1. Project overview

The Nanjing South Railway Station to Lukou Airport section of the Nanjing-Gaochun Intercity Rail System is located in Nanjing, Jiangsu Province with a total length of 35.8 km and composed of 8 stations. It is the world's first supporting rail transit project built specifically for a Youth Olympic Games. Engineering consultation for the project began in May 2010, construction started in February 2011 and the project was completed in June 2014. Total investment in the project was 13.586 billion RMB.

The project supporting the Youth Olympic Games made achievements in several fields such as shallow mining and shield tunneling and elevated U-frame construction. It passes under the Beijing-Shanghai High-speed Railway and has received 17 provincial level and municipal level awards. During the construction phase of the project, great innovations and breakthroughs were achieved in theory, technology and methods, representing advanced global techniques.

2. Playing a leading role in the successful hosting of the Summer Youth Olympic Games and the establishment of a national hub city

As the main transit system for the 2014 2nd Summer Youth Olympic Games held in Nanjing, this project played a leading role in relieving traffic congestion in the city during the games. The project also displayed the overall development strength and charm of the city of Nanjing to the world. Thomas Bach, president of the IOC (International Olympic Committee), praised the Games as "Excellence and perfection". Marianna, the observer from Buenos Aires, the host city for the next Youth Olympic Games, praised the Games as "Offering convenient and efficient transportation". Such high praise clearly shows the efficiency of the associated facilities for this Youth Olympic Games.

nprehensive transportation hubs, Lukou Airport and It has helped to elevate Nanjing to the level of national hub city by reconstructing the city's transport networks. It thus has far-reaching influence on the transport distribution of Eastern China and indeed the whole of China.

3. Positive innovation with high quality, advanced professional levels and a leading position in the industry

1) The project was the first in China to use innovative application of shallow mining and shield tunneling methods (GPST construction method). The practical limitation caused by the minimum earth-coverage depth along the shield section from Jiyin Avenue to Zhengfang Road (M.) was overcome, achieving integrated design and construction connecting the underground tunnel and above ground roads. This avoided any impact on the environment caused by excavating the concealed buried section, thus providing a new solution for tunneling construction. The GPST construction method can also be applied to both international and domestic underground projects such as urban railway systems, exit roads from interchanges and main road tunnels and road tunnel ramps. By using shield tunneling instead of open excavation in the concealed buried section, the site area and earthwork excavation can be reduced by over 50%, which can reduce the removal work required and impact on the surroundings. Shallow tunneling instead of deep excavation can reduce the construction risk and earthwork excavation. It also shortens the construction period, thus generating both economic and social benefits.

2) The project witnessed the first application of elevated U-frame construction to a domestic airport transit line. The U-frame structure can reduce noise efficiently and improve the construction quality and significantly lengthen the service life of additional structures added to the bridge. The concrete section of the U-frame is greatly decreased compared to traditional box girders, thus reducing construction and operational costs. The base plate of the U-frame is just 1/6 that of the box-girder. Its

e construction volume and the visual impact on the cture of the system is optimized with a folded line arrangement, which can also reduce the construction volume. When equipped with an ornamental covered beam underneath, the whole structure can create a harmonious landscape, thus meeting the needs for both landscaping and environmental protection. Such technology is therefore both practical and instructive to both international and domestic metro construction.

3) The project is a typical example for a number of metro tunnels passing under national railway lines such as the Beijing-Shanghai High-speed Railway, Shanghai-Wuhan-Chengdu Intercity Railway, Nanjing-Anqing Intercity Railway and Nanning-Wuhu Freight Line. Using good protection design and route optimization, the operational safety of high-speed railways during the construction period can be guaranteed. The technology used in this project for crossing high-speed railways is a market leader in China.

4) This was the first real use of control center resource-sharing in Nanjing. The vanguard design concept of the multi-line concentrated shared construction was applied to the control center for Nanjing South Station. The multi-line resource sharing allowed the centralization of resource distribution, network distribution coordination and coordination of emergency command. This networking and support represented advanced domestic standards.

4. Transparency and integrity throughout the whole process of project construction

A strict integrity management system is well established in our company. The company president has signed and approved the *Guangzhou Metro Design & Research Institute Co. Limited Regulations on Integrity Risk Management.* In addition integrity training was attended by all the staff in the form of regular departmental lectures and work meetings and e-mail notification.

Our company won the project through public tender. At the commencement of

an integrity clause in the contract with the owner. re selected by public tender and were required to sign an integrity agreement. All decisions and judgments are fair and transparent with recorded minutes of all meetings sent to all parties. A moral code of integrity and equity was strictly followed throughout the whole design process; no remuneration which could affect independent judgment was received. No material incentives were provided to the owner or any other interested party. There was no intentional or unintentional defamatory behavior. There was no action which could affect the independent and fair judgement of the owner such as unauthorized determination of equipment and material suppliers in the design documents.

FIDIC project management methods were applied throughout the project, and the FIDIC standards of contract management, risk management and sustainable development were actively used. The FIDIC concepts of "social responsibility, excellent service, objectivity and equity, corporate integrity, anti-corruption and fair competitive advantage" were fully implemented. After the competition of the project, both national and regional audits found no violation contrary to the professional ethics of consulting engineers.

5. Sustainable development and environmental protection

The completion and operation of this project has made Nanjing a national hub city. This project created a precedent in metro construction with the first application of shallow mining, shield tunnelling and elevated U-frame construction in an airport railway transit system. It has helped to promote the rapid development of air harbour cluster cities along the line, meeting the sustainable development needs of Nanjing's economy and achieving great economic benefits.

The project provided 65,000 direct and indirect jobs during the construction period and 1,800 direct jobs during post-completion operations. There were no fatal accidents during construction.

stem with 6 Type B trains was applied to this project capacity equal to approximately 470 airport shuttle buses or 9,400 taxies, thus significantly increasing the benefits for passengers.

This project is connected with Metro Lines 1 and 3, thus improving the "Cross-shaped" public transport links in Nanjing and connecting the two comprehensive traffic hubs, Lukou Airport and Nanjing High-speed Rail Station, thereby making the city a national hub city. The transport network of Nanjing has been rebuilt, with far-reaching influence on the transport distribution of eastern China and the whole country, thereby promoting urban development and exploitation of resources located along the metro lines. Remarkable economic benefits have been achieved. By the end of May 2015, pollution discharge had been reduced by 3,176 tons producing environmental benefits as a result of decreased air pollution estimated at RMB0.715 billion. This has therefore made a significant contribution in environmental protection and in protecting the historic sites of the ancient capital.

The technology for passing under high-speed railway lines was successfully applied to allow the rail line to pass under the Beijing-Shanghai High-speed Railway. Using separated pylons, line burial depth control, foundation level and distance control, synchronous and secondary slip casting and strict performance monitoring along the Beijing-Shanghai High-Speed Railway, structural deformations of the bridge beams have been efficiently controlled. The shield tunnelling was also conducted successfully. There was no impact on the operation of the high-speed railway service.

This project was the main pillar of the south-north development axis of Nanjing and will further enhance the regional integration and development in the future. In tandem with the continuous development of Yangtze River Delta urban agglomeration and intercity traffic, this project will play a guiding role and the potential for greater urban development will increase. Rail capacity and efficiency will improve and this will further assist the ongoing development of Nanjing as an international metropolis.