ITA TUNNELLING AWARDS 2018

Dongping Tunnel

Foshan, CHINA

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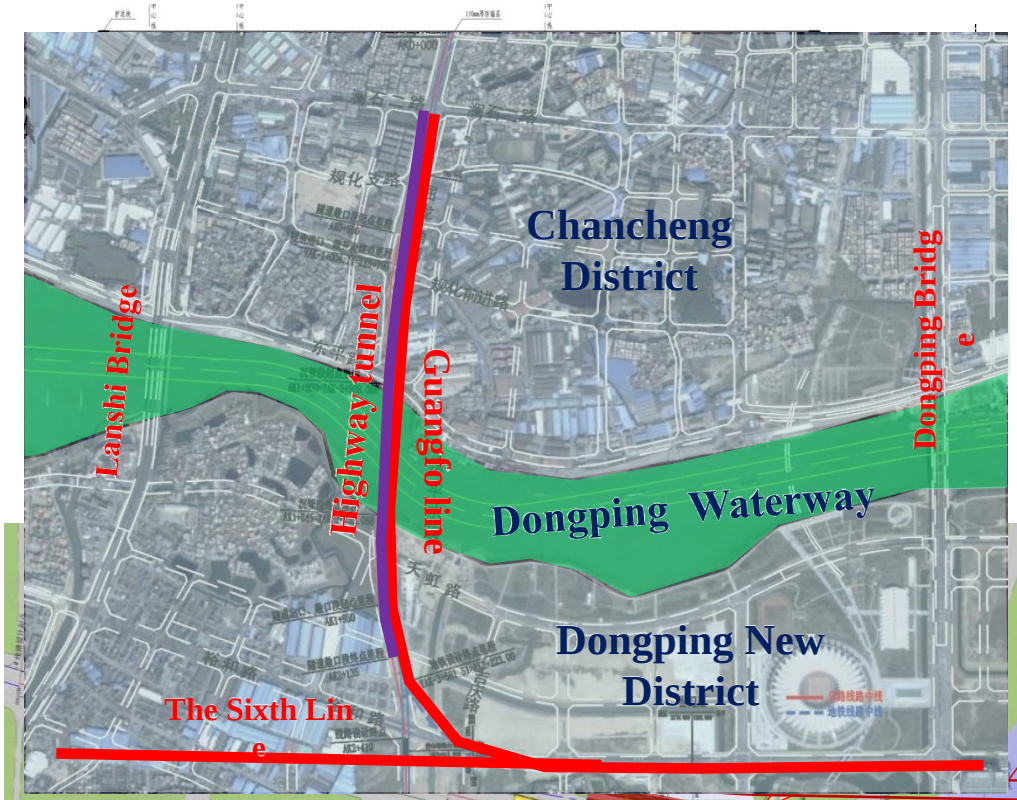
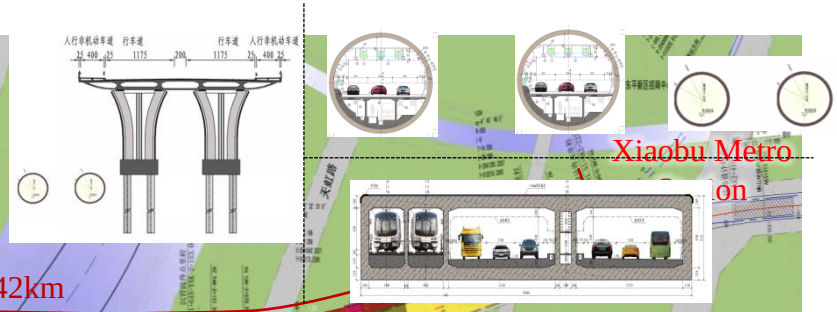




As an important part of Pearl River Delta Region expressway network in the Guangdong-Hong Kong-Macao Great Bay area ,the Dongping Tunnel connects the Chancheng District and Dongping New District of Foshan City. According to the city master planning, both the highway and the subway need the same passage to cross the river.

