce costs, but also has important value in promoting energy transformation and accelerating the achievement of carbon neutrality.

The company has collected data and experience on the construction, management, operation and maintenance of projects built and under construction overseas. Statistics of every aspect have been compiled and continuously updated, including the geographical location, climate type, concrete mix, construction period, contract mode, applicable standards, norms, internal quotas, consumables standards, construction quality, and safety of the projects under construction. The data have been uploaded to the company’s knowledge system for overseas projects to review and learn from.

## 6. Deposition from Stakeholders

*“The Chinese company have completed an important and great project,” Zambian President Edgar Lungu spoke at a ceremony to connect the first units of the project to the grid. “The successful generation of electricity from the Kafue Gorge Lower Hydropower Station is a turning point in Zambia’s quest to become a net exporter of electricity to the SADC region.” He stressed that the hydropower plant is not only an important driver of the country’s industrialization, but will also play an important role in Zambia’s economic recovery in the post-pandemic period.*

——Zambian President Edgar Lungu

# Attachment: Enterprise Related Information



Company Name: Yellow River Co., Ltd.

Company Location: Zhengzhou, Henan Province

Company Website: <http://www.cwb11.com/>

## Company Profile

Yellow River Co., Ltd. (referred to as “the Company”), formerly known as Yellow River Sanmenxia Engineering Bureau, was established in 1955. It is the first mechanized hydro-power construction team approved by the State Council after the founding of People’s Republic of China, and is known as the “cradle of hydro-power in New China”. The company is now a wholly-owned subsidiary of Power Construction Corporation of China (POWERCHINA), with special qualifications of national water conservancy and hydro-power construction general contracting and building construction general contracting, Grade A qualifications of water conservancy industry design and construction industry design, Grade 3 of general contracting on municipal public utility construction engineering, and qualification of import and export trade. It is a state-owned large-scale comprehensive construction and operation enterprise integrating construction, survey design, investment and financing, and trade services.

The Company deepens market-oriented reform continuously, and has developed relatively strong ability of comprehensive management and construction. At present, the company, in China, has 21 functional departments, 7 regional marketing agencies, 13 construction branches, 5 trade service units and 13 holding subsidiaries. Abroad, it has 2 overseas branch bureau, 1 regional headquarters, 5 branches and 3 regional management departments.

The registered capital of the Company is 2.6 billion yuan, and annual business revenue is nearly 30 billion yuan. With nearly 18,000 sets of supporting equipment, the Company’s annual completion reaches 70 million cubic meters of earthwork, 5 million cubic meters of concrete, 50,000 linear meters of tunnels, 25,000 tons of metal structure fabrication and installation, 1.2 million KW of generator set installation, and 3.7 million square meters of housing construction. The company has more than 9,000 employees in service, including more than 390 with master’s degree, more than 5,400 with bachelor’s degree or above, more than 3,100 with intermediate or above titles, and more than 470 registered first-class builders.

Over the past six decades, the Company has completed a large number of influential engineering and construction projects all over the world.

At home, it has constructed and participated in more than 100 national key large-scale water conservancy and hydropower, municipal, industrial and civil construction and road and bridge projects. Hydropower projects were located in Yellow River Sanmenxia, Luohe Guxian, Yellow River Xiaolangdi, Yangtze River Three Gorges, Yellow River Rasiwa, Shanghai Taipu River, Yalong River Jinping and Guandi. Other projects included Huai'an Interchange Ground Culvert, South-to-North Water Diversion, Beijing-Shanghai High-speed Railway, Wushao Expressway, etc. In recent years, the company has taken the initiative to participate in major national strategies such as the construction



of Guangdong-Hong Kong-Macao Greater Bay Area, the ecological protection and high-quality development of the Yellow River Basin, the development of Xiong'an New Area and the Yangtze River Ecological Protection. To further promoting business restructuring and accelerating the pace of transformation and upgrading, the Company has made achievements in all aspects including municipalities, rail transportation, water environment management, pumped storage power plants, housing construction, new energy, green mines and assembled buildings. It has also mastered various business models and operation strategies such as EPC and PPP, gaining the comprehensive management ability to master large and complex projects. The company also contracted the construction of municipal projects of Zhengzhou Third-Ring Road, Longhai Road, Nongye Road, No. 107 Auxiliary Road and the South Forth-Ring road; rail transit projects of Shenzhen Metro Line 7, Line 10 and Line 12, Wuhan Metro Line 11, Changsha Metro Line 4 and Line 6, Zhengzhou Metro Line 5 and Line 8, Luoyang Metro Line 1 and Line 2, Xi'an Metro Line 1; water environment management projects such as the comprehensive improvement of the water environment in the Maozhou River basin in Shenzhen, the comprehensive improvement of the Jialu River in Zhengzhou, the comprehensive improvement of the Sanli River in Nanyang, and the pollution treatment and ecological restoration of the Tang River sewage reservoir in Xiongan New Area; large pumped storage power plant projects such as Dunhua in Jilin, Tianchi in Nanyang, Funing in Hebei, Wuyue in Henan, etc; housing construction projects such as the new campus of Sanmenxia Vocational and Technical College, Shenyang Taifu Science and Technology Building (Lot 04), and Mianchi shantytown reconstruction and resettlement community; housing construction projects such as the Xishan Wind Farm (49.5MW) project in Beipiao, Liaoning Province, the wind power project in Gaochuan, Guangxi Province, the biomass gas production

project in Yifeng, Lankao City, and the domestic waste incineration and power generation project in Luohu City. Other achievements included the significant breakthroughs in the assembly-type construction industry and green sand and gravel, the mining rights obtained in Dongshan, Yanshui, Henan Province, and the success in being included in the industrial base of prefabricated construction in Henan Province.

Overseas, the Company, which established YELLOWRIVER as independent brand to deal with five major international professional business, is one of the first subsidiaries of POWERCHIN that have participated in international business and have developed a higher degree of internationalization, accumulating strong competitiveness and influence in the international market. The company has been accelerating the pace of "Going Global", actively practicing the "Belt and Road Initiative". Based on bidding projects, the Company has kept participating in the construction of overseas projects using various business models such as F+EPC, seller's credit+accounts receivables factoring, and investment-driven EPC. The international projects have helped more than 30 countries and regions in Asia, Africa and America, and have completed overseas projects such as the expansion project of Kariba North Bank Hydropower Station in Zambia, Dikgohun Dam in Botswana, New Cabrera Power Plant in Venezuela, expansion project of Kariba South Bank Hydropower Station in Zimbabwe, Jombe Dara Hydropower Station in Angola, I63 Highway in Bolivia, and road project clusters in Ethiopia and Tanzania. Large projects, whose contract value exceeds ten billion yuan, under construction are Kafue Gorge Lower Hydropower Station in Zambia, Tanzania Hydropower Station, Elsia Highway, São Paulo Subway in Brazil, concerning many fields such as water conservancy and hydropower, energy and electricity, highway engineering, municipal engineering, housing construction, comprehensive agricultural development

and new energy.

At the same time, the Company's business service industry has become a powerful supplement to the construction industry and an important acting point of innovative development, with outstanding characteristics and diversified development in the electric construction system. The business involves real estate development, health care, retail trade, material trade, railroad transportation, food processing, hotel catering and training and education industries, employing more than 1,800 people. Business outlets mainly located in and out of China, especially in the Golden Triangle of the Yellow River of Shanxi, Shaanxi and Henan Provinces, Sanmenxia city and surrounding counties (cities and districts). The brand influence and credibility of Yellow River Hospital (Grade IIIA), Dayu Real Estate, Millennium and Sanlong have been increasing.

With strong technical force and excellent product quality, the Company has obtained national high-tech enterprise and quality, environment and occupational health and safety management system certification. It has international leading technologies of long-distance urban underpass tunnel construction in complex environment, large diameter buried regulator well construction, saturated land layer tunnel construction, extra-strong karst ultra-deep curtain grouting, large channel construction, infiltration type concrete film forming protection, water-based epoxy mortar development and application; national leading technologies of the concrete dam and the panel rockfill dam construction, urban elevated expressway construction, urban river water environment comprehensive management; national advanced technologies of urban subway construction, urban pipe network and pipe jacking construction, hydroelectric turbine and large metal structure installation. It also has the full capability of designing, manufacturing, installation, testing pressure steel pipe, arc gate and pressure vessel. Its working teams have

won national and provincial awards for major construction technology achievements in such projects as high velocity sand-carrying surface treatment, RCC rapid dam construction, dam foundation chemical grouting, extra strong karst area dam foundation seepage control treatment, underwater cofferdam blasting and demolition in complex environment, waveform steel web PC composite beam jacking construction, international engineering hydropower construction, application research of road, bridge and harbor and navigation technology standards, mechanized lining of large channels, deep shaft excavation and support, NE anti-abrasion and repair materials development and application. The Company has obtained 124 national invention patents, 589 utility model patents, 3 design patents, 27 software copyrights, 123 provincial and ministerial science and technology progress awards, 9 national work methods, 601 provincial and ministerial work methods; projects the Company has contracted or participated has won 7 Luban Awards, 8 Zhan Tianyou Awards, 14 national quality engineering awards, 5 Dayu Awards, 4 "100 classic and high-quality projects" in 60th anniversary of the founding of New China, 4 new records of national enterprises, and 1 major innovation project of Chinese enterprises.

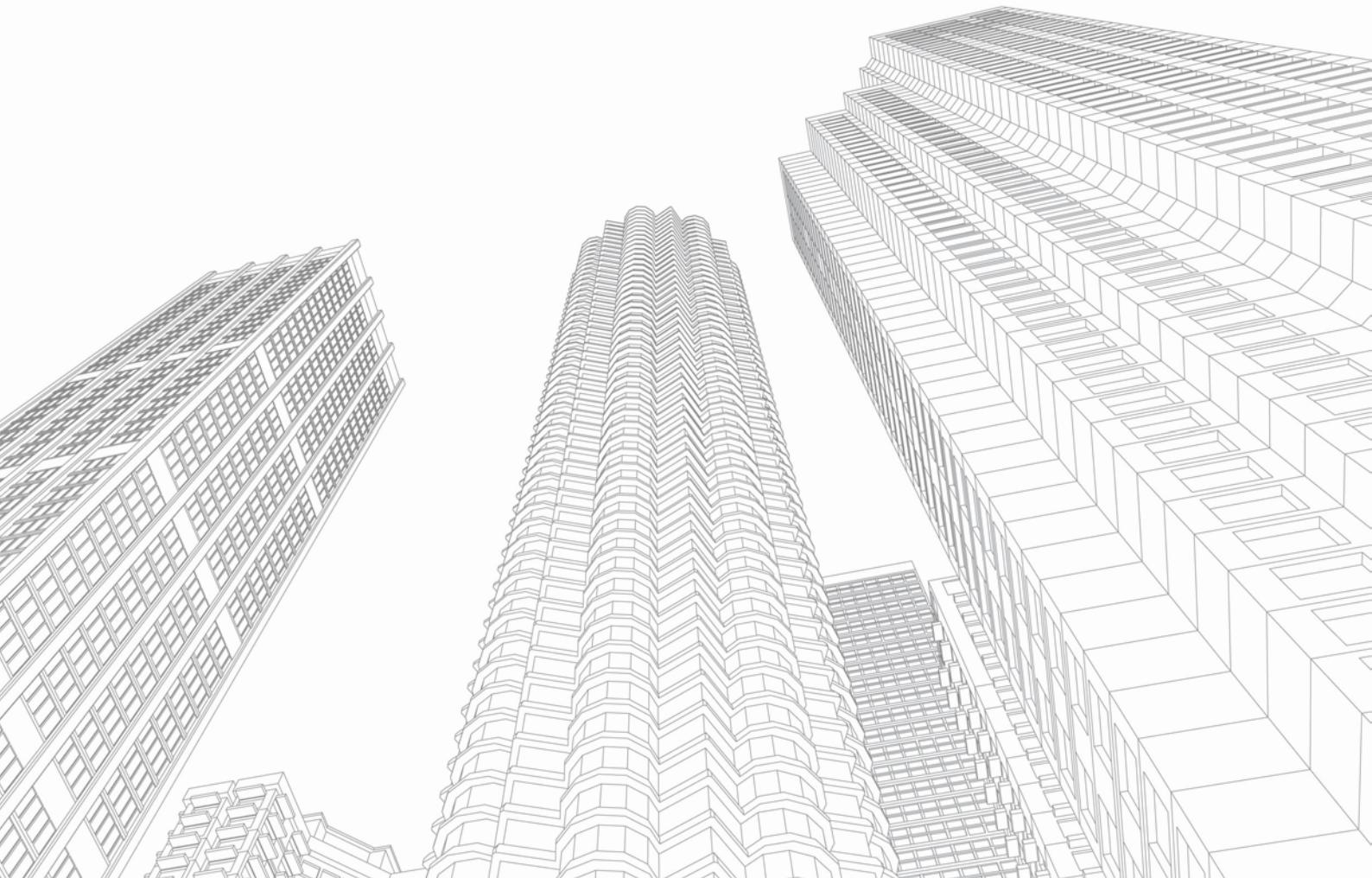
With its strong strength and excellent corporate culture, the Company has won wide acclaim from the society. The company is ranked among the top 500 in China's construction industry, and is a special grade enterprise of China Electric Power Construction Corporation, ranking 18th among the "Top 100 Enterprises" in Henan. It has been awarded as National Civilized Unit, National Advanced Enterprise in Construction Industry, National Excellent Construction Enterprise, National Excellent Enterprise in Electric Power Construction, National "Contract-keeping and Credit-keeping" Enterprise, National Federation of Trade Unions "May Day" Labor Certificate, Advanced Unit in China's Spiritual Civilization Construction, National The company has been honored as a



model unit of enterprise culture construction and an advanced grass-roots party organization of central enterprises. The company's social influence and market competitiveness have been increasing.

Looking into the future, Yellow River Co., Ltd. will seize the opportunities of the times, stand on the tide of development, always uphold the development concept of "innovation, coordination, green, openness and sharing" and the enterprise spirit of "self-improvement and surpassing", vig-

orously implement the "enterprise multiplication plan", strive to promote the "50 billion scale, 100 billion market, 10 billion net assets" strategic objectives, adhere to the fine construction, quality and far-reaching, actively fulfill social responsibility, strive to create value, give back to society, and forge ahead to build the company into a "leading electric construction, industry first-class, employee happiness" comprehensive construction and operation service provider.



## Corporate Culture



Corporate vision

To build a comprehensive construction operation service provider with “first-class electric construction, leading industry position, and happy employees”

Corporate mission

Develop clean energy, protect the environment and contribute to building smart cities

Corporate spirit

Never stop self-improvement, with the courage to go beyond

Team spirit

Inheriting Da Yu’s spirit and never stop making progresses

Corporate value

Responsibility, innovation, honesty and win-win results

Operation purpose

Honesty and trustworthiness create first-class projects

Corporate social responsibilities

Benefit the society with a stronger company

Team culture

Love the country, be loyal to the enterprise, work hard together to make more achievements

Contract fulfillment concept

honest, safe, sticking to regulations, high-quality

Operation principle

Keep promise, continue innovation, lead in technology, conduct win-win cooperation



## Major honors in the Past Three Years



Pakistan PKM project (Sukkur to Multan section) won the National Gold Award for Quality Engineering in 2020-2021



Yalong River Jinping Grade I and II Hydro-power Station Project Won 2018-2019 National Gold Award for Quality Engineering



Zhengzhou 107 auxiliary road fastening PPP project 1-5 standard bridge project won the 2018-2019 National Quality Engineering Award



2019 Wuhan City Rail Transit Line 11 East part (Guanggu Lake Station - Zuoling Station) won the 2018-2019 National Quality Engineering Award



2019 Longhai Expressway Project won 2018-2019 National Quality Engineering Award



2019 Zhengzhou 107 auxiliary road fastening PPP project 1-5 standard bridge project won "China Steel Structure Golden Award"



South Third Ring Road East Extension Project (Nantai Road to 107 Counseling) Construction Project won 2018-2019 China Construction Engineering Luban Award



Bridge Engineering of the North Third Ring Road (Nanyang Road - Zhongzhou Avenue) BT Project in Zhengzhou won the 2016-2017 National Quality Engineering Award



The project of reforming Xuzhai Village, a village in city, and contiguous area won “National Construction Safety Standardization Site for Construction Projects” in 2019



Yellow River Sanmenxia Hospital was awarded “Women’s Civilized Post” in 2021



Won the title of “National Civilization Unit” in 2020



Won the title of “Advanced Group of Henan Province against the New Crown Pneumonia Epidemic” in 2020

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	million yuan	23,397	25,831	29,649
Operating Income	million yuan	23,566	23,920	22,980
Total Profits	million yuan	723	627	848

# Turn Advantage in Resource into Prosperity of the Countryside

◇ China Huashi Enterprises Company Limited

## Introduction

China Huashi Enterprises Company Limited (Huashi), an state-owned enterprise, proactively takes up the responsibility of assisting poverty alleviation and rural revitalization. It has made full use of its advantage, using the driving effect of state-owned capital to inject new impetus into rural development. It has also ensured that people share the fruit of development by facilitating Jiuzhaigou County develop rural industry, cultivate talent, improve employment, increase consumption, transform tradition, form culture, protect the environment and build basic-level organization.



