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Wuhan Sanyang Road Yangtze River Tunnel

CHINA

Presented by : Sun Feng

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1. Overview of the Project

Sanyang Road Yangtze River Tunnel located in Wuhan, China

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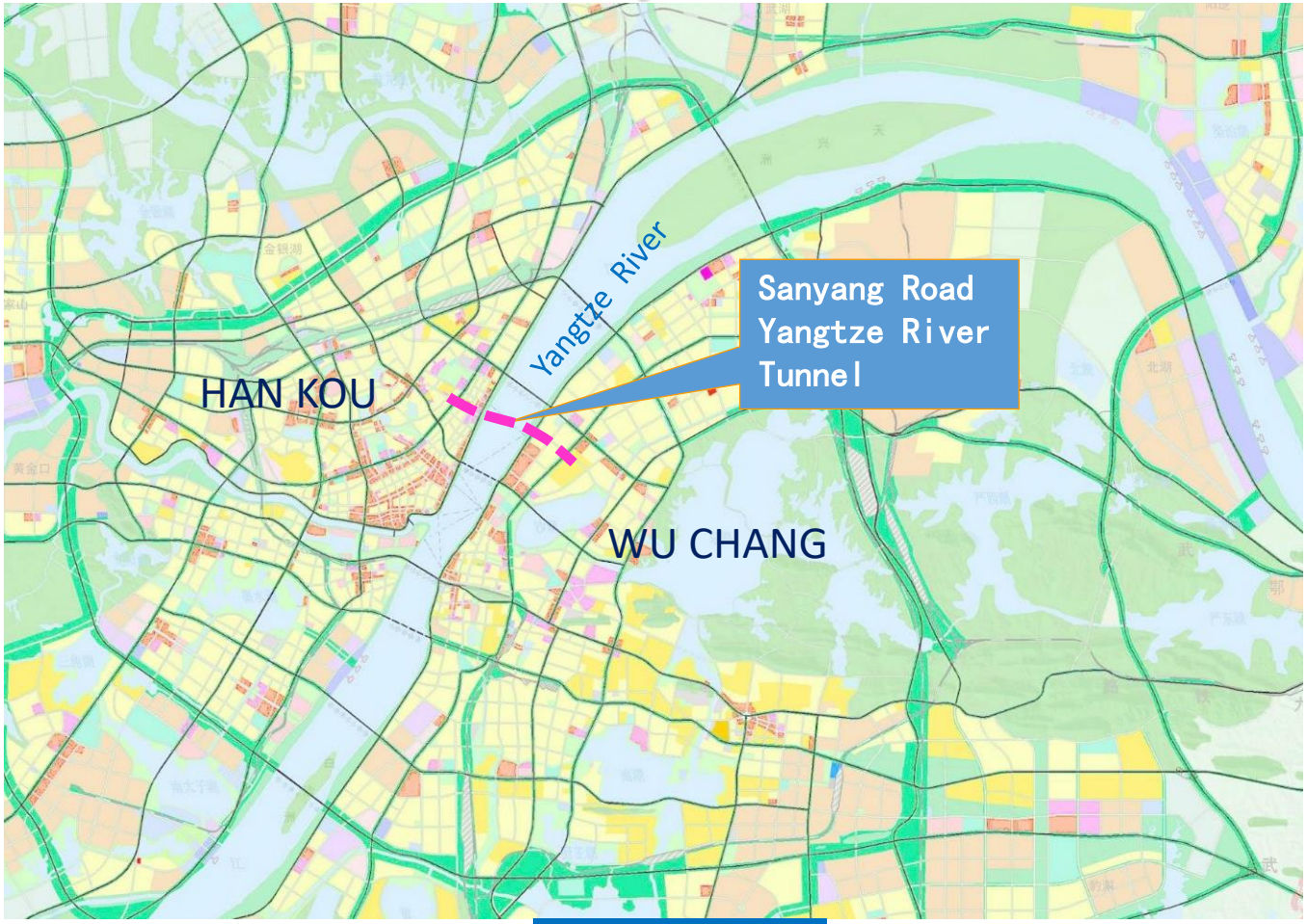
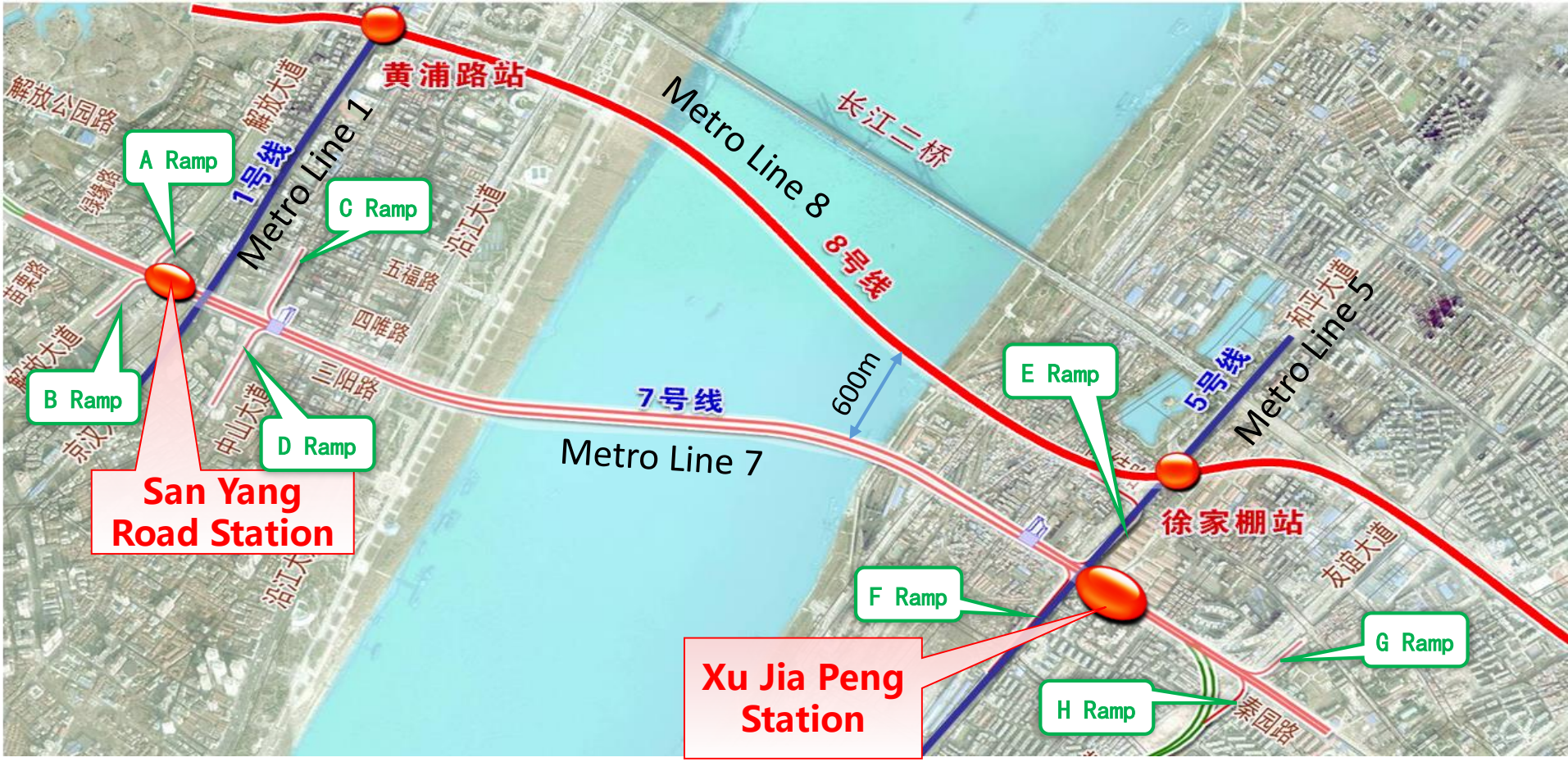
1. Overview of the Project