In order to alleviate the impact on river navigation and urban landscapes, the tunnel scheme was adopted to cross the river. Since the tunnel is located in the downtown area, the existing roads widths narrow. In order to avoid the impact on both sides of the road during the immersed tube method tunnel serves both for highway and metro is adopted finally, which has the smallest transverse land width and the optimal road traffic function.

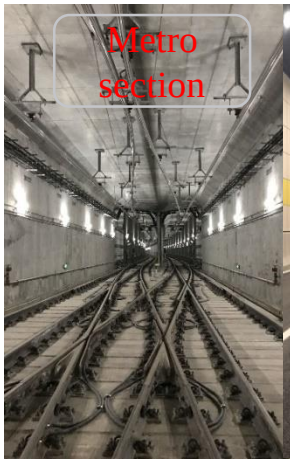
The length of the highway is 2.41 km with bi-directional and six lanes. The highway design speed is 150km/h. The length of the metro is 1.42 km and the design speed is 80km/h.

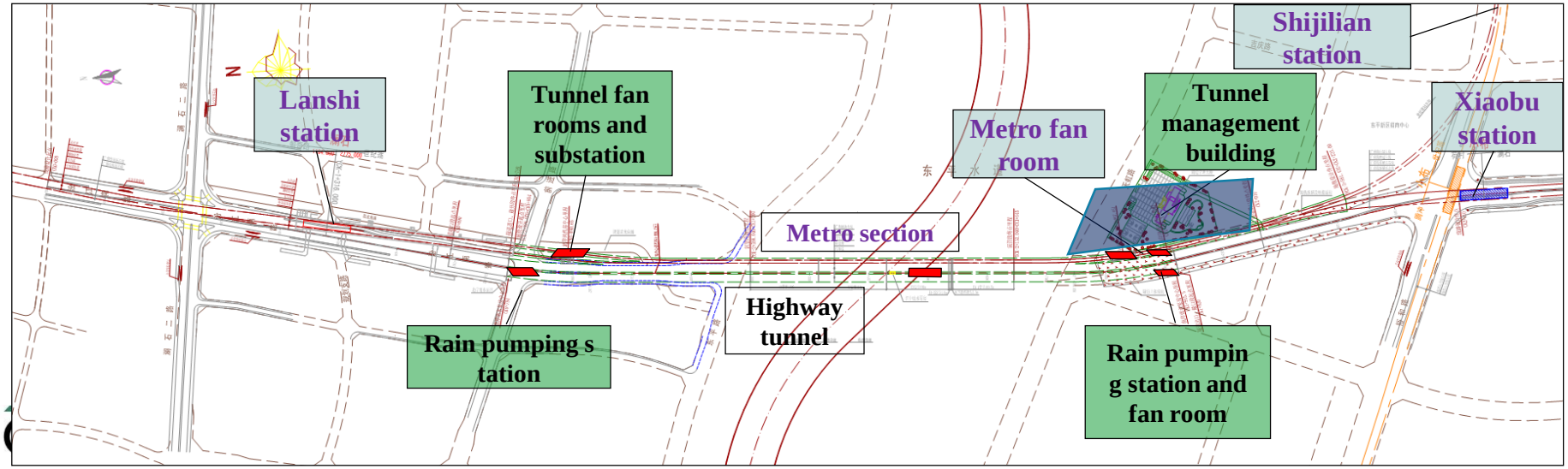
The total investment of the project is 2 billion and 31 million Yuan, with a construction period of 74 months.

1. Project Overview

1.3 General Layout

Project Works include a metro(section), a highway, a dry port, a metro fan room, two tunnel fan rooms and a substation, a wastewater pumping station, and a tunnel management center.

