ITA TUNNELLING AWARDS 2019

The New Badaling Tunnel and Great Wall Station of Beijing-Zhangjiakou High-speed Railway

The People's Republic of China

Presented by : Wen-ge Qiu

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Stakeholders

Client

Beijing-Zhangjiakou Intercity Railway Co., Ltd.

Contractors

中铁五局 中国中铁

China Railway No. 5 Group Co., Ltd

Designer

中铁设计 中国中铁

China Railway Engineering Consulting Group Co.,Ltd

Other stakeholders

中国中铁 北京中铁诚业

Beijing Zhongtie Chengye Engineering Construction Surpervision Co.,Ltd.

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OUTLINE

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1 Overview of the Project

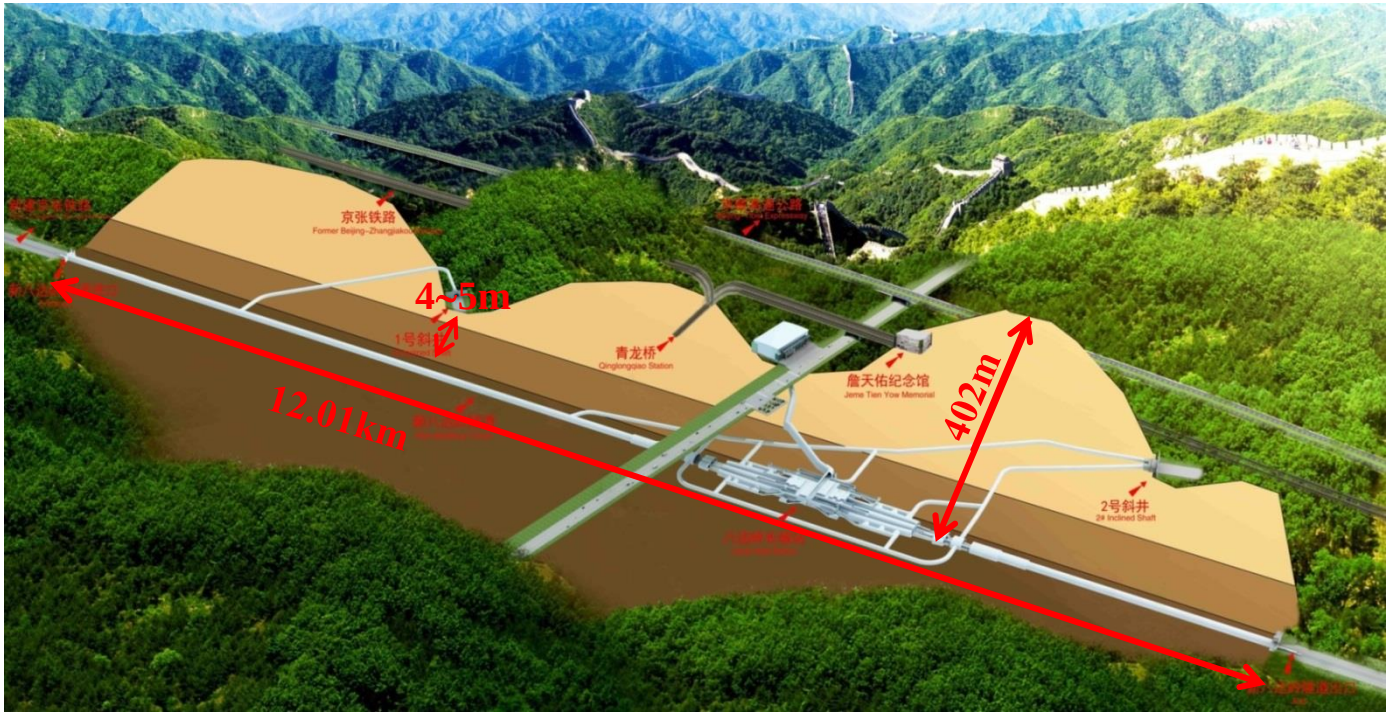
1.1 The Beijing-Zhangjiakou high-speed railway