Tunnel Location

- Sanyang Road Yangtze River Tunnel connects the core areas of Hankou and Wuchang.
- This tunnel is the world's first Road-Metro shield tunnel.
- This tunnel can meet the huge number of people and vehicles across the Yangtze River.

MAJOR
PROJECT OF THE YEAR
- OVER €500 M -



- Main tunnel(road) total length 4660 meters.
- There are 4 ramp tunnels on both sides of the Yangtze River connecting with urban roads. The total length of the eight ramp tunnels is 2680m.
- Station of the Metro Line 7 and the tunnel are located below the road tunnel.

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1. Overview of the Project

- Project Start Time： 14, February 2014；
- Project Completion Time ： 1,October 2018；
- Total investment： RMB 7.39 billion($ 1.05 billion)
- Owners ： Wuhan Metro Group Co.,Ltd

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1. Overview of the Project

Overall design	• **China Railway SIYUAN Survey and Design Group Co.,Ltd**
Participating designers	• Hubei Provincial Communications Planning And Design Institute Co,Ltd • Wuhan Municipal Engineering Design and Research Institute Co,Ltd
Contractors	• **Shanghai Tunnel Engineering Co,Ltd** • China Railway 2 Bureau Group Co,Ltd • China Railway 4 Bureau Group Co,Ltd • China Railway 5 Bureau Group Co,Ltd • China Railway 11 Bureau Group Co,Ltd • China Railway 18 Bureau Group Co,Ltd
Supervisors	• **Shanghai Municipal Engineering Management Consulting Co.,Ltd** • Wuhan Design and Research Institute Co.,Ltd of China Coal Technology and Engineering Group
Shield equipment supplier	• **Herrenknecht AG**

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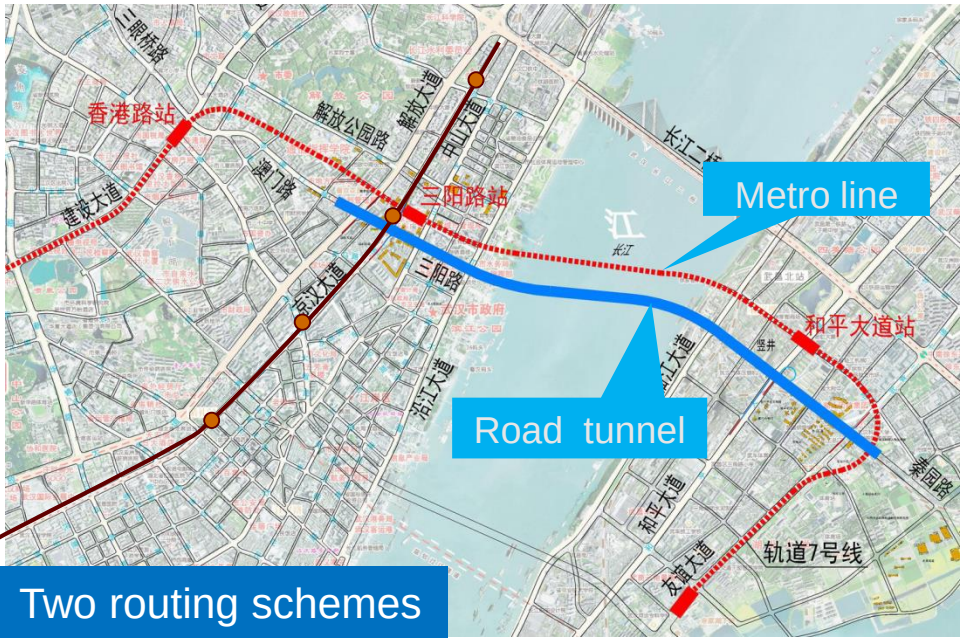
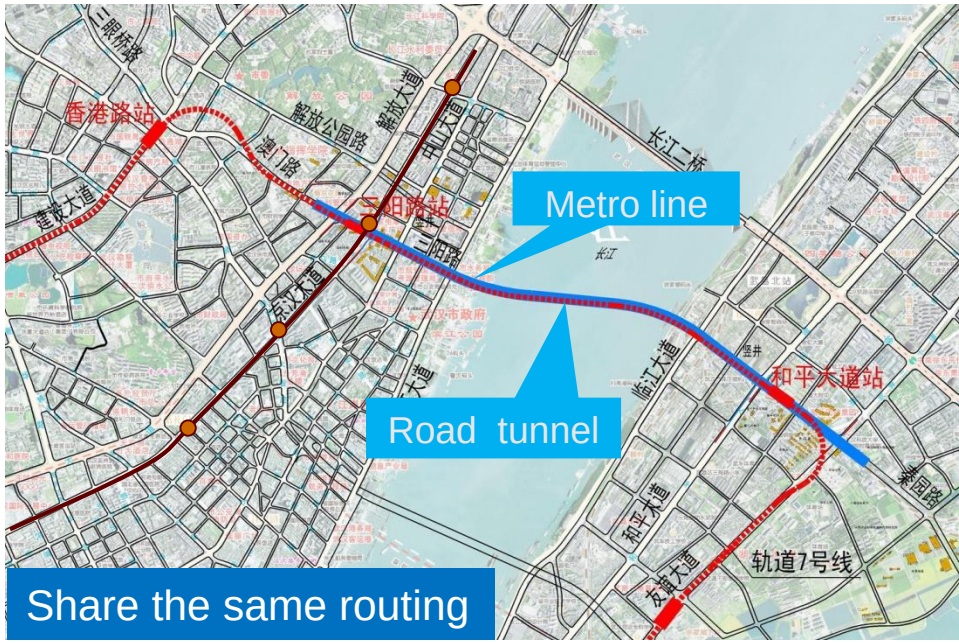
2. Why choose Road tunnel and Metro Co-construction