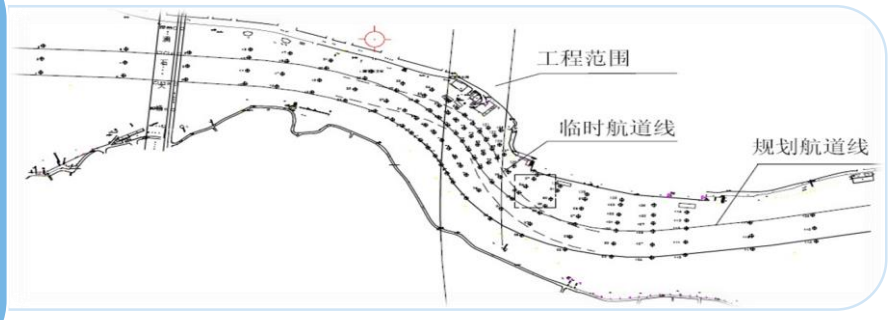




1. Project Overview

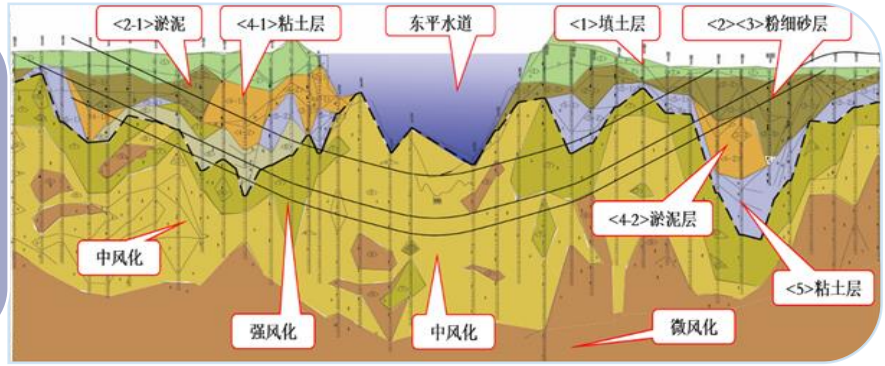
1.4 Construction Conditions

The watercourse has an S-shaped bend, a high velocity of water, serious river-bed scouring, interlaced strata with uneven strengths in the bed, exposed rocks in some sections.



The elevation of the banks is 3.2 m, higher than that of the downtown area , forming a typical “aboveground river ”.

The total excavation volume of the underwater foundation trench is 429000 m^3, including 335,000 m^3 underwater blasting(78%).



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1. Project Overview

1.4 Construction Conditions

Complex environment: There are many ports, wharfs and water gates surrounding the tunnel site, and old buildings densely located on both banks. High level of standards for excavation on tunnel foundation pit and underwater foundation trench are required.

Intensive Shipping: 300 ships/D, which is one of the busiest inland navigation channels in China.

Complex stress for structure: The embankment height on both banks is 5.5m higher above water surface, which brings great influence on the tunnel structure.

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2. Participants

Employer: Foshan New City Development and Construction CO., Ltd.

Survey & Designed by: China Railway Liuyuan Group Co., Ltd.

Constructed by: Guangzhou Salvage
Shanghai Haike Engineering Consulting Co., Ltd.
CCCC Fourth Harbor Engineering Co., Ltd.
Guangdong Yuantian Engineering Co., Ltd.
Guangdong Dezheng Engineering Management Co., Ltd.
China Railway Southwest Research institute Co., Ltd.

Chief Designer: Mr. He Weiguo

Project Started from 12th November 2010

Operation on 22nd January 2017

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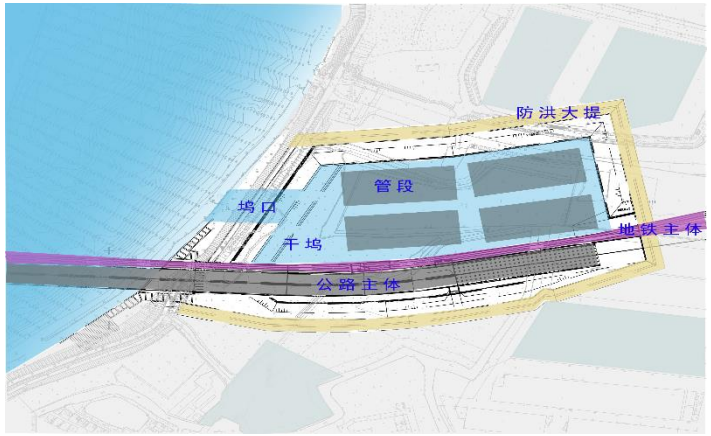
3. Award Winning Reasons & Innovations

3.1 Saving Land Resource

3.1.1 As an important part of the Pearl River Delta express road network in the Guangdong-Hong Kong-Macao Greater Bay Area, the immersed tunnel connects new and old urban areas of Foshan. In the central urban area of the city, it adopts the immersed tunnel to accomplish the joint construction of bidirectional six-lane highway and two-line subway, effectively saving land resources in the narrow road space.