## SDGs

 <p>Goal No.1</p>	<p>China Huashi fully helped Jiuzhaigou County and Yangpo Village, Gyunlian County and Shuanghe Village and Wuling Village to alleviate poverty, and actively participated in the targeted poverty alleviation work in E'bian, Muchuan, Zhaojue, Huidong and Luhuo county as well as Zhongjiang Honghua Village and E'bian Gujing Village to help poor people increase their income and get rid of poverty.</p>	 <p>Goal No.8</p>	<p>Actively implemented the principle of poverty alleviation through employment, providing jobs to people in difficulty.</p>
 <p>Goal No.10</p>	<p>Actively promoted rural revitalization, helped rural development, and reduced the imbalance between urban and rural development.</p>	 <p>Goal No.17</p>	<p>Deeply cooperated with local Alizhai Rural Tourism Cooperative and Jiuzhaigou County Mineral Water Company Limited to jointly promote poverty alleviation and rural revitalization.</p>

## CSR

 <p>Community Participation and Development</p>	<p>It has made full use of its advantage to facilitate Jiuzhaigou County develop rural industry, cultivate talent, improve employment, increase consumption, transform tradition, form culture, protect the environment and build basic-level organization. These all-round efforts has promote local economic growth and people's well-being.</p>		
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## 1. Case Overview

Rural revitalization strategy is a strategy proposed by President Xi Jinping in the report of the 19th National Congress of the Communist Party of China on October 18, 2017. According to the report, the issues of agriculture, rural areas and farmers are fundamental as they are related to people's livelihood, and we must always take solving the "problems concerning agriculture, rural areas and peasants" as the top priority of the work of the whole party and implement the rural revitalization strategy.

As a key provincial state-run enterprise, China Huashi Enterprises Company Limited has always proactively taken up the state-owned company's social responsibility of assisting poverty alleviation and rural revitalization. It has made full use of its advantage, using the driving effect of state-owned capital to inject new impetus into rural development. It has also ensured that all people share the fruit of development and live a quality happy life.

## 2. Case Background

At present, China has realized the first centenary goal as it has built a moderately prosperous society in all aspects. China is starting a new journey of building a modern socialist country in all aspects and is marching towards the second centenary goal. The implementation of rural revitalization strategy is a major decision made by the 19th Party Congress, a major historical task to secure the victory in building a well-off society and a great modern socialist country, and the general acting point of solving the "problems concerning agriculture, rural areas and farmers" in the new era. Without the modernization of agriculture and rural areas, there will be no modernization of the whole country. In the process of modernization, how to deal with the relationship between workers and farmers and the one between urban and rural area,

determines the success or failure of modernization to a certain extent. President Xi Jinping pointed out that without the modernization of agriculture, without the prosperity and strength of the countryside, without farmers living and working in peace and happiness, the modernization of the country would be incomplete, incomprehensive and unstable.

The strategy of rural revitalization is a major strategic plan to fundamentally solve the imbalance between urban and rural development and achieve national prosperity and people's happiness, which is of great historical significance to comprehensively build a socialist modern country and to achieve the second centenary goal. As an operating body that implements the development strategy of the Party and the country and leads the direction of industrial development, state-owned enterprises, including China Huashi, have accumulated a lot of working experiences and methods in the past poverty alleviation actions.

## 3. Responsibility Actions

As a large state-owned enterprise in Sichuan province, Huashi has conscientiously implemented the decision and deployment of the provincial party committee, the provincial government and the provincial State-owned Assets Supervision and Administration Commission on "consolidating and expanding the achievements of poverty alleviation and rural revitalization". The "1355" strategy, with "one Party lead", "three principles", "five aspects" and "five revitalizations", has been devised to facilitate Jiuzhaigou county to develop rural industry, talent, employment, consumption, tradition transformation, culture, ecology and basic-level organization. In recent years, the company has further improved the infrastructure, widened the channels of income generation and further stimulated the vitality of the Sizhai village in Nanping Town, Jiuzhaigou County.

(1) Upholding the leadership of the Party throughout the whole working process.

Huashi has improved the rural revitalization work system which is coordinated by the Party Committee, charged by the leading department, and supervised by each unit. The company has formed a leading group of rural revitalization work with Party Secretary and Chairman Yang Bin as the leader, formulated the five-year plan of rural revitalization and the annual work plan of assistance, and ensured that 21 units under it established the corresponding work leading group and relative personnel to take up responsibility. As the one in charge, Comrade Yang Bin himself presided over the study of rural revitalization work, repeatedly leading teams to do research and hold talks with Luo Zhibo, the then secretary of Jiuzhaigou County. They conducted in-depth communication and exchanged ideas on Jiuzhaigou County's effective transition from consolidating poverty alleviation to rural revitalization, post-disaster reconstruction, and construction of cultural and tourism projects, forming a working mechanism and making efforts to promote its implementation. The enterprise divisional leaders and specific comrades in charge have insisted on holding quarterly special meetings to study the work of Sizhai Village in Jiuzhaigou County, and have been there to promote rural revitalization on the ground, studying and deploying qualified personnel, planning arrangement and granting funds. The main leaders, sub-leaders and heads of basic-level units of the enterprise took the initiative to deliver one-to-one help to the households in Sizhai Village that are prone to return to poverty, and selected cadres in the village to carry out rural revitalization work in an off-duty way. At the same time, a Party construction steering group was selected and stationed in the village to carry out activities such as "I do practical things for the masses", "three meetings and one class", themed Party days, organizational life meetings, democratic evaluation of Party members and Party history lectures. The Party also coordinates to solve the

"urgent, difficult, worrisome and expected" problems of the local people, such as epidemic prevention and medical care, schooling of children, marketing of products, planting and cultivation, culture and entertainment.

(2) Following three principles to improve sustainable development

① According to the principle of "seeking truth from the facts", the company sought the right acting plan in consideration of its own advantage. Huashi is in a labor-intensive construction industry and is good at engineering construction. Taking into account the resource endowment of Jiuzhaigou County and the enterprise's own advantages, Huashi has made full use of the situation to promote employment assistance work. Through Jiuzhaigou infrastructure construction, key project construction and Baihetan hydropower station and series of other projects, employment assistance has helped more than 2,100 people and increased their income by more than 88.2 million yuan. While realizing employment assistance, it has laid the foundation for Jiuzhaigou's infrastructure construction, landscape creation and industrial workers' team development.

② According to the principle of "adjusting measures to local conditions", the company adjusted the construction to local conditions. Around the goal of Jiuzhaigou County to build a national demonstration zone of all-area tourism development, Huashi will support and drive the development of special agricultural tourism and cultural tourism, as an important engine of rural revitalization. The company has fully participated in the transformation of infrastructure along the street, assisting in creating green landscape, micro landscape, night landscape and other sightseeing projects, and has completed the greening and landscape construction area of 106,500 square meters, constructed seven bridges, helped to create the Xiang Yun logo in Yunyue Square, "red flag" land-

scape sculpture, Xiang Yun Bridge, 28th Avenue and many other popular online punch-in sites.

③ According to the principle of “innovating assisting methods”, the company innovated financial tools to better support rural revitalization. Huashi financially assisted local Jiuzhaigou Ali rural tourism cooperative with debt investment and other financial tools to help funds achieve the purpose of preserving value. The new financial support mode has not only ensured the supervision and management of the support funds, but also made the support funds the new source for sustainable income increase.

(3) Acting on five aspects to achieve rural revitalization from all areas

① In-depth cooperation promotes industrial development. Huashi carried out in-depth cooperation with Jiuzhaigou County Mineral Water Co., Ltd. to create branded marketing and design customized cooperation projects. Together they have continuously cultivated and developed collective economy, introduced nice species of pepper, organized labor competitions and other ways to boost the diversified development of the village economy. They are now actively exploring the establishment of an apple plantation industrial park.

② Strengthened social security system consolidates poverty alleviation achievements. Huashi and Jiuzhaigou County jointly invested three million yuan to establish a special fund for preventing poverty-returning, which has been used to help households that are unstable in getting out of poverty, marginal households prone to poverty and households that may return to poverty due to epidemics or other reasons. By setting up public welfare positions such as janitorial and cleaning jobs in the projects under construction, priority has been given to helping local people to realize employment.

③ Comprehensive advertisement assists poverty

alleviation through consumption. Huashi replaced donations with purchase and targeted procurement. The company intuitively uses the two major e-commerce farmer-friendly platforms, “Huashi Yun Cai” and “Jiuzhai Yun Gou”, and continues to promote the special agricultural products throughout the year. The “localized procurement and leasing” has promoted sales of local hardware, building materials, cement and other products, increasing local income by more than 5 million yuan.

④ Training talents increases the choices of making money. Relying on Jiuzhaigou County’s ongoing projects, Huashi carried out practical technology and vocational skills training for rural construction workers, trained Party members to take the lead in getting rich and started family farms. The company cultivated rural e-commerce talents, organizing training on electric business operation, online live broadcast and offline practical teaching. It also raised rural arts and cultural talents, jointly organizing cultural performances to celebrate rural revitalization with village committees, and discovered local residents’ talent for acting and hosting.

⑤ Tradition transformation cultivates modernized habits. Huashi has strengthened publicity and



Assisted poverty alleviation through consumption



Concentrated contract signing activity as replacing donation with trade



Donation activities on Poverty Day



Industrial worker training base

mental guidance, publishing more than 10 briefs about assistant work in provincial media and the official website of SASAC, and delivering more than 50 passages through its own media. At the same time, the company has done a good job in cultivating habits by improving the appearance of villages, building village cultural centers, establishing “point-based markets”, helping students, improving medical standards and improving home hygiene.

## 5. Future Outlook

The implementation of rural revitalization strategy is an overall and historical task related to the comprehensive construction of a socialist modern country. Any one of the “Five Revitalization” cannot be achieved without the others. Huashi will continue to join hands with Jiuzhaigou County, actively exploring new ideas, new modes and new paths of support. They will continue to strengthen

cooperation between enterprises and local governments, take into account the actual development of Jiuzhaigou, adhere to the problem-oriented approach, so as to improve assistance to help achieve the “Five Revitalization”, increase the income of the population in poverty and low-income rural population, stimulate the internal power of rural revitalization development and comprehensively help revitalize Jiuzhaigou.

In the future, Huashi will always adhere to the “fulfillment of social responsibility of state-owned enterprises” as its mission, support and respond to the call of the Party and the State, taking up from economic responsibility, to the due political responsibility and social responsibility. In this way, the company can continuously “expand the space of happiness” from cultural construction, humanistic care, public welfare, ecological civilization and other dimensions.

## 6. Deposition from Stakeholders

*“Huashi, as a large state-owned enterprise directly governed by Sichuan Province, has a long history and strong ability. In recent years, Huashi has been assisting Jiuzhaigou County in poverty alleviation, post-disaster reconstruction and consolidating and improving the results of poverty alleviation and developing rural revitalization, always caring for the people and benefiting the county. It has paid hard toil and contributed inexhaustible power to increase the income of people in Jiuzhaigou County and give the countryside a new look, fully reflecting the responsibility and commitment of a provincial state-owned enterprise. We expect Jiuzhaigou County to continue to work together with Huashi, actively explore new ideas, new models and new paths of assistance, continue to strengthen the cooperation between enterprises and local government, and continue to make more progress.”*

—— Li Weiren, Deputy Secretary of Jiuzhaigou County Committee and Acting County Governor



# The “Contributor” of Community Development & the “Main Force” of Poverty Alleviation

◇ Beijing Yantong Precast Concrete Co., Ltd.

## Introduction

Beijing Yantong Precast Concrete Co., Ltd. adheres to the development idea of “people centered”, keeps in mind the original mission of state-owned enterprises, and participates in community construction and promotes community development through various channels and ways such as supporting community construction, assisting in poverty alleviation, helping people in need, implementing epidemic prevention and control, promoting school enterprise cooperation, and hosting events.



## SDGs

 Goal No.1	<p>In response to the national poverty alleviation policy, we will provide counterpart assistance to poor areas in Inner Mongolia to help alleviate poverty.</p>	 Goal No.3	<p>Carry out activities such as “on duty during epidemic” to protect people’s health.</p>
 Goal No.17	<p>Strengthen the cooperation between schools and enterprises, and cooperate with many colleges and universities to jointly cultivate talents in the industry.</p>		

## CSR

 Fundamental Responsibility	<p>During the construction of the resettlement housing project, the grouting material plumpness monitor higher than the national mandatory standard is introduced to ensure the grouting quality of the grouting sleeve.</p>	 Organizational Governance	<p>The “Capital SOE Open Day” was held to strengthen communication with stakeholders.</p>
 Community Participation and Development	<p>We will participate in community building through various channels and ways, such as supporting community building, assisting in poverty alleviation, helping people in need, implementing epidemic prevention and control, and hosting events to promote community development.</p>		

## 1. Case Overview

As a state-owned enterprise, Beijing Yantong Precast Concrete Co., Ltd has been deeply practicing the social responsibility of state-owned enterprises for many years, adhering to the people-centered development philosophy, and actively fulfilling the original mission of state-owned enterprises in the capital. And it has carried out a series of actions in helping poverty alleviation, helping people in need, supporting community construction, implementing epidemic prevention and control, and promoting school enterprise cooperation. It has been constantly promoting the orderly development of public welfare undertakings, giving back to the society with practical actions.

## 2. Case Background

The Proposal of the Central Committee of the Communist Party of China on Formulating the Fourteenth Five Year Plan for National Economic and Social Development and the Vision for the Year 2035 pointed out that, at present, China has entered a new development stage of building a socialist modern country in an all-round way. As an important material and political foundation of socialism with Chinese characteristics, state-owned enterprises serve the strategic overall situation of the great rejuvenation of the Chinese nation and play an irreplaceable role in the new journey towards the second centenary goal. Based on the new development stage, implementing the new development concept, building a new development pattern, actively fulfilling social responsibility, and constantly improving the ability and level of fulfilling social responsibility, are the natural responsibility of China's state-owned enterprises.

In recent years, as a state-owned enterprise, Yantong has actively fulfilled its social responsibilities, especially in the face of urgent, difficult and dangerous tasks. It has established a good corporate image and become the “mainstay” of epidemic

prevention and control and the “main force” of poverty alleviation.

## 3. Responsibility Actions

(1) Participate in the construction of shantytown reconstruction projects and fulfill the mission of state-owned enterprises

Sunhe Shed Renovation Project in Chaoyang District, with a total construction area of 1.15 million square meters, is the largest resettlement housing project under construction in Beijing, and also a key livelihood project for Chaoyang District to implement the strategic positioning of the capital city. After completion, more than 7000 households can be resettled. The project adopts a fully assembled project, involving five categories and 275 types of prefabricated components, which are various and difficult to prefabricate. As a prefabricated construction enterprise, Yantong has participated in the construction of 62 buildings (23 buildings of the Third Company of China Construction First Engineering Bureau, 21 buildings of China Construction Huajiang and 18 buildings of Beijing Construction Engineering Group) in the first and second bid sections of Sunhe Shed Renovation Project, and has undertaken the supply task of prefabricated components with a total volume of 73% of the project. 95432 prefabricated components have been supplied, with a total volume of 87241m<sup>3</sup>. There are 188000 sleeve grouting in this project. During the construction of grouting sleeves for important connections of prefabricated buildings, grouting material plumpness monitors higher than the national mandatory standards were



Sunhe Shed Renovation Project



Shed Renovation Project Capping

introduced to ensure the grouting quality of grouting sleeves. The project lasted one year and two months, and was fully capped on November 23, 2020. All types of fabricated components used by Yantong Company in this project were completely sold out.