Two routing schemes： **The Metro tunnel cross a large number of existing buildings.**

Housing area to be demolished: 280 000 square metres

Share the same routing scheme： **Significant reduction in land area;**

Housing area to be demolished: 118 000 square metres

Total investment saved RMB 800 million.

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中铁第四勘察设计院集团有限公司 CHINA RAILWAY SIYUAN SURVEY AND DESIGN GROUP CO., LTD.

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3. Overall design of the tunnel

➢ 1) Main technical standard

a) Road Tunnel

Road grade：Urban main road

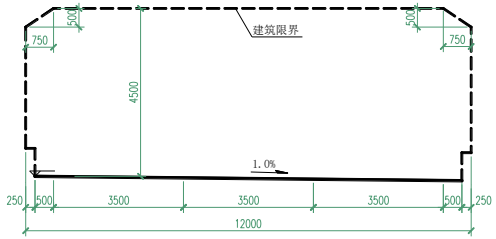
Design speed：60km/h；

Number of lanes：double, 3 lanes one way

Driving limit：lane-width 3.5m，lane height 4.5m

Maximum longitudinal slope：5%

Design life：100 years



3. Overall design of the tunnel

➢ 1) Main technical standard

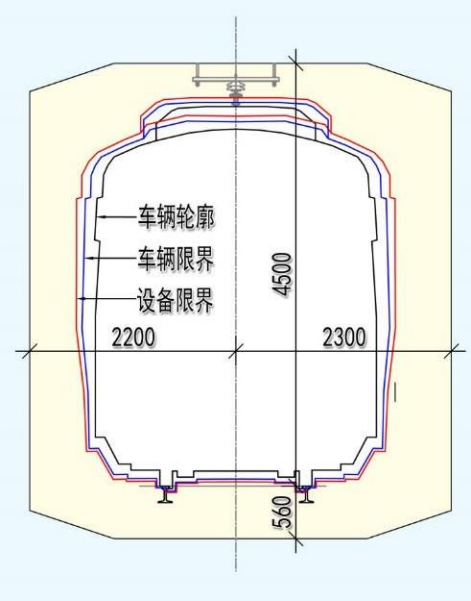
b) Metro Line 7

Design speed：80km/h；

Vehicle grouping：6A，8A are reserved;

Rectangular boundary: 4500mm in width and 4500mm above the top surface of the rail.

Maximum longitudinal slope：30‰



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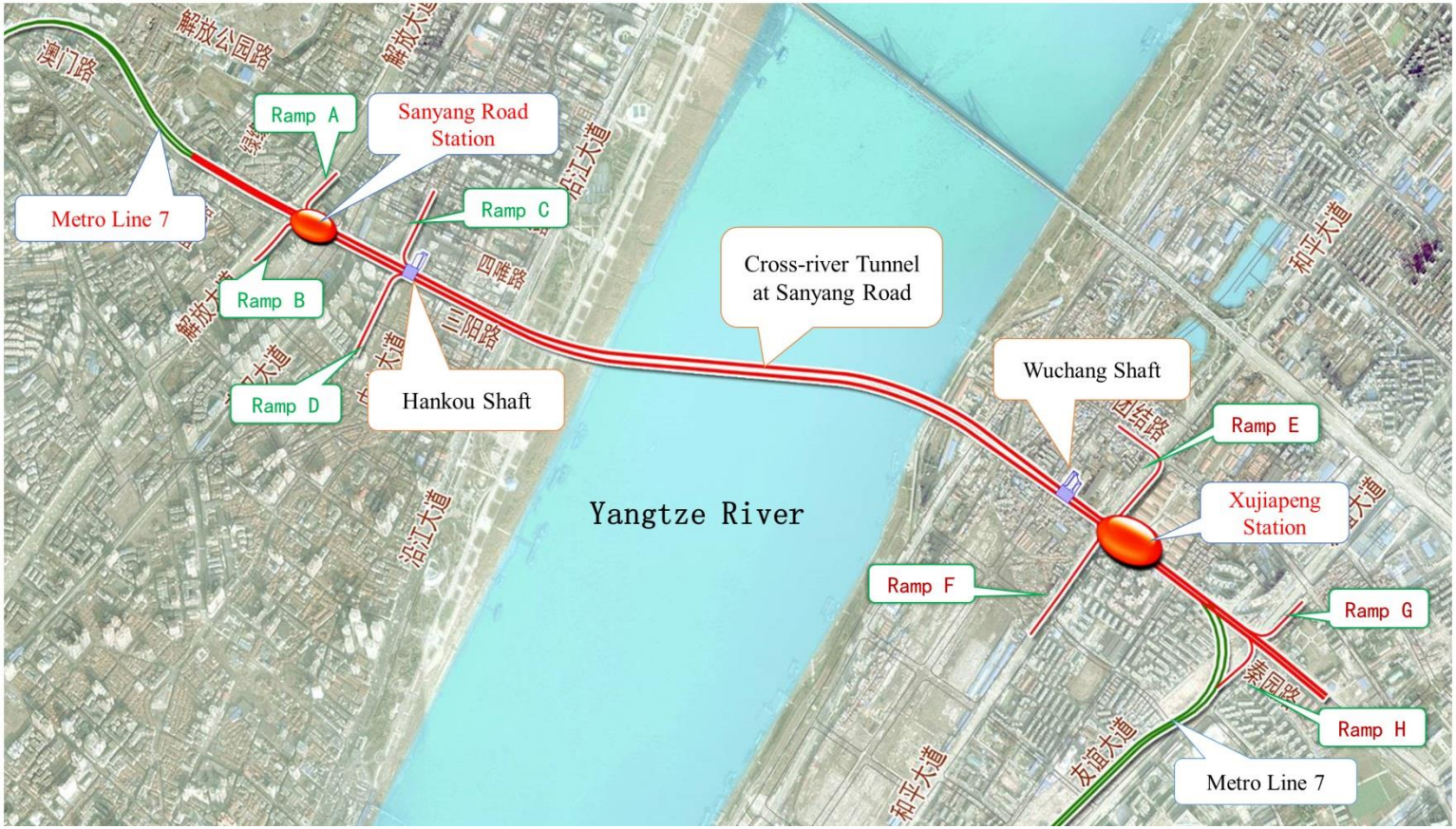
3. Overall design of the tunnel ➢ 2) Plane layout