3.1.2 Dry port on one side of the tunnel is adopted , which shares the same foundation pit with the main on-shore structure of the tunnel. In this way , both the land use in construction and the project cost are reduced.



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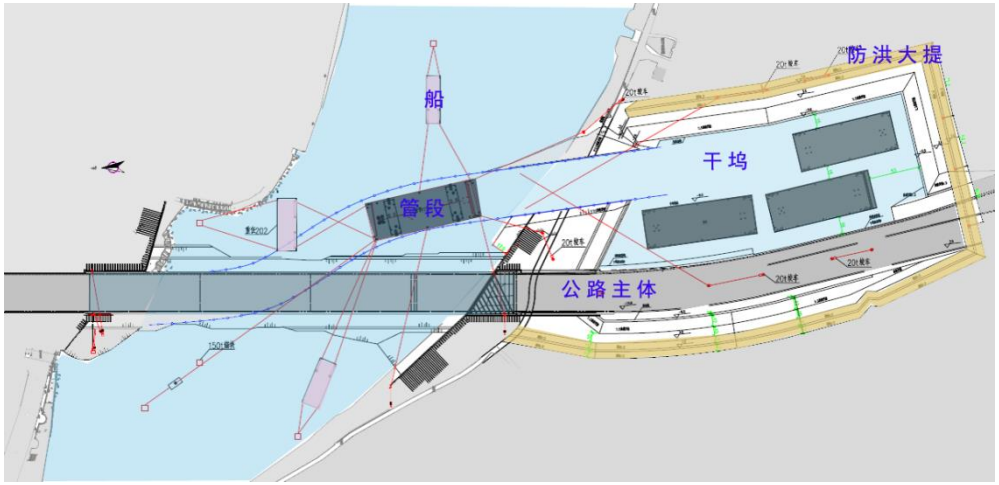
3. Award Winning Reasons & Innovations

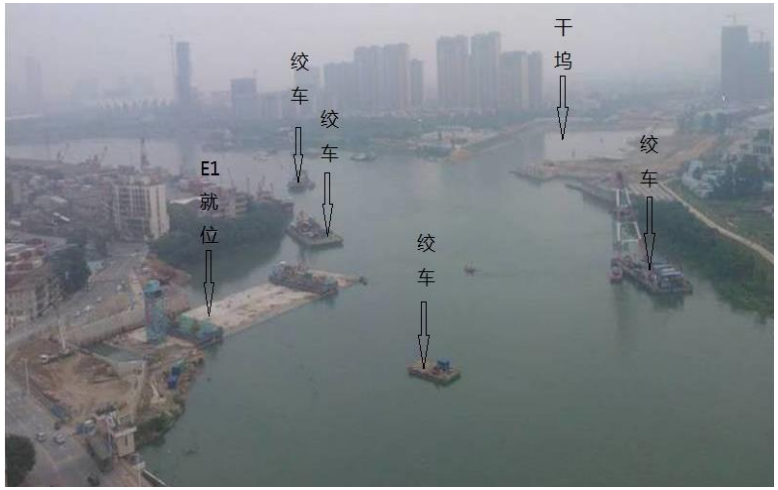
3.2 Construction Technology Innovation

The channel of Dongping River crossing the tunnel is curved, with dense shipping and high speed flow. As the project adopts the innovative technology of rapid sinking of the immersed tunnel, the technology of shock absorption by underwater blasting, the technology of anti-scour and the technology of tunnel settlement control, no accidents occurred during the construction.

3.2.1 Fast floating transportation and immersion Technology

To realize the fast floating transportation and immersion of tunnel segments, the control system of double lifting barge riding crane , PLUS measuring control tower ,PLUS anchor cable force monitoring , PLUS visual centralized display positioning and sinking control system, and removable temporary support system are constructed.