#### (2) Support poverty alleviation and reflect the responsibility of state-owned enterprises

In response to the national poverty alleviation policy, Yantong Company provided counterpart assistance to poor areas such as Changshun Town, Huade County, Ulanqab City, Inner Mongolia, Tai-pusi County, Xilin Gol League, Inner Mongolia, and Nierji Town, Molidawa County, Inner Mongolia in 2021. It purchased nearly 200,000 yuan of materials, successfully completed the poverty alleviation cooperation, and helped the recipient areas win the battle against poverty.

The company has continued to recruit poor households. At present, the company has recruited 2 self owned employees, 2 outsourcing employees and 4 labor team workers from poor households. In 2021, 100 people were newly recruited to help the agricultural population in the region (23 employees, 77 labor teams).

#### (3) The Party and the masses offer love and help the people in need

In 2021, the General Party Branch of Yantong Company, guided by the study and education of the Party history, actively responded to the call of the practical activity of "I do practical things for the masses". We organized the Party members to carry out assistance and condolences to the local nursing homes, brought food, oil, clothing, daily necessities and other materials for the elderly in the nursing homes, and carried forward the traditional virtue of respecting and loving the elderly. True feelings are seen in the detail. We will never forget the original intention and will fulfill the mission.

At the same time, the company actively carried out charity donation activities, and all employees responded positively and enthusiastically, contributing a total of 13,000 yuan. We have been wholeheartedly doing practical things for the masses, doing good deeds, and constantly enhancing the people's sense of gain and happiness.



Condolences to Taowa Nursing Home

#### (4) Participate in voluntary services and support community building

Yantong Company gives full play to the vanguard and exemplary role of grass-roots party organizations and party members in participating in community construction and serving the masses, and continues to carry out the practical activities of "I do practical things for the masses".

Qiantaowa Village, the territory of Yantong Company, is located in the northwest of Nankou Town, 8 kilometers away from the urban area of Nankou Town. At present, the total number of households in the village is 641, with a permanent population of 1350. It is one of the low-income villages in Nankou Town that have been registered. The village collective economic income is extremely weak, with an annual income of only 650000 yuan, 50% of which comes from government subsidies. In the face of this situation, we actively contacted Nankou Town People's Government and Changping District Charity Association, and donated 200000 yuan to Changping District Char-

ity Association in Beijing on August 20, 2019 to help the infrastructure construction of Qiantaowa Village (low-income village) in Nankou Town and improve the villagers' living environment.



Donation ceremony for Qiantaowa Village

On April 8, 2020, we organized Party members and activists to plant trees on both sides of Liqian Road in Qianqian Taowa Village. 100 locusts were planted to support the construction of "beautiful countryside" in Qiantaowa Village.



Organize Party members to plant trees in Qiantaowa Village

In 2021, relying on the "double check in" mechanism of party members, Yantong Company mobilized party members and cadres to return to their local communities to carry out a series of activities such as "epidemic duty, bucket duty, garbage classification, and health day". The number of party members going to the front line of the community reached 80, which effectively improved the lack

of epidemic prevention in the community, and improved the community residents' awareness of environmental protection and garbage classification.

In May 2022, the epidemic prevention and control in Beijing was at a critical stage. Yantong Company actively responded to the call, and selected party members to go to Beiliu Village Community, Liucun Town, Changping District to assist in nucleic acid test and epidemic prevention.



Party members go to the community to carry out garbage classification



Send Party members to the front line to help prevent and control the epidemic

#### (5) Deepen school enterprise cooperation and promote integration of industry and education

The State Council issued the National Vocational Education Reform Implementation Plan, which clearly required that we adhere to the unity of knowledge and practice, integration of work and study, and promote comprehensive and in-depth cooperation between schools and enterprises.

Over the years, Yantong Company has continuously received teachers and students from Jiaotong University, Beijing University of Science and Technology, Beijing Vocational College of Finance and Trade and other colleges and universities to visit the factory for study. Through on-site publicity and explanation of the manufacturing technique and production process of prefabricated components, it has helped teachers and students understand the production process, application fields and the development of prefabricated building industry. It further helps teachers and students expand their professional vision and enrich campus life and promote the integration of professional

production and learning.

On June 22, 2021, the freshmen of Beijing Institute of Industry and Technology visited Yantong Company for study. The heads of relevant departments of Yantong Company led the students to visit the component storage area, component production line and automatic rebar binding workshop. During the visit, the students had a deep understanding of the automation equipment in the factory and the production process of various concrete components, which made them feel the strength of the prefabricated building industry in the novelty.

In 2021, Yantong became the “production practice base” of the School of Electromechanical Engineering of Beijing University of Technology and Beijing Jiaotong University (both of which are 985 colleges). It also worked with Beijing Vocational College of Finance and Trade to build a “situational” labor education practice base, and strengthened



Freshmen of Beijing Institute of Industry and Technology came to visit and study



Signing and awarding ceremony of the situational labor education practice base

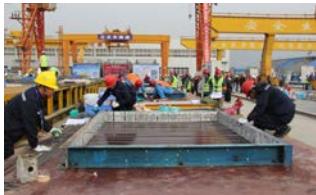
the construction of grass-roots party organizations in schools and enterprises.

#### (6) Undertake events and fulfill social responsibilities

In the fourth “Capital State owned Enterprise Open Day” theme activity jointly sponsored by the Publicity Department of the Beijing Municipal Party Committee, the Beijing Municipal State owned Assets Supervision and Administration Commission, the Beijing Municipal Education Working Committee, the Beijing Municipal Bureau of Culture and Tourism, the Information Center of the State owned Assets Supervision and Administration Commission of the State Council, the Beijing Federation of Trade Unions, the Beijing Municipal Committee of the Communist Youth League and the Beijing Women’s Federation, Yantong Company, as an important reception unit, opened its doors to all sectors of society and accepted the review of society. Nearly a hundred people from the news media and people from all walks of life walked into Yantong to observe the first production line of prefabricated concrete components in Beijing, and knew about the development process of Yantong Company and its achievements in serving the country, which showed the new look of state-owned enterprise. Through this “Capital State owned Enterprise Open Day” activity, Yantong Company made the citizens understand the production process of prefabricated buildings and experience the whole process of “building a house like building blocks”. It demonstrated the charm of prefabricated building technology guidance and intelligent construction, and let all sectors of society further know about, recognize, understand and support prefabricated construction, laying a solid mass foundation for promoting the development of prefabricated construction industry.

In February 2019, Yantong Company undertook the preliminary of the first “Sanyi Cup” National Fabricated Construction Vocational Skills Competition in Beijing and the final of the first Fabricated

Construction Vocational Skills Competition in Beijing Skills Competition “Jianlian Cup”. As the organizer of the first skills competition, Yantong Company actively responded to the national call, fulfilled the responsibilities of state-owned enterprises, carried forward the spirit of craftsmanship, and made outstanding contributions to the industry's selection and training of learning, knowledge-based, skilled, innovative and highly skilled personnel in fabricated construction. It has set off a nationwide upsurge of training high-quality skilled talents and forging large country craftsmen, and promoted the transformation and upgrading of the national prefabricated construction industry.



Skill competition site



Skill competition site

#### 4. Effect of Responsibility Fulfillment

Over the years, Yantong has been committed to the field of prefabricated buildings, focusing on the capital's livelihood and housing project. Since its establishment, the company has undertaken more than 100 public rental housing projects, including Majuqiao Plot Public Rental Housing Project, Hot Spring Public Rental Housing Project, Guogongzhuang Public Rental Housing Project, Chaoyang District Fatou District Coking Plant Public Rental Housing Project, Tongzhou District Taihu Public Rental Housing Project, Chaoyang District Baizhan Security Housing Project Public Rental Housing Plot, Beijing City Sub center Staff Turnover Housing (North Area) Project, and Beijing City Sub center Dongxiaoying Depot Upper Staff Turnover Housing Project, making contributions to the construction of affordable and rental housing in Beijing.

Yantong Company thoroughly implements the important directive spirit of Xi Jinping General Secretary, deeply promotes the construction and reform of industrial workers, constantly expands external training business, carries out systematic, authoritative and practical training for PC assembly workers, and cultivates a large-scale and professional high-quality construction industry workers. It undertakes industry skill competitions, hosts large-scale professional events, and selects outstanding technicians. It deepens school enterprise cooperation, cultivates systematic, authoritative and practical skilled workers, builds a large-scale and professional high-quality blue collar team, and fulfills the responsibilities of state-owned enterprises.

As a state-owned enterprise, Yantong Company focuses on the urgent problems of the people and continues to carry out the “I do practical things for the people” practice activities. Relying on corporate love donations, double check in of party members and other forms, it solves the problems of employees and local residents. It also helps the local community construction by means of voluntary services and charitable donations.

In the work of epidemic prevention and control, the general party branch and party members and cadres of Yantong Company actively responded to the requirements of epidemic prevention and control, and invested in the fight of epidemic prevention and control by means of “double reporting” to the community. In the face of severe and complex epidemic prevention and control situation, the party members of Yantong Company, while doing their own work well, reported to their communities to participate in voluntary services. They rushed to the front line, stuck to the front line and took the initiative to undertake community gate sentry duty, nucleic acid detection security, order maintenance and other work. They gave full play to the exemplary role of party members, effectively improved the lack of community epidemic preven-

tion force, and relieved the pressure on community staff. They have comprehensively created a united atmosphere to fight against the epidemic and worked together to build a grassroots “epidemic prevention network”.

## 5. Future Outlook

As an important material and political foundation of socialism with Chinese characteristics, state-owned enterprises must earnestly fulfill their social responsibilities. Over the years, Yantong has actively fulfilled its social responsibilities, especially in the face of urgent, difficult and dangerous tasks. It has established a good image and achieved good results. In

the future, Yantong Company will continue to strengthen the construction of corporate culture, so that the fulfillment of social responsibility will be rooted in the hearts of enterprise employees and become an important part of corporate culture. We will continue to develop corporate culture in the practice of fulfilling social responsibility. And we will continue to define the scope of fulfilling social responsibility and, on this basis, continue to enrich ways and means. We will help needy workers and people by donating money, materials, visits and condolences, and play a greater role in fulfilling social responsibilities in the new era

## 6. Deposition from Stakeholders

*“Continuous improvement of villagers’ living environment is an important work of the village party branch. Lack of funds has always been the biggest obstacle to the development of Qiantaowa Village. Yantong Company has carried out social public welfare activities for many times over the years, which has helped the economic development of Qiantaowa Village, helped villagers solve their life problems, fulfilled the social responsibility of state-owned enterprises, and delivered positive energy for building a beautiful Nankou.”*

——Chen Zongshi, Secretary of the Party Branch of Qiantaowa Village

*“The signing of this contract with Yantong will further deepen the school-enterprise cooperation, realize the positive interaction of talent training between the two sides, carry out multi-dimensional cooperation and exchanges in scientific research, joint training, practice base construction and other fields, and help the two sides achieve win-win cooperation.”*

——Liu Wenhua, Secretary of the General Party Branch and President of the School of Construction Engineering Management of Beijing Vocational College of Finance and Trade



## Attachment: Enterprise Related Information



北京市燕通建筑构件有限公司  
Beijing Yantong Precast Concrete Co.,Ltd.

Company name: Beijing Yantong Precast Concrete Co., Ltd.  
Company Address: Changping District, Beijing  
Company website: <https://yt.bmrb.com.cn/>

### Company Profile

In August 2013, Beijing Yantong Precast Concrete Co., Ltd. was jointly established by two state-owned enterprises, Beijing Municipal Road and Bridge Group and Beijing Affordable Housing Construction Investment Center to accelerate the construction of affordable housing in Beijing and practice the concept of housing industrialization. In April 2017, Beijing Housing Industrialization Group Co., Ltd. acquired 100% of the equity of Beijing Yantong. The business includes six sectors: PC component manufacturing, new product and new technology research and development, detailed design, engineering technology services, consulting and training, and production and service of basic parts for prefabricated decoration.

Based on the market and looking forward to the future, Beijing Yantong has continued to expand its production capacity on the basis of establishing the first automated production line for prefabricated building components in Beijing, with an annual production capacity of more than 500000 cubic meters. At present, the company's main products include 2 categories and 15 kinds of industrialized prefabricated components used in prefabricated buildings. Among them, there are 9 types of vertical members, including structural thermal insulation and decoration integrated exterior wall panels (sandwich panels), structural interior wall panels, PCF panels and decorative panels, and 6 types of horizontal members, including laminated floor slabs, stair panels, balcony panels, and air conditioning panels.

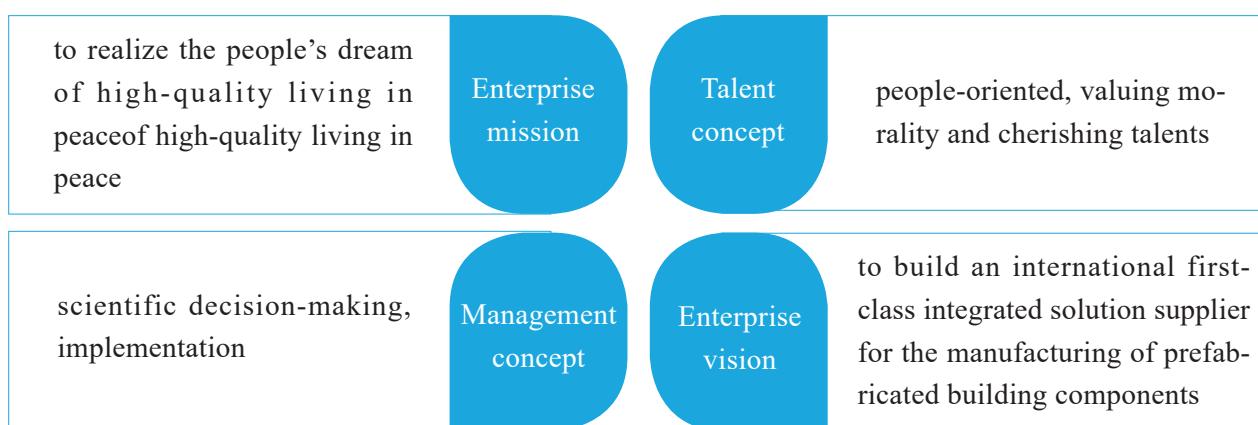


Beijing Yantong has independently developed many projects, such as the prefabricated component information management system (PCIS), prefabricated pavement, prefabricated component stereo storage technology, and rapid assembly template. It has won 48 patents for inventions and utility models, such as “portable multi joint pneumatic small sleeve grouting equipment”, “a light side formwork system for the production of prefabricated concrete wall panels”, and “a nomadic prefabricated component assembly line”, and has obtained 22 computer software copyrights. It has passed the national high-tech enterprise certification and defended the title of “National Top 10 Enterprises for Prefabricated Concrete Components in Housing Construction”. It has won the “2017 China Civil Engineering Zhan Tianyou Award Gold Award for Excellent Residential Quarter”, “2020 China Top 500 Building Materials Enterprises”, “AAA Credit Enterprise with Enterprise Credit Rating”, “Grade

II for Professional Contracting of Building Decoration Engineering”, “Grade II for Professional Contracting of Building Curtain Wall Engineering”, “Grade II for Professional Contracting of Waterproof, Anti corrosion and Thermal Insulation Engineering”, “Ungraded Professional Contracting of Formwork and Scaffolding”, “Ungraded Professional Contracting of Special Engineering (Structural Reinforcement)”, etc.