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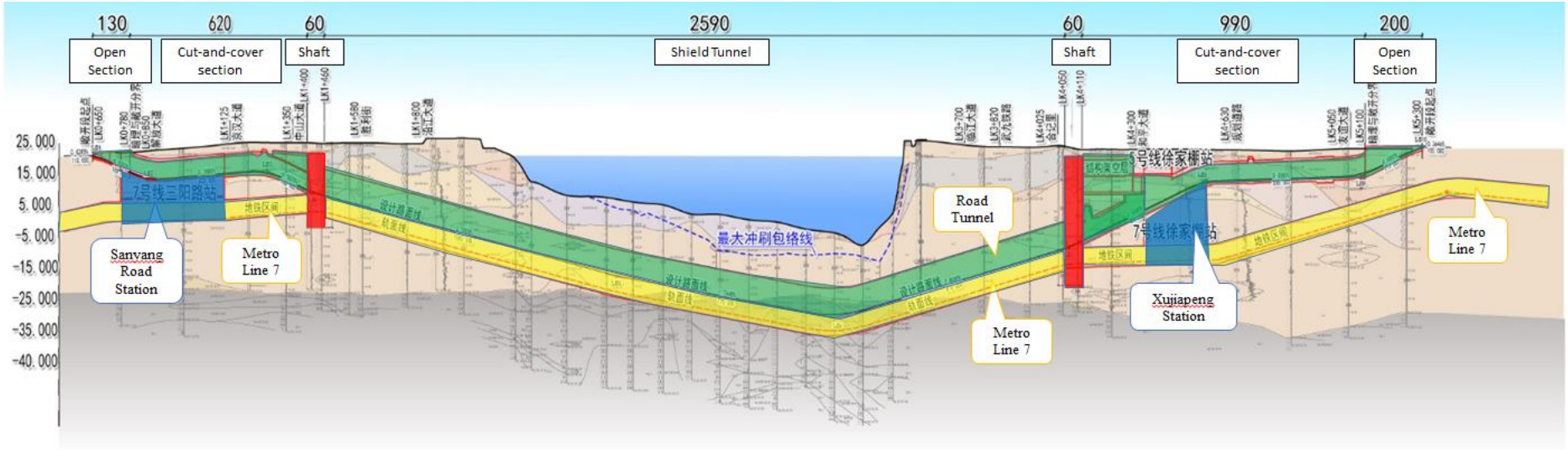
3. Overall design of the tunnel

➢ 3) Profile



- Geology: fine sand, strongly permeable sand layer, moderately weathered rock layer, etc.
- The maximum water pressure of 0.64MPa.
- The maximum longitudinal slope of the co-constructed tunnel is 2.97%.

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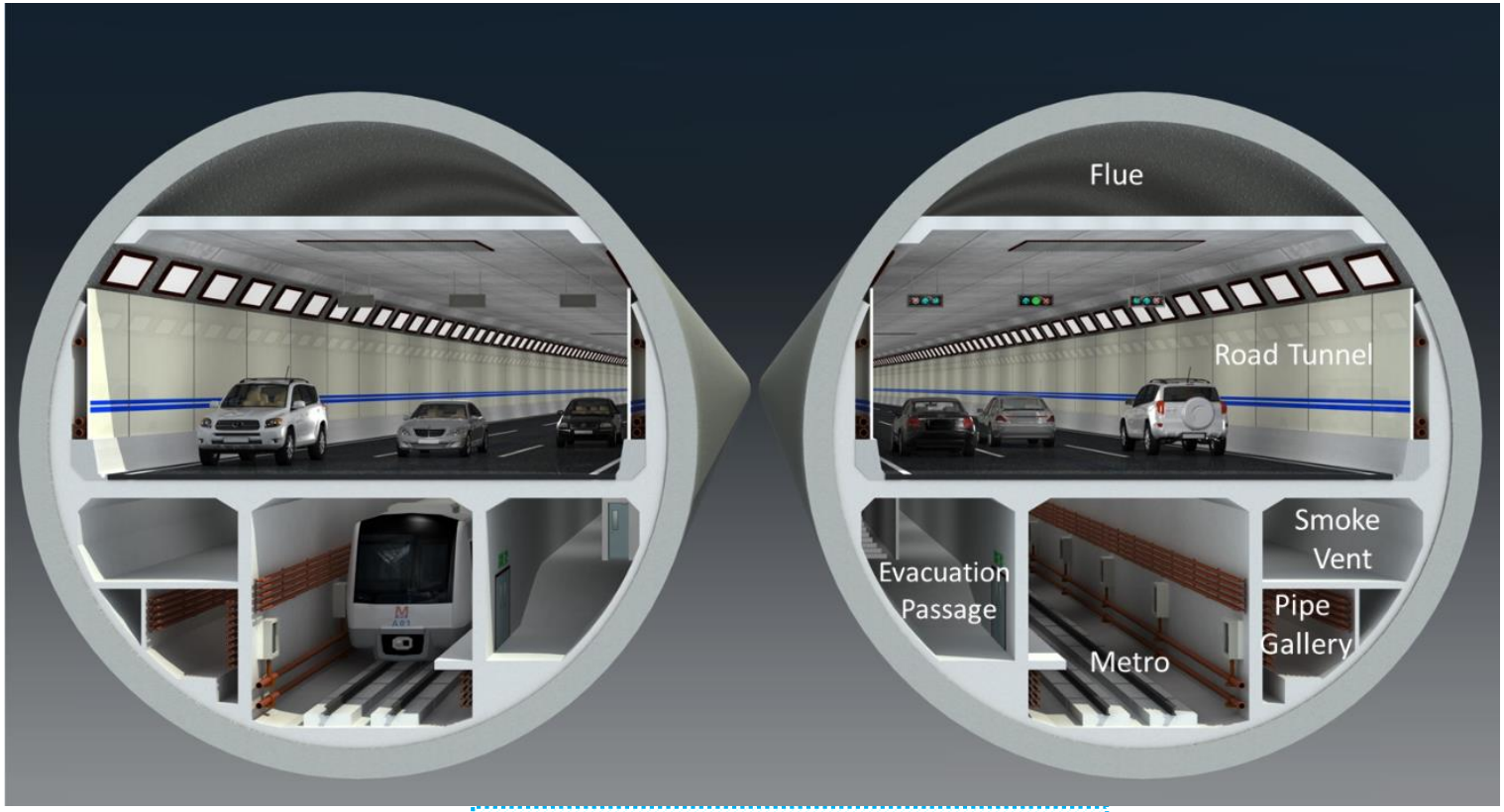
3. Overall design of the tunnel