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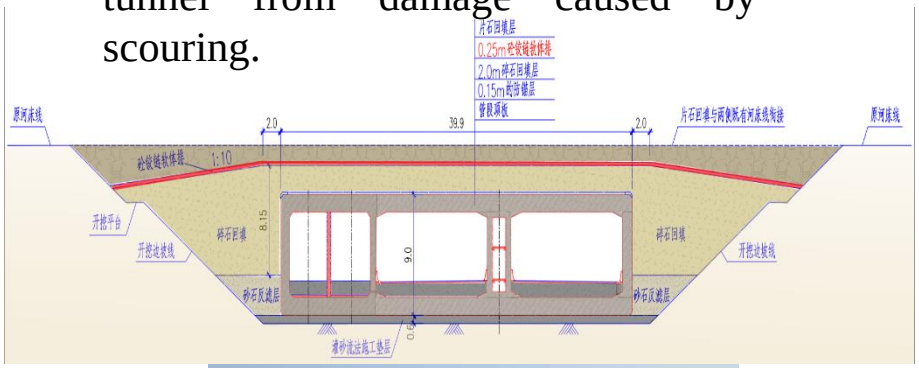
3. Award Winning Reasons & Innovations

3.2 Construction Technology Innovation

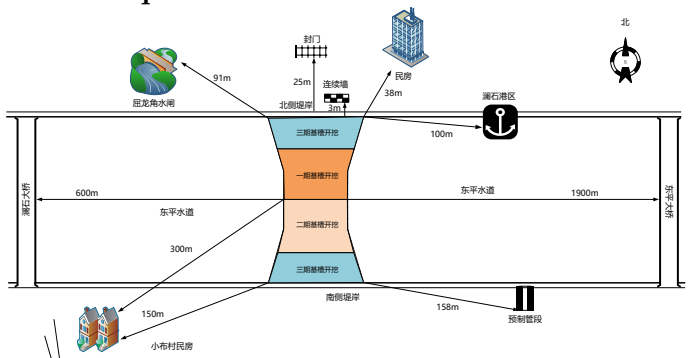
3.2.2 Protection Technology against erosion

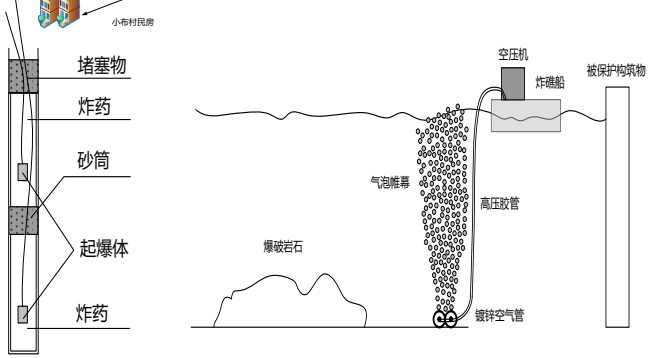
The water flow velocity reaches 4.1m/s during flood season. The hydrological flexible rowed blocks are adopted to protect the immersed tunnel from damage caused by scouring.



3.2.3 Underwater blasting and vibration-reducing technology

Comprehensive blasting technology consisting of milli-second blasting , air bubble curtain and steel sealing door vibration monitoring is adopted. 320,000 m³ rocks excavations by means of underwater blasting is successfully completed in the urban core to meet the environmental protection requirements.