In line with the brand concept of “excellent quality, affordable price and good service”, Beijing Yantong, taking the opportunity of “National Fabricated Building Industry Base”, continues to increase scientific and technological innovation, strengthen corporate culture construction, constantly improve production and service levels, and strive to make the enterprise a world-class supplier of integrated solutions for the manufacturing of prefabricated building components.

## Corporate Culture





## Major honors in the Past Three Years



2021 National Building Materials Industry  
Brand Building Influential Enterprise



Outstanding Contribution Award of "Precast  
• Ten Years" Precast Concrete Component  
Industry



2020 Top 500 Building Materials Enterprises in China



2019 China's Top 10 Enterprises of Housing Prefabricated Components



Second Prize of Science  
and Technology Award of  
Beijing Highway Society

## Employee Data

The company has 213 employees in total, with women accounting for 25.3% and 17.8% of middle and senior managers.

## Performance Data for the Past Three Years

Index	Unit	2019	2020	2021
Total Assets	100 million yuan	9.46	10.61	11.98
Operating Income	100 million yuan	6.64	8.74	9.5
Total Profits	100 million yuan	0.5	0.61	0.69

# Emergency Rescue upon Hearing of “Flood”

◇ Chengdu Construction Engineering Group Co., Ltd

## Introduction

Chengdu Construction Engineering Group Co., Ltd., faced with the serious flood situation in many places in Sichuan, stepped forward, quickly mobilized flood prevention and rescue resources, rushed to many rescue sites at the first time to carry out emergency rescue work, offered mutual support with the local communities, and made contributions to building a resilient city.





## SDGs

 Goal No.11	<p>In the face of the flood situation, launch the emergency response system at the first time to carry out flood control and rescue work, and plan to carry out emergency rescue training and drills in the future to help the construction of a resilient city with practical actions.</p>		
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## CSR

 Fundamental Responsibility	<p>The project department strengthens the investigation of potential safety hazards and information reporting, and deals with emergencies in a timely manner to ensure safety.</p>	 Human Rights	<p>Actively organize the evacuation of personnel in dangerous areas, and transfer all project personnel and migrant workers to safe areas to ensure the safety of personnel.</p>
 Community Participation and Development	<p>Actively participate in the emergency flood control and rescue work, assist the flood affected communities to resume normal life, and fully reflect that the construction industry enterprises are in the same boat with the local people in emergencies and dangerous tasks.</p>		

## 1. Case Overview

In August 2020, many cities in Sichuan such as Chengdu and Leshan experienced heavy rainfalls that forced Sichuan to activate its level 1 flood emergency response system. The streets in many cities, including Jintang, Shuangliu and Leshan, were widely flooded, and some areas had serious waterlogging. Chengdu Construction has swiftly responded to the call to action and promptly mobilized all the resources and personnel for flood relief and rescue. The emergency response team immediately headed to the first site, Jintang, to carry out the rescue work and transferred to the second emergency site overnight, which fully reflected the company's political nature and organizational characteristics as a state-owned enterprise and its spirit of helping and watching out for others in the society.

## 2. Case Background

Since August 10th, 2020, Sichuan has experienced some rare heavy rainfalls in history. The consecutive torrential rains throughout the days have led to severe flooding in many places, displacing many people and families. Many places in Chengdu have been flooded, including the nearly 2000-year-old Huanglongxi ancient town. In addition, the second largest crest from Tuojiang has flooded into the urban areas of Jintang. The Leshan river basin of the Qingyi river has also exceeded the safe water level; as a result, the streets in Leshan city have been generally flooded and some places were severely waterlogged. In many areas, river was backflowing; as a result, many residential garages were completely submerged, and the water and electricity were cut off in residential areas.

## 3. Responsibility Actions

### (1) Leadership on the Front Line

The corporate leaders have successively arrived at the front line to supervise and inspect the flood re-

lief and rescue works. The leaders have headed to the project's construction site, and mainly carried out supervision and inspection on the flood relief system, including the preparation of emergency response plans, the rescue team, the emergency material support, and other aspects of the flood relief work. The leaders have also conducted in-depth inspection and provided guidance on the relief work at several emergency rescue sites and headed to many construction sites that the company was working on in Jintang to give instruction on water draining from site and resumption of work and safe production.

### (2) Promptly Responding to the Government's Call and Leading by Example as a Responsible State-owned enterprise

On August 18th, at around 16:00, after receiving the notice from Chengdu Emergency Management Bureau, the Party Committee of the company quickly activated its first emergency response team and headed to the Sanxing Town of Jintang County with 66 personnel, 2 command vehicles, 5 transport vehicles, 1 bus, 3 large generators, 14 submersible pumps and other relevant materials and equipment. At 21:00, the emergency response team have successfully assembled at the rescue sites, and they only needed 30 minutes to set up the equipment before they began pumping. At 1:30 in the morning on the very next day, all 14 pumps were working at full capacity.

According to the arrangement of the local government, at first, Chengdu Construction was mainly responsible for the pumping and drainage of the underground parking lot in the Zhulin Bieyuan Anzhi community. The community has around 1000 residents, and the water has accumulated to around 200,000 cubic meters in the basement. Facing the huge water volume, the relief team has carried out the work simultaneously from three entrances. The team took turns to work 3 hours in the night and 6 hours in daytime, pumping at 3000 cubic meters

per hour.



Chengdu Construction Flooding Relief Team  
at Sanxing Town, Jintang County

Chengdu Construction has also been actively responding to the call from the local governments, set up a party member emergency response team, a flood prevention and rescue teams, took multiple measures to organize flood prevention and rescue work. The teams carried out emergency rescue, drainage dredging and post-flood housing safety assessment in many places such as The Huanglongxi Scenic Area, Tianfu New District, Caoba Town, Ya'an City, to relieve the local residents' struggles, maintain the local production and living order, and demonstrate the company's social responsibility and responsibility as a state-owned enterprise in times of crises, which was unanimously praised by the local government and the public.

### (3) Continuous Efforts in the Second Round of Flooding Relief

On August 21st, 2020, at 20:00, Chengdu Construction received order to carry out emergency rescue in Leshan from the the Sichuan Sheng Zhufang he Chengxing Jianshe Ting (the Sichuan Provincial Housing and Urban and Rural Development Department). The order received special attention from the leaders of the company; therefore, they immediately launched the emergency action plans and required the company to instantaneously mobilize personnel, materials and equipment to head to Leshan. Within 1 hour, the first batch of

response team was assembled with 31 personnel, 6 cars, multiple water pumps with capacities at 37 kw, 25 kw, 18.5 kw, 10 kw and a generator with the capacity of 200 kw. The team arrived in Leshan at 2:00 am, got in contact with the local housing department, and began aiding the local relief work.



Flooding Relief Team in Leshan

The second batch of emergency rescue teams assembled at 9:00 a.m. on August 22, 2020 in the Xinjin Service Area of Chengya Expressway. The team was deploying 102 personnel, 20 vehicles, 23 pumps, 1 diesel generator of 200kw, 700 kg of diesel and other items, arrived in Leshan at 10:42 to convene with the local housing department. The team was assigned 6 communities to conduct emergency rescues, including the Lishui Tiancheng, Yushui Huafu, West Lake Ziwei, Ma-Liu bian return house, Xintiandi, Wanchen Yuehu County Rescue Point, etc. The teams quickly carried out relevant emergency rescue work.

According to one of the front-line emergency rescuers, the biggest challenge was that "the workload for draining of the parking garage was relatively heavy. To help residents in the communities resume their normal lives as quickly as possible, we had to work throughout the days and nights." After 60 hours of hard work, the team was able to drain 66,000 square meters of water in the basement and completed the flood relief work at Leshan Wutongjiao Lishui Tiancheng community with high efficiency. The relief team was then assigned more tasks in emergency rescue, so they rushed to the next site—the Wanchenyuehujun community—and

carried out the rescue work. Due to flash flooding, the community's water and electricity supply have been cut off since the 18th. Also, the community's parking garage was still filled with water of 1 meter in depth, which poses great challenges for the community to resume its normal life. After installing the equipment under high time pressure, the rescue team began the draining process with two 20cm pumps and ten 10cm pumps. Meanwhile, the first responders alternated shifts throughout the process to make sure that the rescue work could be carried out incessantly. After 27 hours, the floodwater in the basement of Wanchenyuehujun was all cleared, and the team was ready to move to the next stop! Overall, the company completed 215,000 cubic meters of water drainage, more than 3,000 square meters of dredging, and completed more flood control work with more than 300 bags of flood control sandbags.



The Rescue Team Dredging the Roads



The Rescue Team Working Overtime to Complete Pumping

#### (4) Strengthening Responsible Flood Relief

Facing the flash flood emergency, all companies under Chengdu Construction corporation have im-

mediately prepared emergency response plans and rescued the production machinery, equipment and materials. The team comprehensively assessed the situation on site and deployed program specialists to monitor the water level. The project team actively rescued personnel who work in high-risk areas. All program personnels and migrant workers have been transferred to safe areas. This ensured safety for both people and physical capitals.

Meanwhile, the project department is strengthening the investigation on potential safety hazards and information reporting. The company set up a 24-hour duty system in order to monitor the situation at all times and respond in a timely manner. For the parts where there is a hidden danger of water accumulation, measures such as pumping water from foundation pits, setting up warning lines, piling up flood control sandbags, and installing automatic start-stop drainage devices are taken to ensure that safe flood prevention is in place.

### 4. Effect of Responsibility Fulfillment

In the process of this rescue, the first responders dared to fight, comprehensively showing their fearless, dedicated and hardworking qualities. Even if it was the mealtime, the team members only finished quick meals on site in order to carry out relief work as soon as possible. In this fight for flood prevention and relief, the group's ability to "fight" and "fight" when being called upon fully demonstrated the characteristics construction workers who are particularly able to endure hardships, especially able to "fight", and especially able to make contributions to the society. This once again shows their responsibility and establish an image in urgent, difficult, dangerous, and heavy tasks.

Chengdu Construction Emergency Rescue Team won the title of Advanced Collective award for outstanding contributions to the ten projects of developing a happy and beautiful life in Chengdu City in

2021.

## 5. Future Outlook

Chengdu Construction will continue to carry out trainings on emergency rescue skills at hundreds of construction sites in Chengdu. Furthermore, the company go deep into the grass-roots level to investigate on hidden risks, popularize knowledge on emergency response, and facilitate emergency

management nearby. The company will continue to increase the intensity of emergency rescue drills and material and equipment support, and focus on the masses of “urgent difficulties and expectations” problem. By doing this, the company aims to constantly “warm up” the city, and continue to contribute to the development of a happy and beautiful life in Chengdu.

## 6. Deposition from Stakeholders

*“I know that Chengdu Construction is a responsible and accountable state-owned enterprise and I’m very excited and relieved to see you coming!”*

——Home Owner at Wanchenyuehujun Residential Community



The heroism of the first responders deeply touched the residents of the community, and the developers, properties and owners representatives of the community sent pennants to express their gratitude and admiration

““You’ve been working very hard these days, thank you very much!”

——Du Chi, Director of Leshan Municipal Bureau of Housing and Urban-Rural Development



Du Chi, Director of the Leshan Municipal Housing and Construction Bureau, visited the emergency response team members

““Thank you all!”

——Citizens of Leshan who passed by the project



## Attachment: Enterprise Related Information



Company name: Chengdu Construction Engineering Group Co., Ltd.

Company Address: Chengdu, Sichuan province

Company website: <https://www.cdceg.com.cn/>

### Company Profile

Chengdu Construction Engineering Group Co., Ltd., formerly known as Chengdu Construction Engineering Bureau, has a history dating back to 1950. In September 2018, it was restructured by Chengdu Construction Engineering Group Corporation and changed to the current name.

At present, the company has more than 70 wholly-owned, holding and shareholding enterprises. It is one of the most competitive large-scale state-owned comprehensive construction enterprise groups in the central and western regions of China. It is the first construction enterprise in Sichuan Province with an output value of more than 100 billion yuan. It has been among the “Top 500 Enterprises in China” for 11 times, and has been awarded the first batch of “National Fabricated Construction Industry Base” and “Headquarter Enterprise” in Chengdu. The total assets of the Company exceed 100 billion yuan. It has more than 16,000 employees, more than 6000 professional and technical personnel, and more than 180000 workers.

The company and its affiliated enterprises have 3 special grade qualifications for general contracting of construction projects approved by the Ministry of Housing and Urban Rural Development of the People's Republic of China, 3 Grade A qualifications for design in the construction industry (construction projects), 1 Grade A qualification for design in the construction industry (civil air defense

projects), more than 20 Grade I qualifications for general contracting of construction projects, municipal utilities, highway projects, electromechanical projects and more than 170 professional contracting qualifications. It has the qualification of general contracting enterprise for complete foreign aid projects approved by the Ministry of Commerce and foreign trade operation qualification. The business area has expanded to more than 20 provinces (autonomous regions and municipalities directly under the Central Government) including Beijing, Tianjin, Chongqing, Guizhou, Hubei, Fujian, Shandong, Anhui, Shaanxi, Jiangxi, Guangdong, Zhejiang, Hainan, Qinghai and Tibet, as well as international markets such as Angola, Kenya, Belarus, Mongolia and Gabon.

The company undertook (participated in) thousands of high-quality projects, such as Chengdu Tianfu Square, Chengdu Shuangliu International Airport, Daocheng Yading Airport, Xichang Satellite Launch Center, Taiyuan Satellite Launch Center, Hainan Wenchang Space Launch Site, “Intel” Chengdu Production Office Building, the construction project of Chengdu Universiade Village (integration of industry and education) for the 31st Summer Universiade, Foxconn Chengdu Industrial Base, the main building of Qingshuihe Campus of Chengdu University of Electronic Science and Technology Avenue (Chengwen Road) expressway. It has won one of the one hundred classic and high-quality projects in the 35 years of reform and opening up, the title of “meritorious enterprise”

and one “classic project” for the 70th anniversary of the founding of New China, 64 national quality awards and scientific and technological innovation awards such as Luban Award, National Quality Project Award, Zhan Tianyou Award, more than 1000 municipal and above quality project awards, 31 national safe production standardization sites (the original national AAA construction site) and more than 1600 provincial and municipal safe and civilized construction sites.

The company was approved to establish a post doctoral innovation practice base, and its nine affiliated enterprises were recognized as national high-tech enterprises. It has 881 national patents, 15 national construction methods, 561 provincial construction methods. It has completed 51 national, industrial, group and provincial standards for engineering construction and 37 municipal and above scientific research topics. It has won 33 provincial and municipal science and technology progress awards and established 2 national safety culture construction demonstration units and 6 Sichuan safety culture construction demonstration units. The company’s “ingenuity to the party” party building brand was awarded the first prize of national enterprise culture outstanding achievements.

The company promotes green and low-carbon development with the goal of achieving carbon peak and carbon neutralization. It has competitive advantages in the whole industry chain, such as intelligent construction and building industrialization technology research and development, architectural design, green building materials production, assembly construction, harmless treatment of construction waste and resource utilization. The comprehensive strength of building industrialization is the first class in China and leading in the west. It has laid out several large-scale industrial bases in Qingbaijiang, Jianyang, Shuangliu in Chengdu as well as Ya'an, Luzhou and other places. Its market share of fabricated parts and its capability of

harmless treatment of construction waste and resource utilization rank first in the province, and it was awarded the first training base for fabricated construction talents in Sichuan Province. Relying on the comprehensive capacity of the whole industry chain, it has built the first fully assembled plant of Bosch Group in China, which was among the world Top 500 Enterprises. It has also built a large number of prefabricated housing and municipal green demonstration projects with great social impact and high technical content, such as the first batch of national prefabricated building evaluation standard A-level example Jinfeng New City resettlement housing, AA level example Chengdu Construction Industrialization Company Scientific Research Center, Sichuan A-level demonstration project Cauchi resettlement housing, and the third ring road expansion and reconstruction.