➢ 4) Cross section



Inner diameter:13.9m

Outer diameter: 15.2m

Width: 2m

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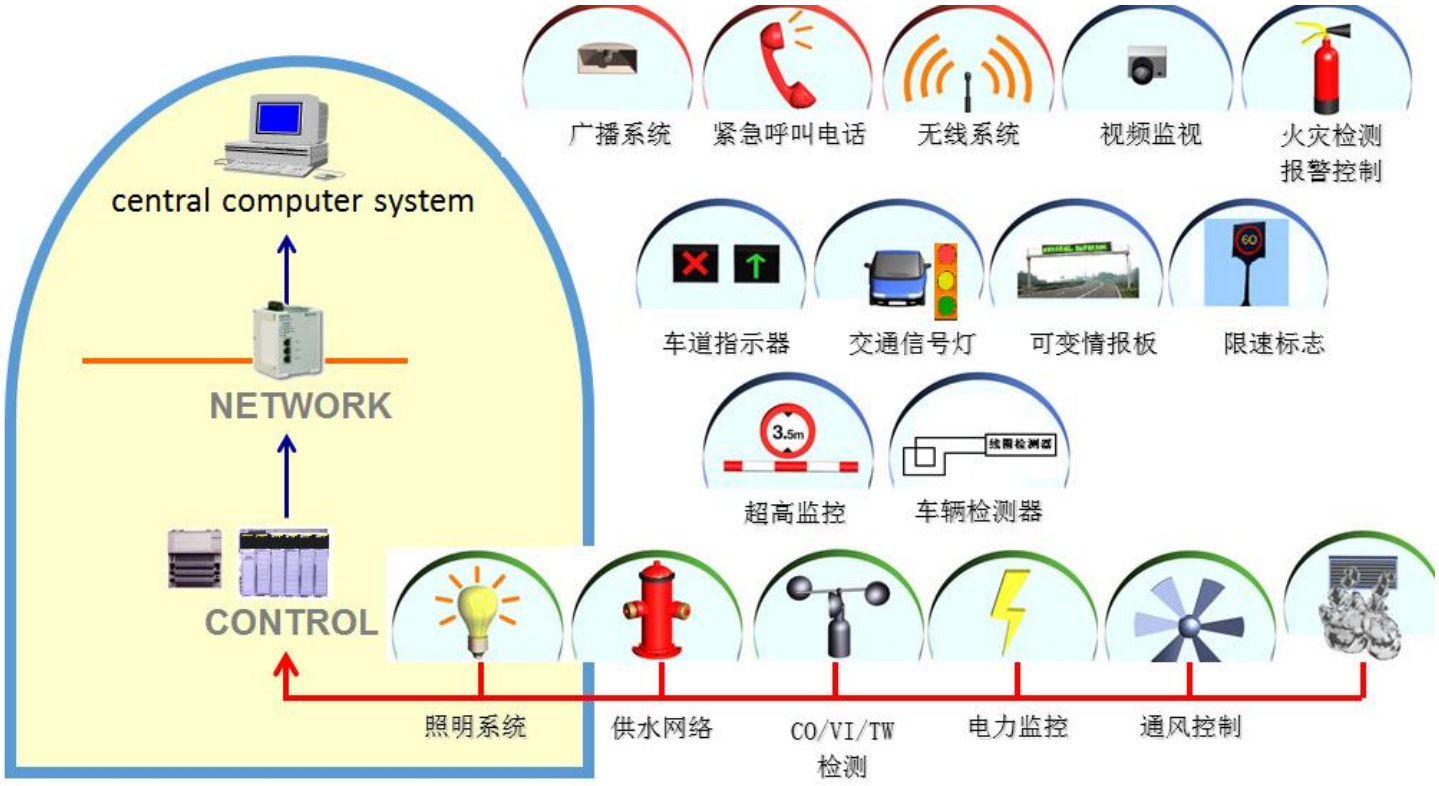
3. Overall design of the tunnel

➢ 5) Mechatronic System



- Ventilation
- Water supply and Drainage, fire control system
- Power and lighting
- Monitoring System

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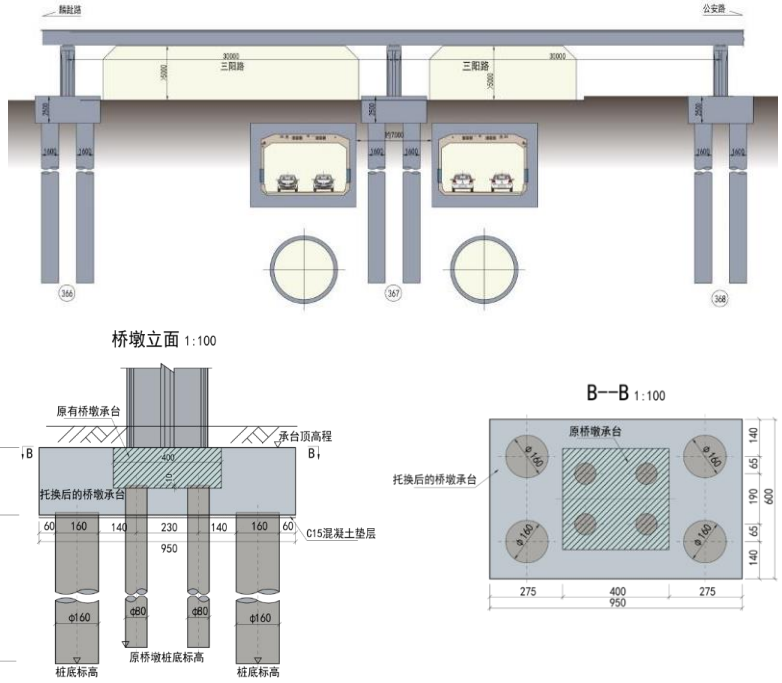
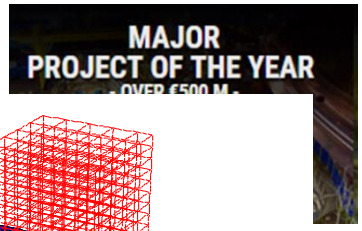
4. Project Difficulties and Solutions

➢ 1) Difficult building environment

The tunnel goes under an existing urban road overpass and Metro Line 1 Overpass.