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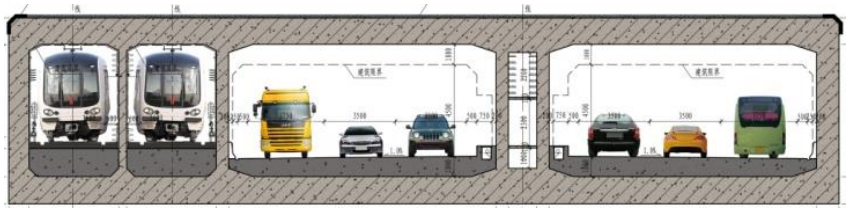
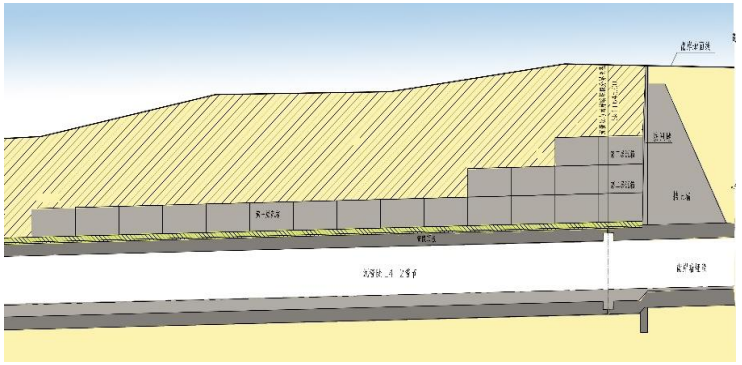
3.Award Winning Reasons & Innovations

3.2 Construction Technology Innovation

3.2.4 Settlement Control for transition between the immersed tubes and on-shore

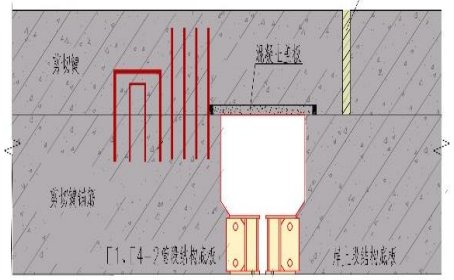
The rail-road combined tunnel is subject to strict requirements on the settlement. Differential settlement is effectively controlled by reducing the load on the on-shore tunnel structure and enforcing the structure ,etc.





Reducing the load of caissons on the on-shore

The steel plates are processed into W-shape on side walls



Composite structure combining shaped steel and concrete in the floor

3.Award Winning Reasons & Innovations

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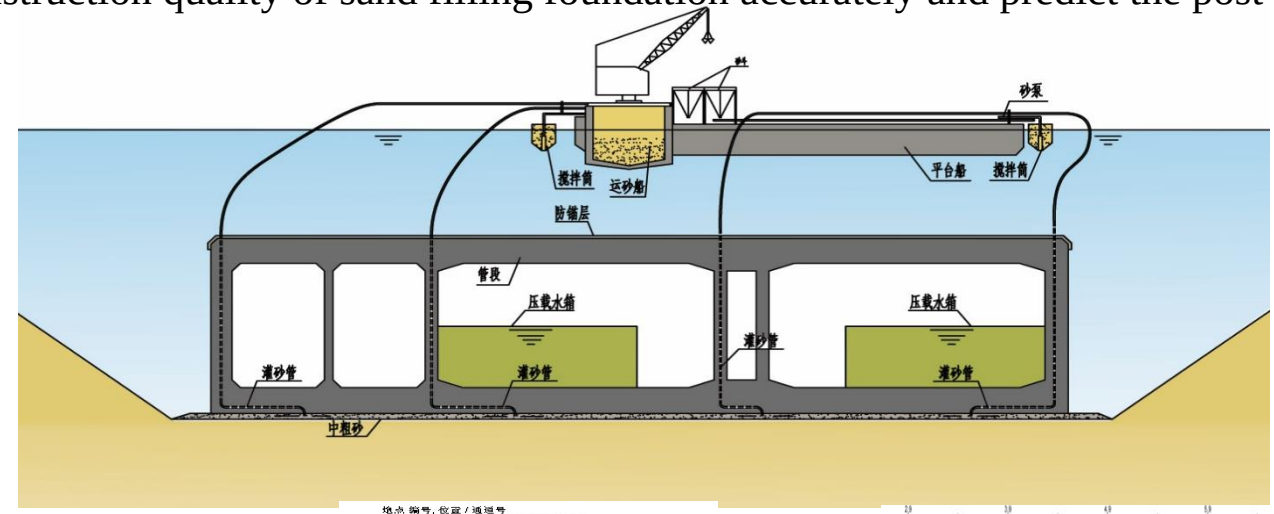
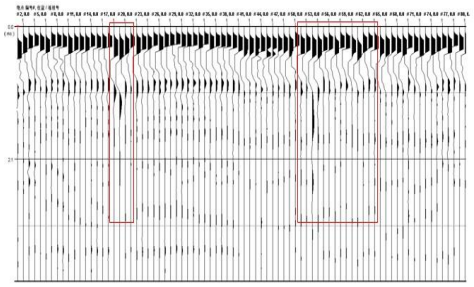
3.2 Construction Technology Innovation