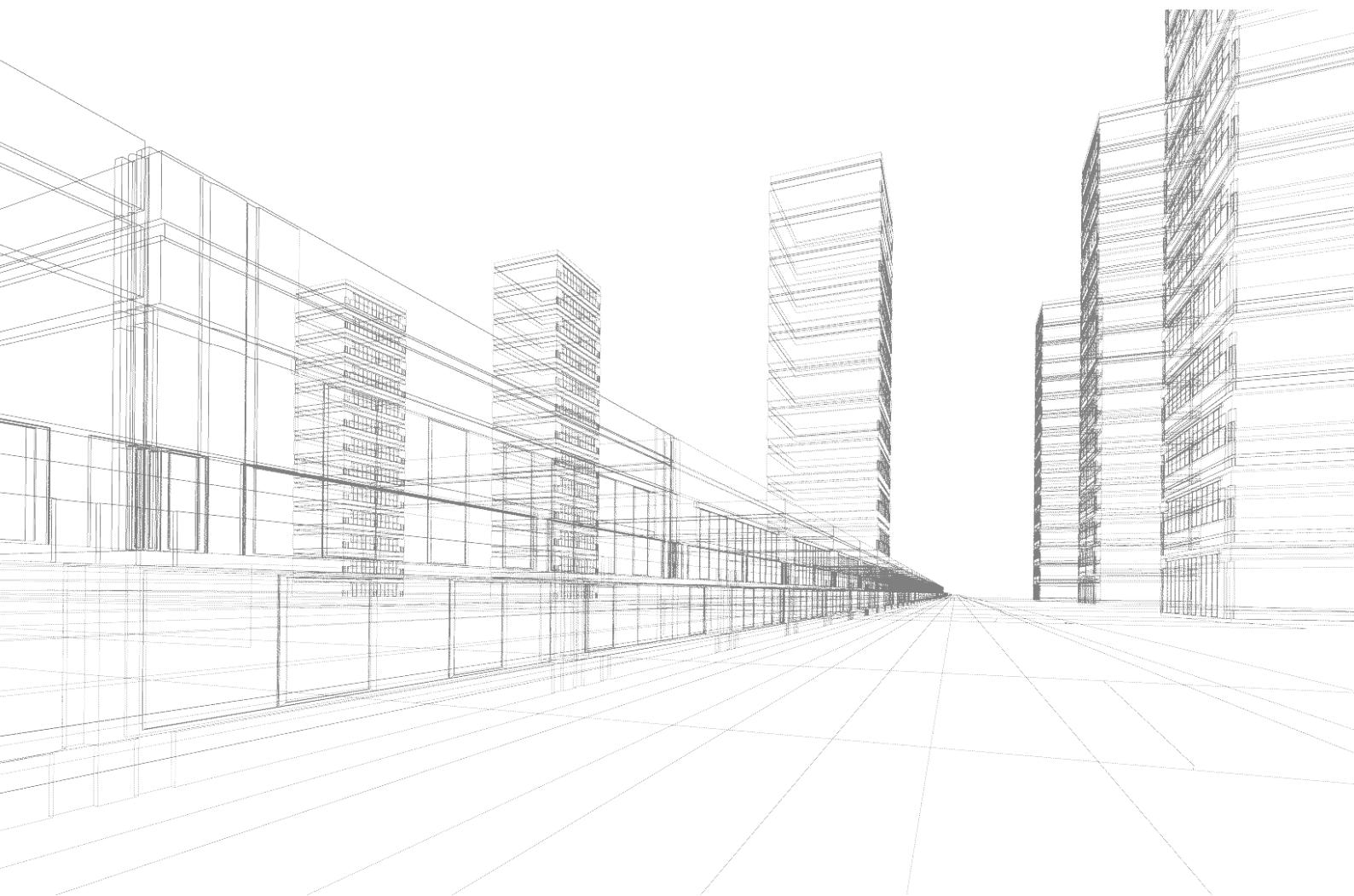
The company has outstanding emergency rescue ability and bravely undertakes urgent, difficult and dangerous tasks. It fully participated in the rescue and relief and post disaster reconstruction tasks of the “5.12” Wenchuan Earthquake, “4.14” Qinghai Yushu Earthquake, and “4.20” Lushan Strong Earthquake and successfully completed the flood fighting and rescue tasks of rainstorm and flood disasters in Chengdu Tianfu New Area, Jintang County, Leshan City and other places. As the only social emergency rescue team of construction unit in Chengdu, the company’s emergency rescue team was awarded the “Top Ten Projects for Building a Happy and Better Life in Chengdu in 2021” Advanced Collective. It has actively participated in the construction of government subsidized housing and secure housing projects, focused on targeted poverty alleviation, and has successfully completed the key provincial projects of poverty alleviation - Liangshan Prefecture Zhaojue County Relocation Poverty Alleviation and Resettlement Project, and the construction of Baihetan hydropower Station Huidong County Resettlement Site Project. It has effectively completed the construction of Covid-19 prevention and



control medical institution and special isolation point emergency project, such as Phase II decoration and reconstruction of Chengdu Public Health Clinical Medical Center, reconstruction of centralized isolation sites in Pidu District, and Chengfei Hotel, observation point for epidemic prevention in Qingyang District of Chengdu, and has accelerated the construction of Tianfu International Health Service Center. It has won many honors, such as “Advanced Enterprise in Sichuan Construction Industry to Fight against the Covid-19 in 2020”, “Chengdu Enterprise with Outstanding Performance in Coping with the Epidemic”, etc.

Adhering to the brand spirit of “building a dream

with ingenuity and aspiration leading to success”, the company takes “build thousands of magnificent buildings, create a better life, build green boutiques, and create a century of brilliance” as its corporate mission, adheres to building an industrial system with prominent main businesses and coordinated development. It strengthens the two pillar businesses of housing construction and municipal road and bridge construction, and optimizes the four major businesses of survey and design, mechanical and electrical installation, decoration and building materials logistics, striving to build a “green construction integrated service provider with full industrial chain and full life cycle”.



## Corporate Culture

	
Brand spirit	build dreams with ingenuity. Aspiration leads to success
Enterprise mission	build thousands of magnificent buildings, create a better life, build green boutiques, and create a century of brilliance
Enterprise vision	green construction, engineering construction for a hundred years, engineering construction of 100 billion yuan
Core values of the enterprise	sunshine, honesty, wisdom, gratitude
Business philosophy	extensive development, deep cultivation, honesty and win-win
Management concept	scientific, standard, accurate and efficient
Safety concept	safety first and prevention foremost
Team concept	work together for innovation
Talent concept	Be virtuous and talented. Ethic takes precedence. Make full use of talents
Quality concept	build boutique of the era, establish benchmark of the industry
Exemplary concept	loyal, responsible, diligent, innovative, enterprising, honest
Enterprise style concept	able to bear hardships, fight and risk
Implementation concept	practical and responsible, unity of knowledge and practice, good start and good end, use good methods to achieve good results
Social responsibility concept	contribute high-quality products to benefit the society



## Major honors in the Past Three Years



Sichuan Top 100 Enterprises in 2021



Top 100 Chengdu Enterprises in 2021



Outstanding Contribution Certificate of Splendid Qingyang Construction in 2020



Worker Pioneer in 2021



2021 National Market Quality Credit Rating Certificate



Tax credit rating A



Credit rating of financial institutions AA+



2018-2019 National Quality Project Award



2019-2020 China Installation  
Engineering Quality Award  
(Installation Star)



China Civil Engineering Zhan  
Tianyou Award Gold Award for  
Excellent Residential Quarter  
in 2020



Outstanding Contribution  
Award of Chengdu Top  
Projects of Building a Happy  
and Better Life in 2021

## Employee Data

The total number of male and female employees is 1291, including 927 male employees and 364 female employees. Among them, there are 8 middle and senior female managers and 20 male managers.

## Performance Data for the Past Three Years

Index	Unit	Year of 2019	Year of 2020	Year of 2021
Total Assets	100 million yuan	419.151645	484.379601	560.673619
Operating Income	100 million yuan	164.970177	173.981034	272.355628
Total Profits	100 million yuan	4.173219	7.014128	1.765321

# Battle Against Poverty & Open the Way to Prosperity

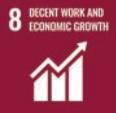
◇ Sichuan Chuanjiao cross Road & Bridge Co., Ltd.

## Introduction

Sichuan Chuanjiao cross Road & Bridge Co., Ltd. has built a high-quality and security guarantee road to poverty alleviation and prosperity with practical actions, showing the multidimensional impact of basic road construction on poverty alleviation, reducing regional inequality and solving employment and travel problems of mountain residents, and making contributions to the development of poverty-stricken areas.



## SDGs

 Goal No.1	Improve the traffic environment and provide a basis for economic development in poor areas.	 Goal No.8	Promote the commuting of townships, facilitate the employment and travel of residents in poor areas, and promote regional economic development and rural revitalization.
 Goal No.9	Promote the construction of safe and high-quality township infrastructure, and help the high-quality development of poor areas.	 Goal No.10	Build bridges between remote areas and central areas to reduce regional inequality.

## CSR

 Fundamental Responsibility	In the process of building roads, strengthen quality management, ensure safe production, and fulfill the basic responsibilities of construction enterprises in multiple dimensions.	 Community participation and development	Participate in the construction and development of poverty-stricken areas through transportation, industrial, cultural and consumption poverty alleviation.
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## 1. Case Overview

The Puge project, Provincial Road S464, undertaken by Sichuan Chuanjiao cross Road & Bridge Co., Ltd. is located in Puge County, Liangshan Yi Autonomous Prefecture, Sichuan Province. The project has a total length of 57km and was officially commenced building on April 2, 2020, including 6.5km of poverty alleviation. The construction of the critical section would be completed before September 30, 2020. All the 6.5km sub-grade, pavement, bridge, and traffic safety projects needed to be completed in just five months. The construction period is limit and the task is arduous. Moreover, the project is located in the hinterland of Daliang Mountain, with complex geological conditions and extremely poor transportation conditions. The long rainy season shortened the effective construction time, making the originally tight construction period even more difficult. In addition, the project is located in ethnic areas, and the differences in language and customs hindered the land acquisition and demolition work of the project subject. Finally, the last section of the road of the poverty alleviation was completed on September 29, and the target task of the “9.30” node was successfully completed. The people of Li'an Township and Wenping Township along the line finally crossed from the muddy path to the road



Organize the youth commando team and the pioneer commando team of Party members of Chuanjiao road&bridge to ensure the smooth flow of vehicles

## 2. Case Background

Puge county is located in the Hengduan Mountains of the Yunnan-Guizhou Plateau, with steep terrain, mountains and rivers, juxtaposed peaks in the east and west. The natural resources are rich and the ecological environment is beautiful. The Yi compatriots migrate and multiply in this “paradise” and have created a colorful Yi culture. However, today, with the rapid economic development, the former “paradise” has become the biggest obstacle to the economic development of the Yi compatriots. The original inter-town highway had a small sub-grade width and poor pavement condition, which has seriously affected the communication between the villages and towns along the line and the outside world for many years and restricted the local economic and social development. As an important passage out of Puge County, this project connects more than 19 towns in the county and serves more than 100,000 people. It is the top priority of transportation poverty alleviation in Puge County. The completion of the project will further improve the traffic environment of poor townships and villages along S464, promote the rapid economic and social development of ethnic areas, and maintain ethnic unity. It is a basic and strategic project to promote the economic development of Puge County, and also a key livelihood project in the year of poverty alleviation in 2020 and the end of the 13th Five-Year Plan.

## 3. Responsibility Actions

Since the project won the bid, the leaders of the company and the branch have attached great importance to the project construction, and have gone deep into the project inspection and guidance work many times, requiring the project to follow the tone of “beginning is the decisive battle, and starting is the key point”, to fully promote the project construction and resolutely complete the “9.30” goal. To this end, the company quickly established a project management team. With the arrival of

the first batch of management personnel on February 17, 2020, the Pugh project officially began to operate. In order to ensure that the project can quickly enter the construction stage, the leadership team carefully organized the site entrance personnel to carry out various preparatory work, actively communicated and coordinated with the local government, the owner and all parties involved in the construction, and took multiple measures at the same time. The red line and temporary land acquisition were completed in the shortest time, and the temporary construction facilities such as concrete mixing station and reinforcement processing plant were built. The project successfully rose from the temporary construction preparation stage to the construction stage, making substantial progress. It has achieved a good start of “running into the field and winning the first place”, laying a good foundation for subsequent construction.

However, Puge County is located in the hinterland of Daliangshan Prefecture, where traffic is blocked, resources are scarce and transportation is difficult. The geological conditions are not optimistic with broken rock formations and abundant groundwater, which have brought great difficulties to the construction. What's more serious is that June-September is the local flood season, and the rainfall accounts for 80% of the whole year. Under such extreme weather conditions, the effective construction time was further compressed, and the project was difficult to move forward. In the face of this dilemma, the project team wasn't flurried and took combined measures to solve the problem. In terms of progress management, the project adopted the “five fixed” method of “fixed leadership, fixed personnel, fixed tasks, fixed time limit and fixed responsibilities”. According to the overall deployment of “parallel flow construction and breakthrough of key parts”, the project team formulated nodes weekly on the basis of the “9.30” goal, reversed the construction period and carried out on schedule. The construction organization design was continuously optimized based on the

principle of process control and dynamic adjustment, and the responsibilities were compacted layer by layer and assigned to each person. In terms of construction organization, the project has adopted an unconventional approach of increasing the input of personnel and mechanical equipment. More than 60 sets of construction mechanical equipment have been invested in the peak period of operation, and more than 200 on-site construction workers have been employed. Members of the project leadership team were responsible for their divided assignment. They were on duty 24 hours a day, rain or shine, and took turns to catch up with the progress. The technical personnel lived on the front line, close to the service regardless of the weather, which greatly improved the construction efficiency.

Jian Wen, the leader of Puge S464 party group and project manager, said, “we must not ignore the construction quality and safety because of blindly rushing the construction period, and we must not cross the red line.” Even during such a high-intensity rush period, the project still implemented strict engineering safety and quality management systems. First, the construction was strictly in accordance with the design documents and construction design drawings. The construction technical standards, quality inspection and acceptance standards were strictly mastered. Before the construction of each process, the technical disclosure must be carried out and the on-site technical personnel must check. Second, the system of side station for concealed project and the system of video data for reference were carried out, so as to achieve real-time monitoring and accountability. Third, safety is strictly controlled. In view of the complex geological conditions, the project established a double prevention mechanism of hierarchical control of safety risks and hidden danger investigation and treatment, identified safety risks, formulated pre-control measures, investigated and treated safety hidden dangers, and achieved the goal of zero accidents.

On September 29, 2020, the last section of the road surface of the poverty alleviation section was rolled and formed, which marked that the “9.30” target of the project was completed on schedule. The people of Li'an Township and Wenping Township along the line finally crossed from the muddy road to the road leading to happiness new village.



The first beam slab was successfully poured



The last section of the Puge project of provincial highway S464 was rolled and formed. The “930 target” was fully completed

#### 4. Effect of Responsibility Fulfillment

Liangshan Yi Autonomous Prefecture is the place that Jinping Xi general secretary and the Central Committee of the Communist Party of China are most concerned about. It is also the area with the toughest task of winning the poverty alleviation battle in Sichuan Province. During the entire construction process of the provincial highway of S464 Puge project, we resolutely implemented the

spirit of “overcoming difficulties, being willing to contribute, and being brave to win”, and worked together to fulfill our mission. The outstanding achievements of the project have successfully completed the “9.30” target task. On December 28, 2020, the Puge County Transportation Bureau awarded the project the honorary title of “Advanced Unit in Poverty Alleviation”, and the project manager Comrade Wen Jian was awarded the honor title of “Advanced Individual in Poverty Alleviation”.



The people's Government of Puge County, Liangshan Prefecture awarded the honorary banner of “example of road construction industry, model of county enterprise cooperation” to the provincial highway S464 Puge Project

#### 5. Future Outlook

It is the original intention and mission of Chuanjiao Company to fight poverty alleviation and contribute the strength of state-owned enterprises. The company has made a lot of efforts and exploration in the practice of fighting poverty and building a moderately prosperous society in an all-round way. It has undertaken the task of providing targeted assistance to Ziran villages in Chaotian District of Guangyuan City and tackling poverty in some areas of Sichuan Province, especially the three prefectures of Ganzi, Aba and Liangshan. It has made positive contributions to the country's decisive victory in poverty alleviation through

transportation, industrial, cultural and consumption poverty alleviation. In the future, we will continue to carry forward the new era road and bridge spirit of overcoming difficulties, being willing to make contributions and being brave to win. In August 2021, we completed the follow-up 47km construc-

tion task of the provincial highway S464 Puge, making due contributions to the economic and social development of Puge County, the implementation of the Rural Revitalization Strategy, and the consolidation and expansion of the achievements of poverty alleviation!