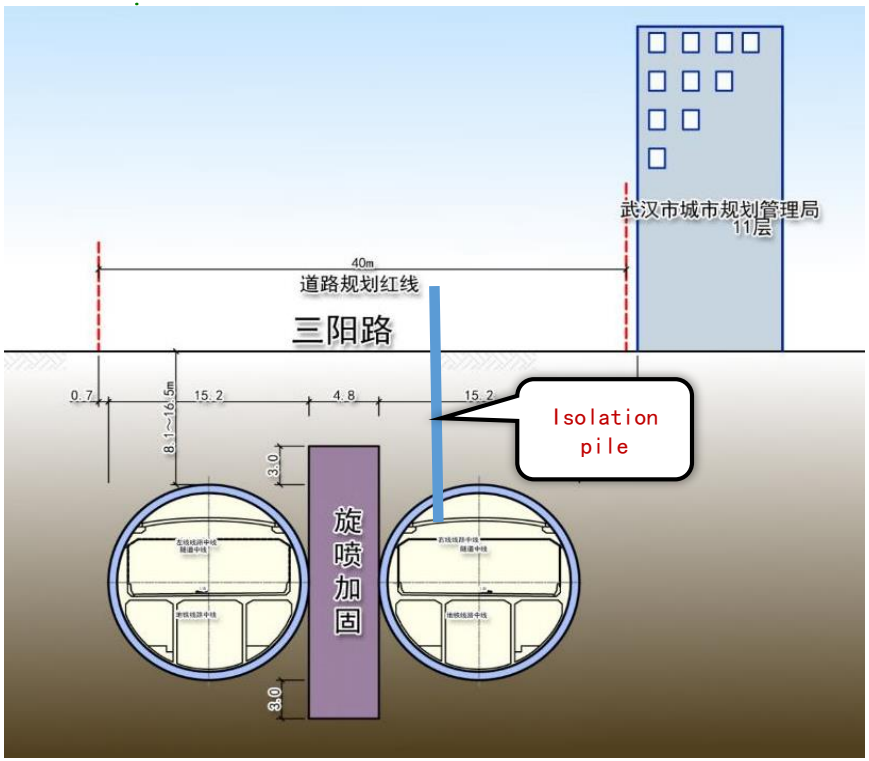


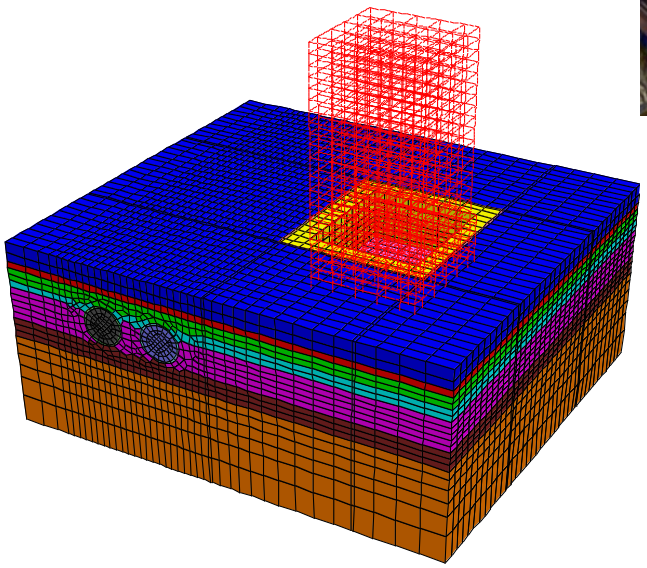
- Urban road overpass was demolished and reconstructed.
- Pile foundations of the metro overpass were underpinned before excavation.



4. Project Difficulties and Solutions

➢ 1) Difficult building environment





- The narrowest distance between two tunnels is only 4.8m, about 0.3D.
- It is also very close to the existing buildings.
- Measures: jet grouting reinforcement and isolation pile.

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4. Project Difficulties and Solutions

➢ 2) Complex geological conditions

- Geology: fine sand, strongly permeable sand layer, moderately weathered rock layer, etc.
- The shield machine has a diameter of 15.76m.

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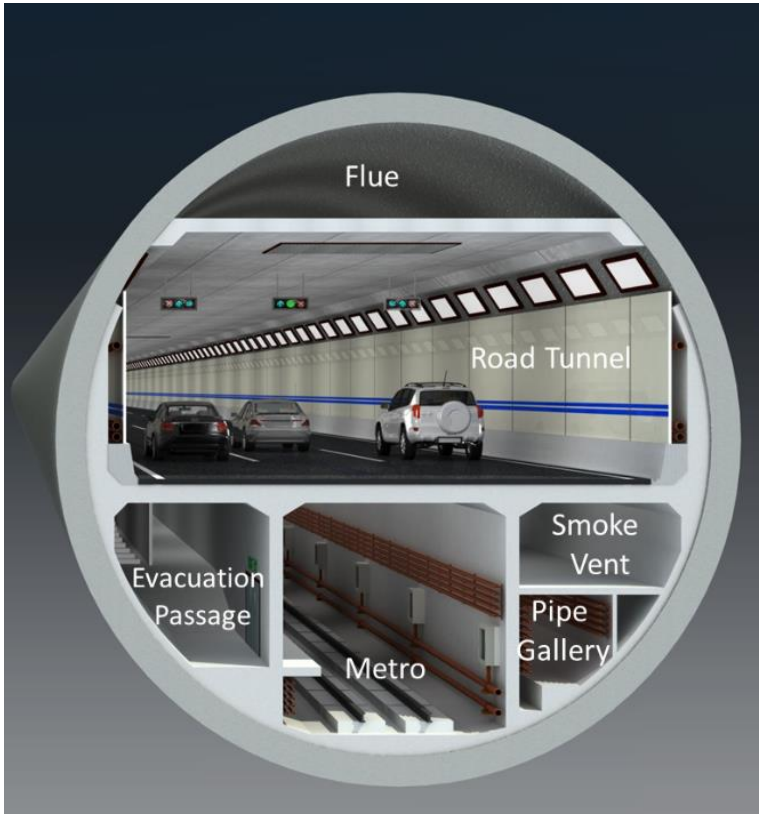
4. Project Difficulties and Solutions