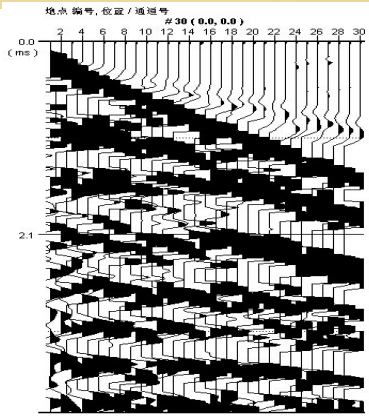
3.2.5 Nondestructive Test on sand filling foundation

Elastic wave imaging etc. is applied to non-destructive testing on the sand filling bedding, which can distinguish the construction quality of sand filling foundation accurately and predict the post-construction settlement.

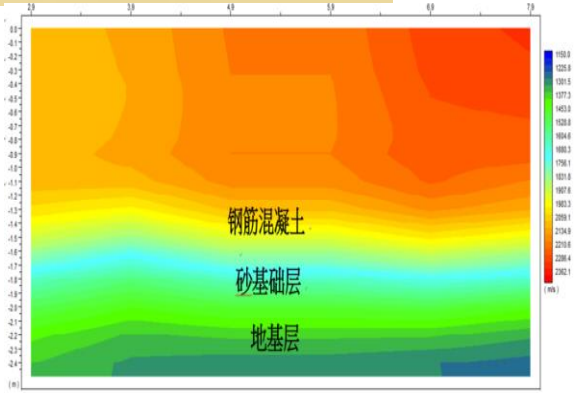




Waveform recording of elastic wave imaging



Waveform record with Wave Method



Surveying line high frequency Rayleigh surface wave effect drawing

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3.Award Winning Reasons & Innovations

3.2 Construction Technology Innovation

✓ Research on key technology of sand foundation for immersed tunnel project of the south extension in Fenjiang
✓ Experimental study on towing and floating and sinking settlement of immersed Tunnel Element,
✓ Treat measures of protecting elelment tubes in the overlay layer agaist erosion
✓ Study on influence of river bed change and sand movement on immersed tube tunnel operation and protection measures
✓ Study on underwater excavation method for pipe section foundation trench
✓ Study on treatment scheme of pipe section foundation
✓ Comparison of bank-protection form and study on three-dimensional structure calculation of grid wall
✓ Study on dry dock scheme
✓ Flood control evaluation report of the two phase crossing tunnel project of the south extension in Fenjiang , Foshan and Guangfo line.
✓ Impervious and anti cracking control of durable concrete and mass concrete.
✓ Special topics on Navigation Safety Assessment Report.
✓ Health monitoring system during operation of Dongping tunnel in Foshan.

Totally12 key-technology researches have been developed during construction, two Patents for Invention and five New Utility Models have been obtained, which shall provide a good demonstration and reference for similar tunnels.

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3.Award Winning Reasons & Innovations

3.3 HSE Management

During the construction period, the comprehensive HSE management system has been established and carried out completely. No safety accidents have occurred during the construction period.