## 6. Deposition from Stakeholders

*“Poverty alleviation is an important livelihood project. At the beginning of the implementation of the project, we should respect the masses, actively understand their real thoughts and understand their plans for the future. Thinking from their perspective, party cadres should have the responsibility of helping the poor and the accurate self positioning, and establish a positive and optimistic attitude towards life, instead of flaunting themselves in the moral Highlands, commanding and refuting the opinions of the masses constantly.”*

—— Mai Xianquan , project manager of Puge project of provincial highway S464 of Sichuan Chuanjiao road & Bridge Co., Ltd



Reporters from the Sichuan Observation Program of Sichuan satellite TV went deep into the project of the upgrading and reconstruction project of Puge section of provincial highway S464 to interview and record the special program of poverty alleviation



## Attachment: Enterprise Related Information



Company name: Sichuan Chuanjiao cross Road & Bridge Co., Ltd.  
Company address: Guanghan, Sichuan Province  
Company: <http://www.sccjlq.com/>

### Company Profile

Sichuan Chuanjiao road & Bridge Co., Ltd. is located in Guanghan City, Sichuan Province, the famous Sanxingdui ancient site. It is a backbone enterprise specializing in the construction of transportation infrastructure. The company has a registered capital of 1.22 billion yuan and a total assets of about 6.2 billion yuan. It has the extragrade qualification for construction general contracting of national highway projects and class A design qualification in the highway industry.

The company has four main business branches, a wholly-owned subsidiary, a holding subsidiary, a retirement and property management center and an equipment leasing Station. It is mainly engaged in infrastructure construction such as roads, bridges, tunnels, municipal, maintenance and geological disaster management. It has more than 500 sets of main equipment. At present, there are 1680 employees, including 2 persons with high titles, 169 persons with senior professional titles and 431 persons with intermediate professional titles.



The company originated from the professional traffic construction team established in 1950. At the beginning of its establishment, it participated in the construction of important trunk roads such as Chengdu-Aba, Sichuan-Tibet, Chengdu-Chongqing, Sichuan-Shaanxi, Sichuan-Hubei road and other railway construction such as Chengdu-Kunming railway. The company has participated in the construction of almost all expressways in the province. It also participated in the construction of key projects in more than 20 provinces and autonomous prefectures such as Hunan, Hubei, Chongqing, Tibet, Xinjiang, Qinghai, Inner Mon-

golia, Jilin, Hebei, Henan, Shanxi and Shaanxi. It successively participated in the construction of roads, bridges, airports and other projects in more than 10 countries such as the Middle East, South Asia and Africa. The projects are generally praised by the owners and all social circles. It has won the “Luban Award”, “Zhan Tianyou Civil Engineering Award”, the national “First Prize of highway traffic quality project”, the “demonstration model project” of the Ministry of communications, the Gold Award of “Tianfu Cup” and the “Third Batch of National Green Construction Demonstration Project”, and won 34 national patents.

## Corporate Culture

We will focus on the development of enterprises through culture, and strive to enrich the development details. Continue the red blood and carry forward the fine tradition. We should innovate on the basis of good traditions, improve our cultural level and further improve the soft power of the company. First, we should improve the “two systems” and create the “wind vane” of Chuanjiao culture. We will improve the system of standardizing words and deeds, and promote the “three educations” of speciality, culture and sports and skills; Improve the value concept system, and establish the work style of “being realistic, pragmatic and simple”, the work standard of “newer, better and stronger”, and the work concept of “innovation, accommodation, diversity and efficiency”; Improve the standardization level of the project image construction. According to the actual situation of the project, we will strive to create a characteristic image project, enhance the influence, and further polish the “business card of Chuanjiao Company”. Second, it is necessary to build “two systems” and depict the “scenic line” of Chuanjiao culture. We will establish the target responsibility

system and sign the target responsibility letter for safety and honesty. We will build a moral culture system and insist on “study every week, one class every month, one competition every quarter, and one theme every year”. The competition on enterprise culture and a series of lectures on “the most beautiful employees” will be carried out. A series of activities will be organized, such as school-enterprise joint construction, social-enterprise joint construction, enterprise-enterprise joint construction and red education, so as to guide employees to change their thinking. The third is to cultivate the “three advantages” and build the “main front” of Chuanjiao culture. We will cultivate the mainstream values, promote the self-management design of all employees, and advocate “fight for honor, battle for reputation”. We should cultivate core competitiveness, develop based on high-quality, strengthen responsibility, enhance the concept of overall planning, cultivate systematic thinking, and improve management level. We will also raise social reputation, pay attention to high quality and sustainable development, and always adhere to the goal of “striving for the first”.



## Major honors in the Past Three Years



Micang Mountain tunnel project of Taoba Expressway won the National High Quality Project Award in 2020-2021



"Zhongzhou Cup" of Henan Construction in 2020 (provincial quality project)



2019-2020 Henan provincial engineering construction Quality Project Award



World record for carrying flags



Jiangxigu expressway project won the Tianfu Gold Award of Sichuan construction project in 2018-2019



Mianxi Xichong expressway project won the Tianfu Gold Award of Sichuan construction project in 2018-2019



Taoyuan (Chuanling boundary) - Nanjiangling project of Taoba Expressway won the Tianfu Gold Award of Sichuan construction project in 2018-2019



Ya'an-Luding section of Ya'an-Kangding Expressway won the Tianfu Gold Award of Sichuan construction project in 2018-2019



Zhengzhou airport to Zhoukou Xihua Expressway phase II ZT-42018-2019 project won the Tianfu Gold Award of Sichuan construction project in 2018-2019

The third Prize of Science and Technology Progress  
Research on multi span seismic joint restoration and underwater crack repair technology of pier column of "512" "Miaoziping super large bridge after the earthquake"

## Performance Data for the Past Three Years

Index	Unit	Year of 2019	Year of 2020	Year of 2021
Total Assets	100 million yuan	8764422413.85	10261877584.23	10588540000
Operating Income	100 million yuan	252695776.8	288135723.92	574189109.12
Total Profits	100 million yuan	234738218.81	273261928.53	512591200.25

# For a World Full of Love

◇ Jiangsu Suzhong Construction Group Co., Ltd.

## Introduction

Jiangsu Suzhong Construction Group Co., Ltd. (hereinafter referred to as Suzhong) attentively participated in combating COVID-19, targeted alleviating poverty, caring for the vulnerable, and other charitable activities. The company acts on the principle of “Benefiting from the society and contributing to the society” and sends positive energy. These together make a responsible enterprise.



## SDGs

 <p>Goal No.1</p>	<p>Helped people in impoverished areas like the Lüliang Mountains. Offered money to build infrastructures and alleviated poverty through consumption to increase the income of the poor households.</p>	 <p>Goal No.2</p>	<p>Improved nutrition for the young and the old. Sent milk and bread to left-behind children for free. Made dumplings for the seniors in the nursing home.</p>
 <p>Goal No.3</p>	<p>Actively participated in combatting COVID-19. Guarded people's health by mobilizing the strength of the enterprise and making full use of its advantages.</p>	 <p>Goal No.4</p>	<p>Concerned for left-behind children by sending them computers, stationery, sports equipment and sports-wear, and other daily necessities, improving their living conditions.</p>
 <p>Goal No.6</p>	<p>Solved the problem of inadequate drinking water supply at school by funding the project of sewage system construction and reservoir engineering.</p>	 <p>Goal No.10</p>	<p>Ameliorated inequality in economic growth, education, and other fields by aiding the vulnerable such as poor households, left-behind children, and senior citizens.</p>

## CSR

 <p>Community Participation and Development</p>	<p>Attentively participated in combatting COVID-19, targeted alleviating poverty, caring for the vulnerable, and other charitable activities, so as to improve people's well-being.</p>		
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## 1. Case Overview

For more than 70 years, Jiangsu Suzhong Construction Group Co., Ltd. (Suzhong) has always adhered to the public welfare concept of “Benefiting from the society and contributing to the society” and actively participated in public welfare undertakings. In the process of company’s development, it has carried out extensive public welfare activities such as disaster relief, poverty alleviation, donation to education, and visiting the elderly. They insisted on giving back to the society with a grateful heart and pass on the quality of goodness.

## 2. Case Background

Enterprises form an important driving force for social development and progress, while society is the basis on which enterprises depend and expand. Over the past 70 years, from Hai'an to the whole country and the world, Suzhong Construction has grown from a labor union of grass, wood and tile industry with a dozen workers to a large modern construction enterprise group. In the development process, the company has always adhered to the public welfare concept, dedicated to cultivate a harmonious and charitable corporate culture, taking public welfare undertakings such as disaster relief, poverty alleviation, donation to education, respect for the elderly and other public welfare undertakings as an important carrier for enhancing corporate spirit. The company also encouraged employees to actively participate in social public welfare undertakings. The development of the enterprise continues to give back to the society, improve people’s livelihood and well-being, and give off the “Suzhong temperature” that creates a happy ambience.

## 3. Responsibility Actions

(1) Sense of responsibility - great love in front of disaster

In 2020, the sudden outbreak of COVID-19 wor-

ried every Chinese, so did with everyone in Suzhong Construction Group. The company made careful deployment immediately and called for loving donation. In just two days, all employees raised donations of 1.6 million yuan. Subsequently, the company donated more than 1 million yuan to purchase medical supplies to help Wuhan, the most severely affected area then, to combat the virus.

As a nationwide construction enterprise, the company assumed responsibility and undertook and participated in the construction of anti-epidemic hospitals in many places. Take the urgent task assigned to the Nanjing Regional Company as an example. They were asked to immediately build more contagious wards in the Third People’s Hospital of Bengbu City, Anhui Province. The company spared no time and organized more than 40 civil engineering personnel, more than 200 steel plate house construction personnel, and more than 150 water, electricity and equipment installation personnel to form a “fully armed” elite team and entered the field that night. Starting soil digging and cushion construction that night, the construction was completed in 16 days at the fastest speed to help fight against the epidemic. The second example is the Subsidiary Suzhong Dake took the initiative to undertake the project of intellectualized construction of three hospitals with the fame of “Xiaotangshan Hospital” in Guangxi, including People’s Hospital of Guangxi Zhuang Autonomous Region (temporary negative pressure ward project) in Yongwu, Liuzhou Longtan Hospital, and Wuzhou Third People’s Hospital (Emergency Hospital). Racing against time and operating day and night without stop, the company made great contributions to Guangxi’s fight against the epidemic. The third model work was done by the Beijing-Tianjin-Hebei regional company. Hearing the request from the Epidemic Prevention Headquarters for volunteers to build anti-epidemic isolation houses in Zhengding and Huangzhuang in Shijiazhuang Province, workers of Suzhong responded

quickly, and urgently assembled 38 volunteers to support Zhengding New District. After five days and five nights of continuous efforts, all the construction tasks delivered by the headquarters was completed with quality and quantity more than three hours ahead of schedule. When CCTV “Focus Interview” program reported the construction situation, Suzhong Construction was specifically praised.



Wuzhou Third People's Hospital (Emergency Hospital)  
constructed by Suzhong



CCTV “Focus Interview” program arranged special report on the company’s construction of anti-epidemic isolation houses in Zhengding and Huangzhuang

The people of Suzhong participated in the fight against the epidemic in different ways on the front lines across the country. As soon as the twentieth project department of Suzhong engineering company learned that the 120 tons of donated materials received in Shanghai were difficult to unload and repack due to lack of manpower, all staff were

immediately mobilized and gathered to participate after taking nucleic acid tests. They worked for 12 hours on-end in the rain, unloading, sub-packaging and distributing materials. As a responsible leading enterprise in Jiangsu, the company undertook the construction task of the centralized disinfection parking lot for transport vehicles in Hai’an. It was another anti-epidemic project Suzhong carried out for its hometown after the construction of mobile cabin hospital.

During the period of frequent epidemics, many Suzhong people were fighting on the front line of local epidemic prevention. Some of them were in white coat who assisted in nucleic acid testing, and some were in blue who participated in the disinfection of epidemic areas, and some were in red to help epidemic prevention and control, so on and so forth. Suzhong people, no matter where they were, actively responded to epidemic prevention policies, practiced social responsibilities with practical actions, and rushed to the front line of epidemic prevention and anti-epidemic volunteer services.

In the 2008 Wenchuan earthquake, the company donated 2.02 million yuan, and organized a construction aid commando to join the post-disaster reconstruction of the disaster area; in 2010, the company donated 550,000 yuan to Yushu-Zhouqu debris flow; in 2013, the Ya’ an earthquake, donated nearly 400,000 yuan; in 2016, the Yancheng tornado disaster area, donated 1 million yuan; 2020, COVID-19 pandemic, donated 2.06 million yuan; 2021, Suzhong people resolutely devoted themselves to disaster relief in the extraordinary rainstorm in Henan.

Over the years, the company has always lent a hand to the people in the disaster-stricken areas, manifesting a strong sense of social responsibility.

(2) Loving hearts - targeted poverty alleviation brings happiness

The flag of Suzhong also flutter in Lüliang Moun-



tains, the northwest of Taiyuan, Shanxi Province, where members of the Shanxi area Party group started overall targeted poverty alleviation. Xinzhuang Village is a remote place hidden in the mountains with all the low-rise houses and poor villagers. It was hard for the village Branch to find a chair to entertain guests. Suzhong people helped the village in need, as Suzhong staff quickly formed support pairs with villagers and funded the village committee to build a 500-square-meter activity room.

In May 2021, a news written “Attention! Hai'an Huangke Village's cabbage fell below the lowest price, urgently looking for help!” spread rapidly in the WeChat Moments. Suzhong's leaders attached great importance to the news and immediately took action to help farmers. Jianghai regional company, Nanjing regional company, and general engineering contracting company quickly organized vehicles and personnel to go to the site to purchase 28 tons of Chinese cabbage and deliver it to all the canteens of the project department in Hai'an and nearby cities. As a result, “Love Cabbages” became a “Love Dish” that benefited front-line employees.

In the same May, Qingdao Laoshan started its cherry picking season. However, many poor families in rural areas lacked labor. The Ninth Engineering Company offered to help the countryside and actively participated in the themed poverty alleviation public welfare project in Laoshan District, picking cherries for households living on the minimum allowance in pairs and adding their

household income.

The company carried out various poverty alleviation activities, implemented caring projects and feedback projects, and established the Guo Mingyi Love Team in Suzhong, donating 1 million yuan to the Hai'an Charity Foundation every year for charitable relief. Suzhong people have created traces in all kinds of public welfare activities.

### (3) Concerns - help children eager for knowledge

In the early summer of 2016, Lu Guoxing, the manager of the Tenth Engineering Company, and his companions came to the campus of Banghe Town central primary school located in the Sichuan-Tibet border. They brought love there. The brand-new schoolbags and school supplies they took make the children in Tibetan areas more than happy. It seemed that the valley was filled with love of caring volunteers and happiness of Tibetan children, nourishing the most beautiful Gelsang flower.

In the early summer of 2018, Chairman Da Honghu came to Shouyi School in Yangqu County, Shanxi Province, with full care for the left-behind children. He was also there for the commencement ceremony of “Sewage System Construction and Reservoir Project”. Suzhong had sent 50 brand-new computers to open a window to the world for the children, and set brand-new sports equipment to enrich children's recreational and sports life after school. The new sewage system and reservoir would drastically improve the school's water supply.



#### Unveiling Ceremony of the Groundbreaking of the Charity Aid Project

In 2021, in order to help a little girl "Nannan" have her own house as soon as possible, to concentrate on learning, comfortable life, 16 engineering company transferred mainstay, overall optimization of resources, high standard construction of Rizhao city Lanshan district happy town ShenJiaZhuang village "hut" trouble child care project, teenagers begin to build a dream place for trouble. In the golden autumn and warm September, Su-zhongDake came to Tomorrow School in Nanning City to send the orphans autumn sports clothes, milk, bread, pencils and other living and learning materials, and lit the lamp of hope for the students in need with practical actions. The flying dreams are growing up in the campus.