➢ 3) Complex cross section



Utilization of the cross section reached 95%

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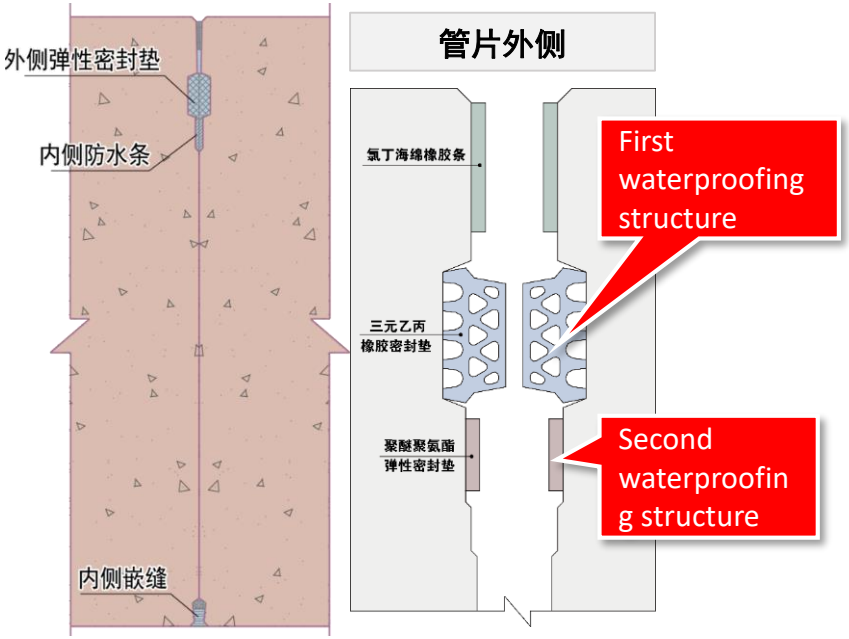
4. Project Difficulties and Solutions

➢ 4) Large tunnel diameter and high water pressure

- The largest diameter shield tunnel in mainland China.
- (9+1) block

4. Project Difficulties and Solutions

➢ 4) Large tunnel diameter and high water pressure



- The maximum water pressure is about 0.64 MPa.
- Two waterproof gaskets are arranged outside the segment joint.

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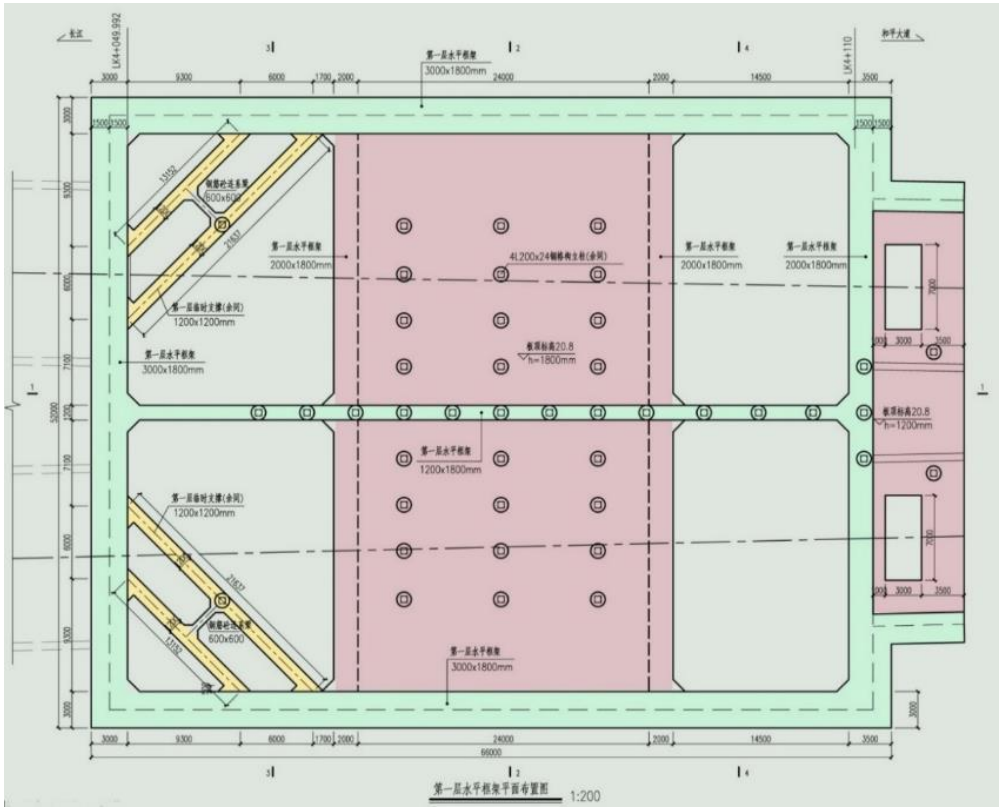
4. Project Difficulties and Solutions

➢ 5) Ultra-deep shaft



Foundation pit

- Length: 66m;
- Width: 52m;
- Depth: 44.1m.