Flood Emergency Drill

Site Safety Education

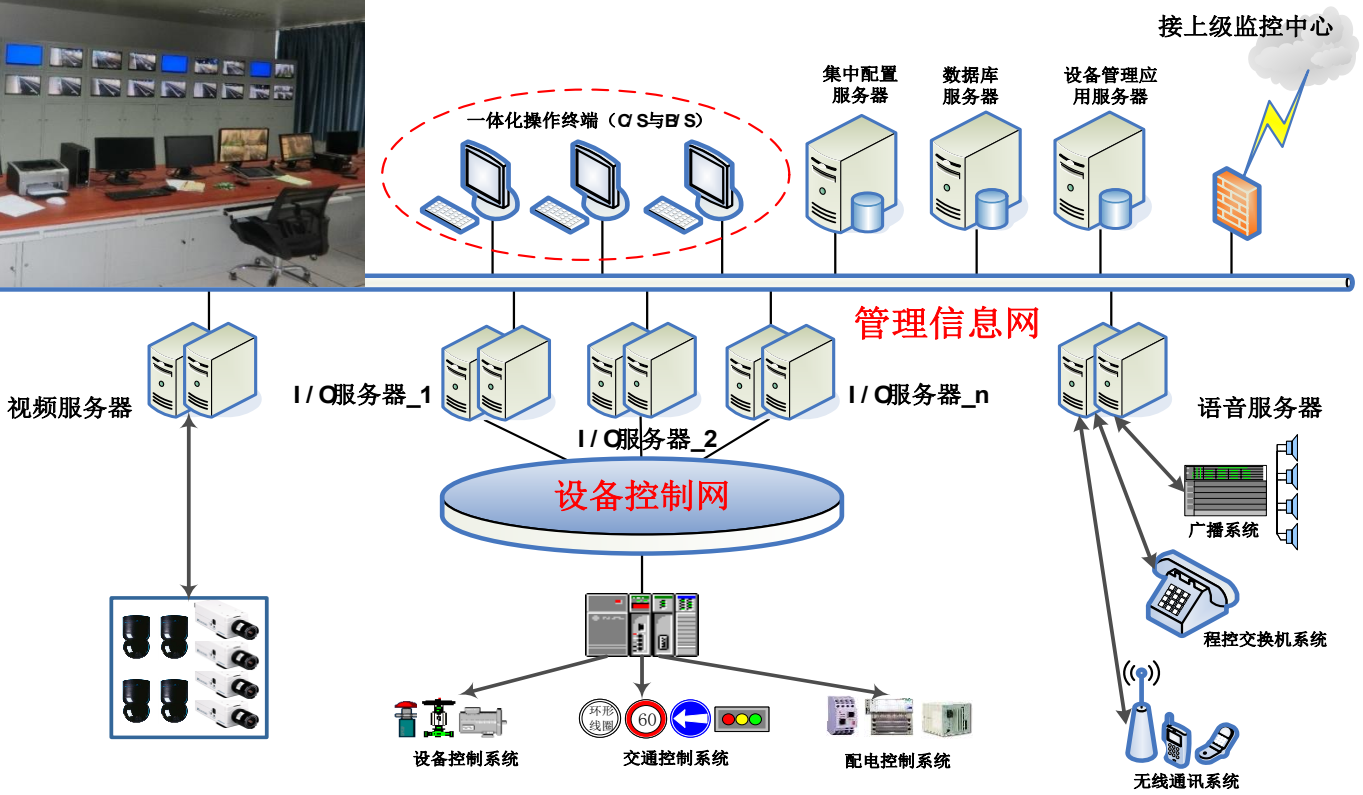
(2011-2017)

SN	Safety Accidents	Number of Injuries	Ratio of Injuries
1	None	0	0
Total	None	0	0

Construction Unit: Foshan New City Development and Construction CO., Ltd

Drowning Rehearsal

4. Operation Management



The tunnel is equipped with comprehensive mechanical and electrical system facilities, which can not only ensure the normal operation of the tunnel, but also have a good ability to deal with emergencies whenever accidental accidents occur.

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4. Operation Management

Car Self-ignition Case Handling inside Dongping Tunnel

On 8th August 2018, a sudden car self-ignition case occurred in the tunnel. Upon accident report, evacuation, smoke exhaust, fire extinguishing, overhaul inspection, and traffic recovery etc. were quickly completed within an hour by using the comprehensive equipment system in the tunnel, reflecting a very excellent emergency response capability.

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4. Operation Management

Social Impact：

- Strengthen communication between both sides of the river and promote urban development
- 3.5km detour distance reduced for vehicles entering into the central downtown area.
- 50 acres or more of urban land resources will be saved after rail and road combination construction completed.
- Exemplary construction method has been adopted successfully in four tunnels in China, providing a good reference for tunnel standard system establishment of immersed tube method in China.

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Thanks!

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China Railway Liuyuan Group Co., Ltd.