Concrete measures to help students have taken root and sprouted in ordinary campuses, blossoming into a public welfare flower of "poverty alleviation and education, walking with love".

#### (4) True feelings - let the old people feel the warmth of the sun

Care for the old and the old. Party members and active Party members from the headquarters of the Northwest Regional Company went to Xi'an Jimin Nursing Home with towels, soap, shampoo and other daily necessities to visit and comfort the lonely elderly, sending them the care and warmth of the Soviet people in the cold winter.

The youth and vitality of the volunteers of the 16th engineering company came to Ri Zhao Zhong Sheng Welfare home. They kneaded dough, rolled skins, mixed fillings, wrapped dumplings for the old people, and the old people chatted while they were wrapping, laughter wafted out of the room, full of fireworks breath of life. Watching the old people eating hot dumplings, each volunteer felt warm in his heart.

At Fu ShouJu Nursing Home in Shijiazhuang's Chang'an district, 24 volunteers from the Seventh Engineering Company formed a team to deliver new washing machines and televisions to the elderly. Some of the volunteers and the elderly chat, some accompany the elderly playing chess, some follow the nursing staff to do voluntary services... In the nursing home, bright red volunteer clothes become a beautiful scenery.

As year-round builders, volunteers accompany the elderly, just as they accompany their parents, grandparents and grandparents in their hometown. The lonely old people are no longer lonely because of the arrival of volunteers. The kind smile on each old person's face is warm as the sun.

#### 4. Effect of Responsibility Fulfillment

In the face of the economic new normal, the company focuses on high-quality development, engineering excellence and success report frequently, scientific and technological innovation highlights are numerous. In the continuous development of the company at the same time, always with a sincere heart to return to the community. In 2021, the annual tax paid exceeded 2 billion yuan. In recent years, it has provided tens of thousands of jobs for migrant workers and attracted more than 300 college students every year. In the past ten years, the company has donated more than 20 million yuan, highlighting the temperature and height of Jiangsu.

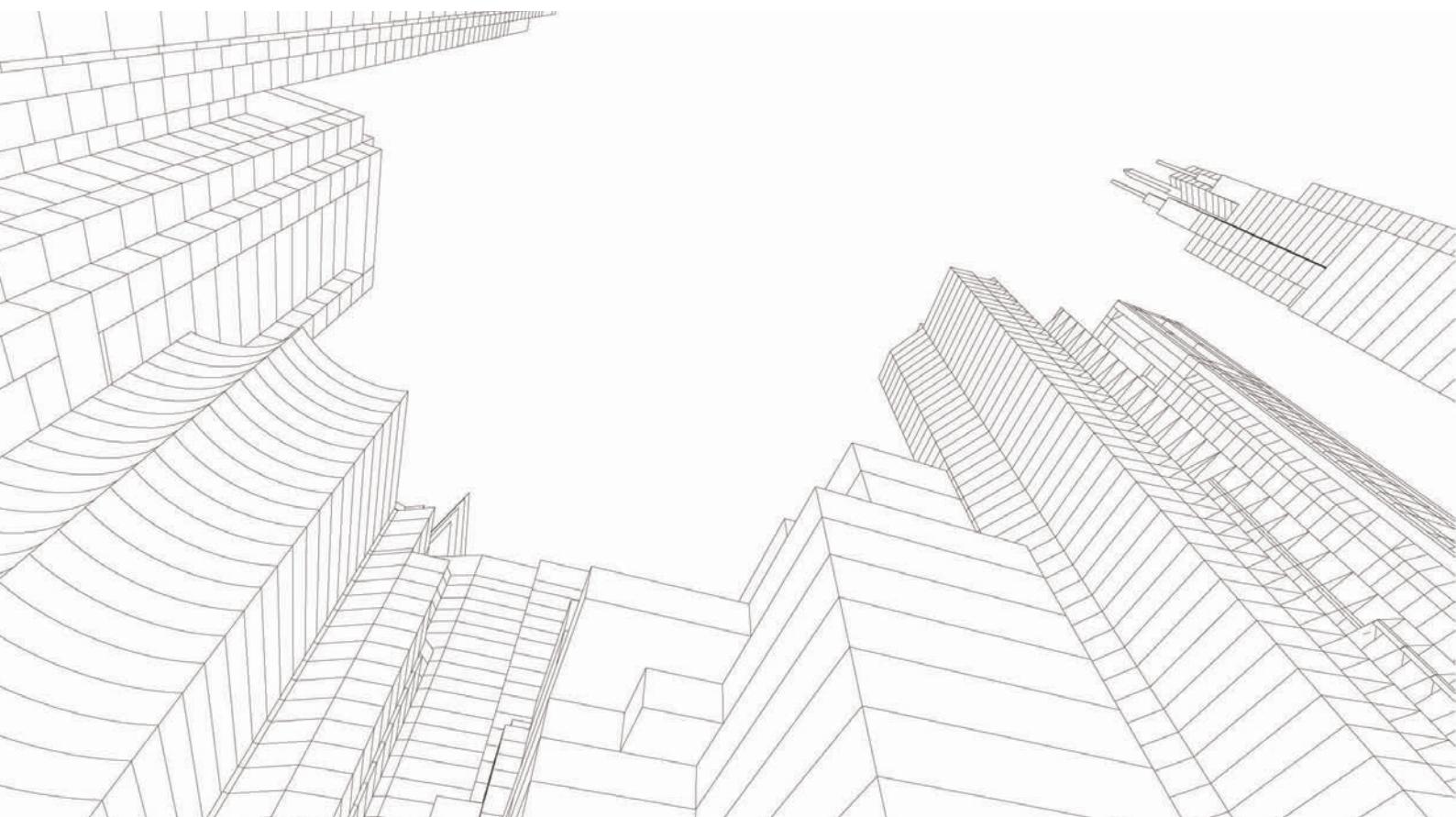
As the United Nations industrial development organization Chinese construction enterprise so-



cial responsibility project pilot enterprises, the company joint central enterprises, local state-owned enterprises and private enterprises to fulfill the social responsibility standard “initiative, help promote the construction enterprises to fulfill social responsibility, awarded by the United Nations industrial development organization type” performance evaluation of construction enterprise society responsibility excellent title. At the same time, the company has been awarded the honorary titles of “the Red Cross Humanitarian Assistance Unit”, “the Most Caring Donor Unit”, “the Most socially responsible charity Star Enterprise”, “The most Caring Charity Enterprise”, “The Charity Star Unit” and so on in Nantong City. Da Honghu, the chairman of Da Honghu, was selected as the “Model of Charitable Donation in Hai'an”, “Advanced Individual for Charitable Donation in Hai'an in 2014-2018” and “Advanced Individual for National Social Poverty Alleviation.”

## 5. Future Outlook

Public welfare is an ancient and noble moral cause, and it is also an important way to build a social moral system. Helping others to help themselves and help others has long been embedded in the spiritual family tree of the Chinese people. Poverty alleviation, helping the weak and economic leanings have long been printed in the minds of the Chinese people. As a company with a sense of social responsibility, Suzhong Construction has always carried out the public welfare spirit of “giving consideration to justice and interests, and attaching equal importance to virtue” with practical actions. In the future, the company will make unremitting efforts to take public welfare as an important carrier to cultivate corporate culture and enhance corporate spirit, and build a world of love and four seasons of love with public service dedication!



## 6. Deposition from Stakeholders

*“As a leading enterprise in Haian construction industry, Suzhong Construction Group has been rising and strengthening all the way in the fierce market competition for 70 years. Its comprehensive strength has been significantly enhanced, its position in the industry has been continuously improved, and a large number of high-quality projects have been created. Group from a single set of construction enterprises grow into construction, municipal, intelligent, decoration, geotechnical engineering, new building materials, engineering general contracting, investment and development and the coordinated development of the modern enterprise group, in order to promote haian construction development added a bright color, high quality for the construction of economy is strong, and the people rich, beauty of environment, high degree of social civilization in the new haian made a positive contribution.”*

-- Yu Haizhong, Deputy Secretary and Mayor of Hai'an Municipal Committee

“People in Jiangsu will always be grateful and strive to shoulder social responsibilities. In the future, the construction of Suzhou province will definitely be more competitive and strong to stick to the main construction industry and long-term value.”

-- Da Honghu, Chairman of Jiangsu Suzhong Construction Group Co., Ltd.



# Build a Community of Responsibility with the Power of Social Public Welfare

◇ China Shanxi Sijian Group Co., Ltd.

## Introduction

China Shanxi Sijian Group Co.,Ltd actively builds a quality oriented social responsibility management model, adheres to the concept of community of responsibility, vigorously participates in community construction, regularly carries out social public welfare activities, actively gives back to the community, and promotes the development of local communities.



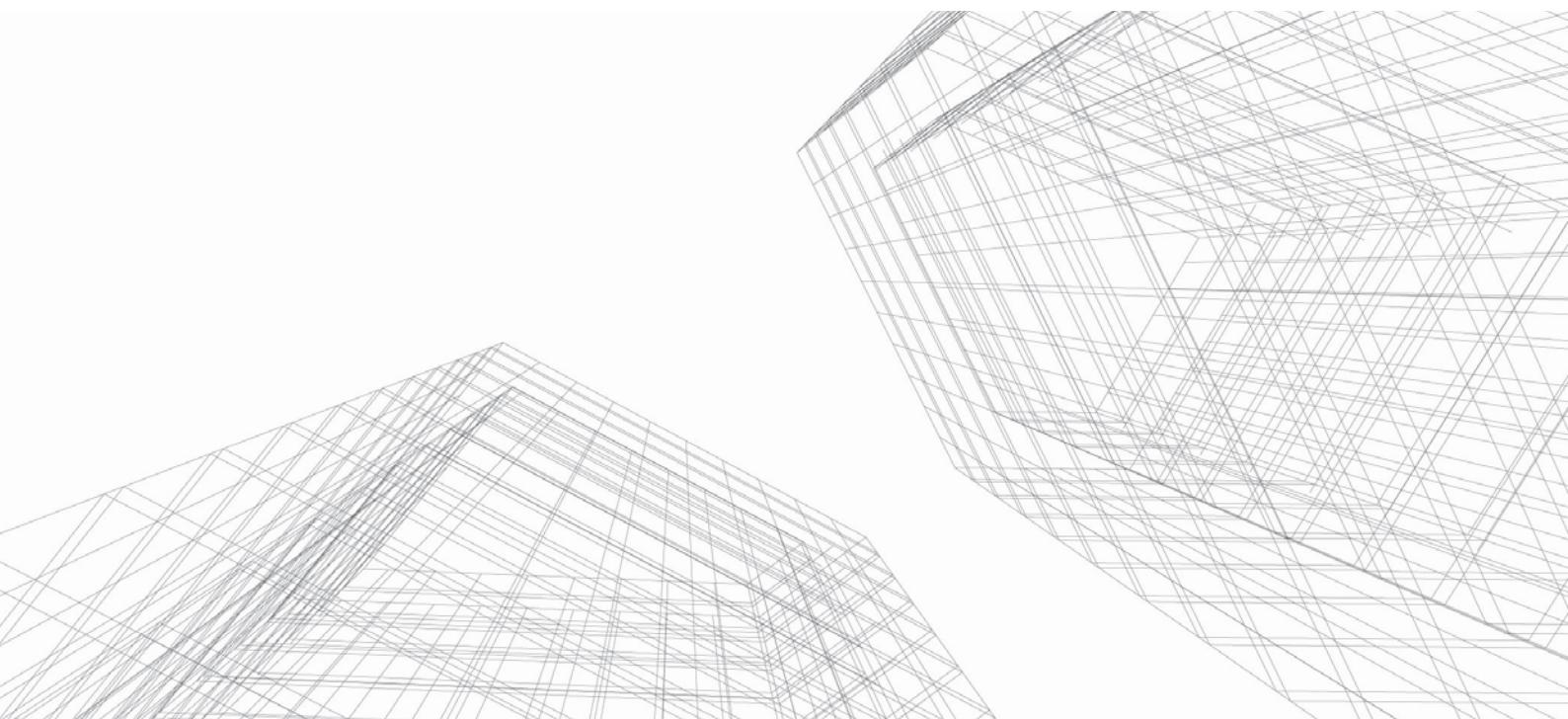
## SDGs

 Goal No.2	<p>Carry out the activity of “sending thousands of families with philanthropy” and donate rice, flour, oil and other necessities to more than 300 poor families and people who are poor due to illness in 13 counties (cities, districts) of Yuncheng City.</p>	 Goal No.3	<p>Purchase epidemic prevention materials and donate them to epidemic prevention and control stations in local counties. Establish a volunteer team to carry out nucleic acid sampling in the community, which helped the local epidemic prevention and control and protected the health of the people.</p>
 Goal No.4	<p>Donate books, school supplies, toys, etc. to children in need to improve their learning conditions.</p>	 Goal No.9	<p>Actively participate in township roads, urban heat supply, river governance and other projects, and improve local infrastructure.</p>
 Goal No.10	<p>Carry out assistance activities for vulnerable groups, build township roads and other infrastructure, and take various measures to reduce the gap in economic development and education services.</p>	 Goal No.13	<p>Implement the concept of green environmental protection, strengthen environmental management, promote green construction, maintain ecological balance, and reduce environmental impact.</p>



## CSR

 Fundamental Responsibility	<p>Strengthen the quality management, strictly control the construction quality, pay attention to the performance of the construction period, and complete the project construction with high quality. Adhere to the style of integrity and establish a long-term and stable cooperative relationship with the owner.</p>	 Organizational Governance	<p>Establish and improve the social responsibility management system, establish a social responsibility leadership organization with the participation of senior leaders, and promote social voluntary services in a regular manner.</p>
 Environment	<p>Implement the concept of green environmental protection, strengthen environmental management, promote green construction, maintain ecological balance, and reduce environmental impact.</p>	 Community Participation and Development	<p>Actively participate in community construction, carry out diversified social public welfare activities such as poverty alleviation, environmental protection, community services, care for the elderly, participation in emergency relief, and volunteer services for epidemic prevention and control, and transfer positive energy.</p>



## 1. Case Overview

“Let’s join hands to sow the seeds of cooperation and reap the fruits of development together, so that people of all countries can be happier and the world can be a better place!” The keynote speech delivered by the Xi Jinping General Secretary at the opening ceremony of the second “the Belt and Road” International Cooperation Summit Forum won strong resonance among the participants.

Hold hands, grow together and create a better future. Since its establishment, the 14th Branch of Shanxi Sijian Group Co., Ltd. (hereinafter referred to as the “Branch”) has taken conscientious performance of corporate social responsibility as its own responsibility, and used the concept of value-added enterprise service to satisfy users. With the initiative of joint development, it has sowed the seeds of responsibility, enhanced the sense of responsibility and the ability of employees to perform their responsibilities, jointly built a community of responsibility, and promoted local development.

## 2. Case Background

Social responsibility is the unity of corporate interests and social interests. The act of corporate social responsibility is a “mutually beneficial” act to safeguard the long-term interests of the enterprise and meet the requirements of social development, which can create a broader living space for itself.

It is of great significance for enterprises to fulfill their social responsibilities, which can help them improve their image, increase their competitiveness, create a good environment for their sustainable development. And by assuming social responsibilities, the cultural construction of enterprises can also reach a higher level.

The social responsibility management system has become the current global language system and value system, a yardstick to judge the value of an enterprise’s existence, and a cornerstone to en-

sure the sustainable development of an enterprise. Therefore, Shanxi Sijian Group Co.,Ltd has to undertake social responsibility and fulfill social obligations, which has become an inevitable choice and internal requirement for the development of the enterprise itself. In this regard, the company has established a social responsibility leadership organization held by the senior management of the enterprise to provide organizational and system guarantees for the enterprise to fulfill its social responsibilities. Social responsibility is the unity of social interests and corporate interests. The act of corporate social responsibility is a “mutually beneficial” act to safeguard the long-term interests of enterprises and promote social development.