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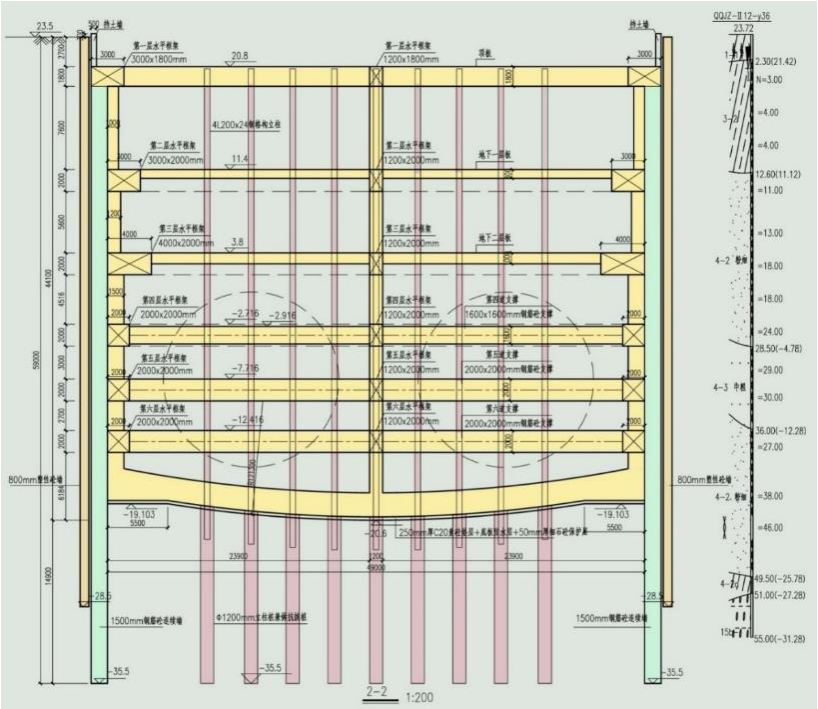
4. Project Difficulties and Solutions

➢ 5) Ultra-deep shaft



- A 59m deep and 1.5m thick diaphragm wall was used, with 6 concrete supports.
- A plastic concrete seep-proof screen was provided outside the diaphragm wall.
- The inner wall and the retaining wall were overlapped and constructed in reverse order.
- The bottom plate was curved to reduce the structural stress.

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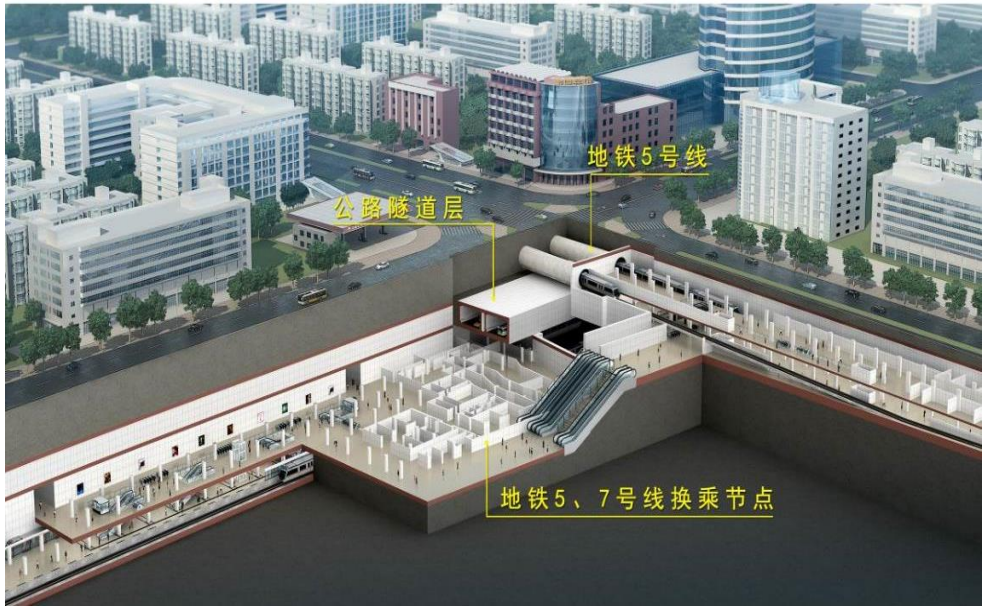
4. Project Difficulties and Solutions

➢ 6) Complex open-cut structure



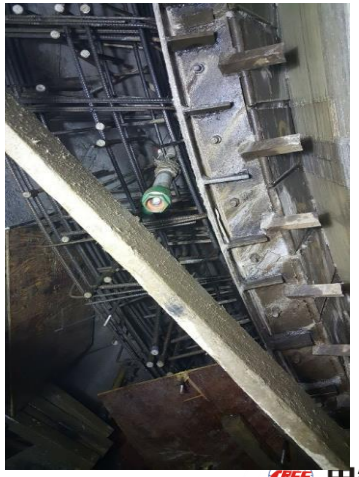
- Xujiapeng Station is the interchange between Metro Line 5 and Metro Line 7, and the excavation depth is 36.7m.
- A 1,500mm thick diaphragm wall is constructed around the station.
- 1m thick moderately weathered rock layer is laid at the bottom of the wall, and pressure grouting is performed at the toe of the wall.

4. Project Difficulties and Solutions

➢ 7) Shield launching in sand layer with high water pressure

The overlaying of shield launching is 24m

- Reinforcement and water proof of the portal: reinforcement by freezing method and deep agitation reinforcement.
- Auxiliary precipitation: meet the conditions of the shield launching and receiving.
- Portal seal: Install the portal water proof box.



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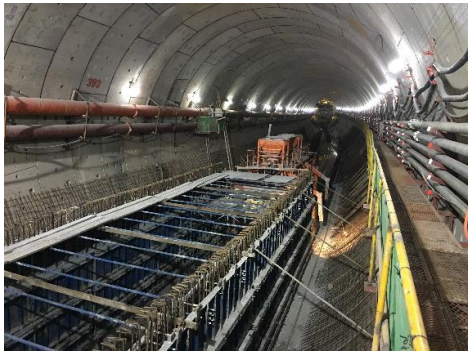
5. Engineering photos

Shield Machine Cutter Head

Shield Launching

Segment Lining

Shield Arriving



Construction Site

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5. Engineering photos

Operation of Wuhan Sanyang Road Yangtze River Tunnel

5. Engineering photos

Tunnel Monitoring Center

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Data aggregation

- From 2010 to 2013, three years of preliminary research work was carried out, and a total of 217 geological boreholes were completed.
- A total of 15 companies participated in the construction of the tunnel, with more than 11 million working hours.
  The excavated volume of the tunnel 2.58 million cubic meter.
- No safety accidents or casualties during construction.
- Recently, 380 trains and 40,000 cars pass through the tunnel every day; In the future, there are 640 trains and 86,000 cars.
- Net benefit Sanyang Road Tunnel= ca. RMB 1348 mill. ($193 mill)

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Thank you for your attentions!