With the concept of “providing high-quality projects for the society based on the performance of construction period and high-quality products, and contributing to social progress based on employee happiness and user satisfaction”, we have created a first-class enterprise group in the field of domestic engineering construction. We are committed to becoming a model of fulfilling social responsibility in China and building a quality oriented social responsibility management model through joint construction, consultation and sharing.

The company actively engages in social welfare, gives full play to the advantages of state-owned enterprises, and participates in voluntary services and social practice. In 2021, we have built and improved the social responsibility management system and have promoted the normalization of voluntary services. Party, workers and league organizations at all levels actively carry out various forms of social public welfare practices and voluntary services, such as poverty alleviation, environmental protection, community services, caring for the elderly, participating in emergency relief, epidemic prevention and control volunteer services. We strive to give back to the society with love, and transfer positive energy.



Under the relevant measures and guidance of the group company, the branch company is trying its best to promote the development of the local community with the power of value-added services and public welfare and the concept of community of responsibility.

### 3. Responsibility Actions

The company has constantly strengthened the concept of high-quality development, implemented comprehensive quality management at different levels and businesses, actively introduced advanced quality management methods such as excellent performance management, and committed to establishing and implementing a unique integrated management system based on international management standards. It is the first enterprise in Shanxi Province that integrates eight management system certifications, and has successively passed the integration of quality, environment, occupational health and safety, informatization and industrialization, AAA level excellent quality management system certification and social responsibility management system certification and evaluation. Focusing on the development vision of "becoming an outstanding service provider in the whole life cycle of construction", the company has adhered to the "inheritors of Luban spirit and practitioners of craftsmanship spirit", created a first-class enterprise group in the field of domestic engineering construction, and formed a management system with its own characteristics.

The company has determined that the implementation steps of the social responsibility management system are divided into three stages: social obligation stage, social responsibility stage, and social response stage. The company will take actions to respond to current and future social problems, gradually play a positive role in society, and use the power given to the enterprise to promote social progress.

#### (1) Honest service and participation in community construction

In 2015, when the branch company first entered the Houma market in Shanxi Province, it actively practiced the concept of green environmental protection in the product production process, strengthened environmental management, promoted green construction, and maintained ecological balance. With high-quality service, integrity style, and efficient work rhythm, it was unanimously praised by the construction party. It persuaded the owner to use aluminum alloy templates instead of wood templates. The use of conventional wood templates consumes a lot of wood resources, which has a certain impact on the natural ecological environment. The use of aluminum alloy templates effectively saved resources, achieved sustainable development in the production process. We strive for the balanced development of production and operation, society and environment, and have successfully established a 7-year cooperative relationship with the owner.

In 2017, the branch company undertook to build the Lucheng central heating project, which was one of the ten practical things for people's livelihood determined by the Lucheng Municipal Party Committee and the Lucheng Municipal Government that year. The construction of this project was related to the people's livelihood in Lucheng, shouldering the responsibility of timely heating for thousands of households. From the commencement of construction to the heating season, there was only a construction period of more than 50 days, and it was still facing the obstacles of the rainy season. The time was tight and the task was heavy. The project management personnel were brave to overcome difficulties and worked hard to speed up the progress of the project. The whole line was connected on time, so that people in Lucheng could enjoy the heat brought by heating in the cold winter. The People's Government of Lucheng City highly recognized the spirit of Lucheng Central

Heating Project to strive to achieve the goal, and sent a letter of thanks to Shanxi Sijian Group Co., Ltd. The branch company awarded the title of “Sijian Iron Army” to the Lucheng central heating project team.



Appearance of Baisha River in Xiaxian County

In 2018, the construction of Baisha River Project in Xiaxian County was a concrete action of Shanxi Sijian to implement Xi Jinping General Secretary's concept of “clear waters and green mountains are as valuable as mountains of gold and silver” and promote the strategic thinking of “two mountains, seven rivers and one basin” ecological protection and restoration. At the beginning of the construction, the project team of Shanxi Sijian established the responsibility concept of fully improving the urban ecological environment and realizing the happiness of the people in Xiaxian County as soon as possible. It took 3 years for the project department to reasonably deploy the construction process, orderly divide the construction work surface, and scientifically allocate the construction time. During this period, the epidemic pressure was overcome, and a dry garbage river was built into a new ecological river. Now Baisha River in Xia County, with the identity of “the back garden of Yuncheng”, has become a good place for many citizens to play, and a comprehensive place for leisure, sightseeing, fitness, inheritance of Xia Coun-



Appearance of Yongji Yanhuang Tourist Highway



Appearance of the Road from Yuanqu County Forest Farm to Nanpo

ty history and education of revolutionary tradition.

From 2018 to 2020, adhering to the concept that “building a happy road for the township people is a conscientious project”, the branch company undertook the road reconstruction project of the east section of Taifeng Street in Wenxi County, the Yongji Yanhuang Tourist Highway, and the reconstruction project of the road from Yuanqu County Forest Farm to Nanpo. During the construction, it strictly controlled the construction quality, paid attention to the implementation of the construction period, and completed the construction of three township roads with high quality and high standards. It has promoted regional economic development, facilitated the travel of township people, improved people's living standards, and improved the consumption environment.

(2) Not forget the origin and Promote community development

① Continue to help the college entrance examination and practice corporate responsibility



Assist the college entrance examination in 2018



Assist the college entrance examination in 2020



Assist the college entrance examination in 2021



Assist the college entrance examination in 2022

Since 2018, the branch has continued to support the college entrance examination. On the college entrance examination day every year, it will set up a “Love Service Station” to prepare the students and their parents with emergency heatstroke

prevention drugs, stationery, mineral water and other necessary items, and assist the traffic police to maintain order, create a good environment for the candidates, cheer for the students, and fully demonstrate the social responsibility of state-owned enterprises. The continuous development of support for the college entrance examination has established the full pride of employees and the responsibility of the enterprise. From only one service point for college entrance examination at the beginning to serving all the examination site in Yuncheng now, from the original few employees to the present more than 20 employees who actively participate, from the original shy service to the present considerate and comfortable service, the branch has not only gained the growth and strength of employees, but also provided a high-quality feedback for the development of the community.

② Help national level events and show enterprise dedication



Group photo of Lucheng project team of the branch company helping the Second National Youth Games

In 2019, the torch relay activity of “Shanxi Gas Cup” of the Second National Youth Games was held in Lucheng District, Changzhi City. The branch company actively responded to the call and deployed Lucheng project team to help the Second Youth Games. Everyone was actively involved and enthusiastic, participating in services such as distributing mascots of the “Second Youth Games” to residents along the street, maintaining order on site, cheering and shouting for the torchbearers. The torch relayed a kind of spirit, and the support team of the branch company also showed the spirit

of enterprise dedication, which has won the unanimous praise of residents along the street.

③ Care for vulnerable groups and reflect enterprise warmth



The Deputy Secretary General of Yuncheng Municipal Government awarded the “enterprise of love and dedication”

In January 2021, the branch company, together with the Yuncheng Red Cross, carried out the activity of “sending thousands of families with fraternity”. They donated rice, flour, oil and other necessities with a total value of 100,000 yuan to more than 300 households of poor people in 13 counties (cities, districts) of Yuncheng City and sent them the warmth of the Shanxi Sijian. The Deputy Secretary General of Yuncheng Municipal Government expressed his heartfelt thanks to Shanxi Sijian for its kindness in public welfare, supporting public welfare, participating in public welfare, and bravely undertaking corporate social responsibility, and awarded the honor badge of “Enterprise of Love and Dedication”.



Donate materials for the “Sunshine Youth” project of Yuncheng First Time Volunteers Association

On June 1, 2022, the staff of the branch company spontaneously donated money to purchase materials, donated 6 air conditioners, 3 children's wardrobes and 20 summer cool quilts to the “Sun-

shine Home" of the first time love volunteer association of Yuncheng City, and used them to help the children in need of "Sunshine Teenagers" of the volunteer association. This time, the branch company continued to pay attention to vulnerable groups, and tried its best to help others, which was passed on. The children of the branch company's employees also actively participated in the love dedication, donating 78 books, 18 toys, 5 boxes of school supplies, etc.

The warmth of the enterprise bloomed in the community and was passed on to the next generation.

④ Join hands to fight the epidemic and show the responsibility of the enterprise



Donate epidemic prevention materials to Yanhu District of Yuncheng City



Donate epidemic prevention materials to Xia County epidemic prevention headquarters

In February 2020, the COVID-19 epidemic was raging. We all encountered the situation that it was difficult to purchase protective articles. We also carried out the resumption of work and production under pressure in very difficult times. When encountering these situations, the branch company gave full play to its personnel at the first time, purchased epidemic prevention materials of more than 170000 yuan, and donated them to epidemic prevention and control stations in Yuncheng City, Yuncheng Yanhu District, Linyi County, Xia



The photo of volunteer team helping nucleic acid test of all staff



Employees help community work

County, Yongji and other counties. It helped the local epidemic prevention and control.

In April 2022, the situation of the new round of COVID-19 was severe. The normalized nucleic acid test of all staff and requirements added a responsibility to the work of each community. Members of the volunteer team of the branch actively participated in the nucleic acid test in the community. They had a clear division of labor, pushed cotton swabs, pasted bar codes, assisted the elderly, and maintained order. In two hours on the same day, they completed the nucleic acid testing of 1351 people in the community. The high-quality and efficient service has been unanimously praised by the community staff.

⑤ Timely emergency rescue shows enterprise speed



The branch company donated materials to the flood disaster area

In October 2021, Shanxi Province continued to rain, resulting in disaster in many places. The branch company immediately prepared military coats, one-piece rain pants, protective gloves, glare flashlights and other urgently needed materials, which were sent to Jishan County and Xinjiang County respectively to contribute to flood control and disaster relief. The employees also made voluntary donations for post disaster reconstruction, totaling 8265 yuan. It made a timely and warm contribution to the society.

When one drinks water, one must not forget where it comes from. The society provides us with the basis for development, and the branch company can survive well in the society. We should repay the society with a strong sense of responsibility. The branch company has shouldered the responsi-



bility. With the sense of responsibility of positive energy, it has affected every employee, promoted everyone to establish the spirit of selfless dedication and fearlessness, and let responsibility and action deeply rooted in the hearts of employees, so that they can give full play to their self-worth. The branch company and employees have jointly built a community of responsibility. They have made timely and active contributions to a better society and promoted the development of the community.

#### **4. Effect of Responsibility Fulfillment**

We draw strength from our role models to help every employee take responsibility consciously and become a pioneer in the struggle.

In 2020, the pledge of “fighting for 100 days and opening up the Zhongyin Road” enabled all the project staff to overcome difficulties and achieve the goal. In order to make the Jiefang Road project smoothly open to traffic before the third “National Farmers’ Harvest Festival”, the project staff worked day and night and completed the goal. During the construction process, we built temporary driveways for citizens, installed lighting lamps, sent the elderly hospital, built temporary bus stops, helped trapped vehicles, assisted traffic police, etc. At the time of work, public welfare actions have become warm daily actions for the employees. In 2021, the construction period of Beixiang central heating was very tight. Overcoming difficulties and supplying heating on time has become the common goal of everyone. At the same time, they explained heating knowledge to the elderly and widows, and explained heating precautions to villagers one by one, which sublimated the responsibility of the staff. After the project was

completed, the villagers sent out 19 thank-you banners which hung the whole meeting room...

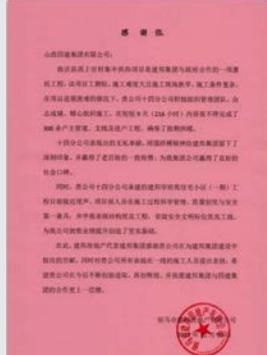
Because of the cornerstone of employees who are energetic and committed, in 2021, the operating revenue of the branch was 1.295 billion yuan, 26 times higher than when it was established in 2015. The construction output value exceeded 1.4 billion yuan, 28 times higher than when it was established in 2015. The profit was 59.5663 million yuan, 41 times higher than when it was established in 2015. The per capita income was 153,100 yuan, four times higher than when it was established in 2015. The branch was rated as one of the top ten third level units (comprehensive) of Shanxi Construction Investment Group in 2021, the advanced branch of Shanxi Sijian Group Co.,Ltd in 2020 and 2021, and won the “Progress Management Cup”, “Economic Benefit Cup”, “Talent Construction Cup”, “Spiritual Civilization Cup”, “Transformation and Development Cup” (five out of the group’s ten cups) in 2021. Many projects were honored as advanced projects of Shanxi Sijian Group Co.,Ltd.

The strength of the staff has promoted the strength of the branch, and the strength of the branch has promoted the local development.

#### **5. Future Outlook**

We will let every employee who enters the branch company not escape from responsibility and responsibility, be brave to take on responsibilities and fight, have the responsibility of standing up and taking the lead, and closely link responsibility with the goal of realizing dreams and social dedication. We will give every person responsibility and mission, and take expanding the spiritual territory of employee responsibility as the long-term goal.

## 6. Deposition from Stakeholders



*The selfless dedication and indomitable spirit of the 14th branch company impressed Jianbang Group and won the unanimous praise of the people. It has won a good social reputation for our group company."*

——Houma Jianbang Real Estate Co., Ltd

In November 2017, Houma Jianbang Real Estate Co., Ltd. sent a letter of thanks



*"Faced with the difficulties and pressures of tight time and heavy tasks, your company took the overall situation into consideration, bravely shouldered the heavy burden, acted quickly and unconditionally, and immediately organized human resources and machinery to invest in the project construction. The project department made scientific arrangements, carefully deployed, strengthened management and civilized construction, implemented safety and linked quality at all levels, and completed all work well."*

——People's Government of Lucheng City

In April 2018, Lucheng Municipal People's Government sent a letter of thanks



*"Faced with the pressure of tight schedule and heavy task, all the project personnel of your company worked together to overcome difficulties. They went to all lengths to rush the construction period and successfully achieved the construction period goal two days ahead of schedule."*

——Changzhi Senlian Joined Hands Real Estate Co., Ltd.

In September 2020, Changzhi Senlian Joined Hands Real Estate Co., Ltd. sent a letter of thanks



*“Your company has made scientific arrangements and meticulous arrangements during the construction process. From site management, process requirements to later operation, we can see your company's strict system, excellent professional quality and social responsibility of dedication.”*

——People's Government of Beixiang Town, Yanhu District, Yuncheng City

In December 2021, the People's Government of Beixiang Town, Yanhu District, Yuncheng City sent a letter of praise



*“During the operation phase of centralized heating, the project department took full responsibility for the operation, assigned special personnel to be on duty 24 hours a day, actively entered the villagers' homes, explained the heating knowledge to the villagers, and solved the heating problems in the villagers' homes. The value-added services of the project department were unanimously praised by the villagers.”*

——People's Government of Beixiang Town, Yanhu District, Yuncheng City

In June 2022, the People's Government of Beixiang Town, Yanhu District, Yuncheng City sent a letter of thanks



*“Your company's Yuncheng Wuyue Plaza Project Department has made outstanding achievements in progress and safety site civilized management in the evaluation of the general and subcontract site management of the Yuncheng Wuyue Plaza Project.”*

——Yuncheng Xincheng Hongyu Real Estate Development Co., Ltd

In June 2022, Yuncheng Xincheng Hongyu Real Estate Development Co., Ltd. sent a letter of praise



*"The project is in the decoration stage this year, and there are many professional subcontractors. Your company adheres to the morning meeting and evening report system every day, actively organizes all subcontractors to hold meetings, and tries your best to solve all difficulties encountered on site, which perfectly explains the responsibilities of the general contractor."*

——Wenxi Shengbang Real Estate Development Co., Ltd

In June 2022, Wenxi Shengbang Real Estate Development Co., Ltd. sent a letter of praise



*"During the construction process of your company, the project staff always adhere to the high standard of work requirements, and have won high recognition from all parties with a high sense of responsibility, scientific arrangement and careful deployment."*

——Yuncheng Xinchangyuan Real Estate Development Co., Ltd

In June 2022, Yuncheng Xinchangyuan Real Estate Development Co., Ltd. sent a letter of praise

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