It begins from Beijing North Station, travels west to Zhangjiakou South Station, with total length of 174km which is a key supporting transportation infrastructure for the Beijing Winter Olympic Games in 2022 and the Beijing-Tianjin-Hebei coordinated development

1 Overview of the Project

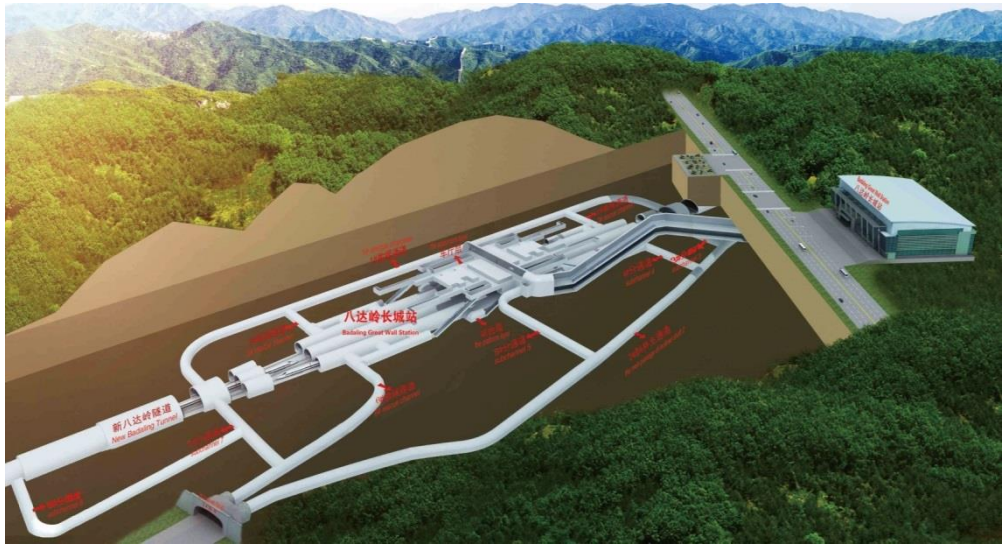
1.2 The new Badaling tunnel

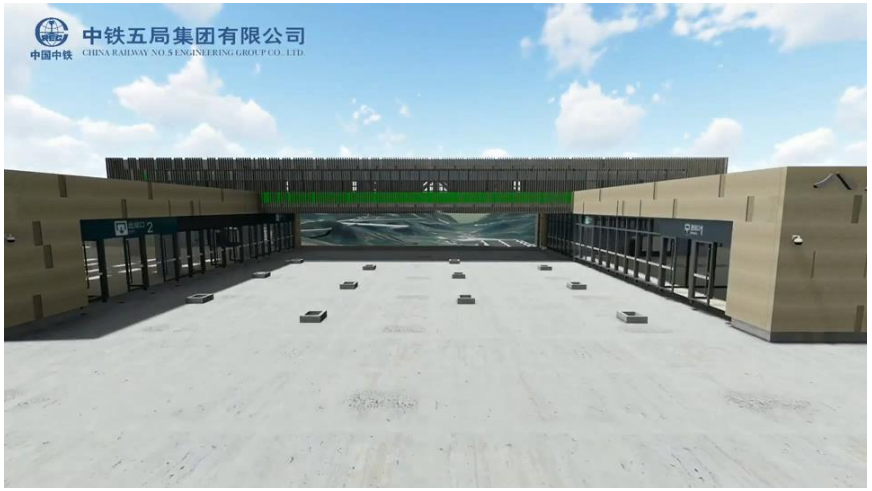
It is the key control project of the whole railway, with a total length of 12.01km. The maximum buried depth of the tunnel is 402m, and the minimum shallow buried is 4-5m. It is located in the Badaling core scenic spot of the world cultural heritage, continuously crossing underneath the Juyongguan, Shuiguan and Badaling Great Wall.



1 Overview of the Project

1.3 The Great Wall Station





It is located in the New Badaling Tunnel, which is an underground station. The structure of Station is designed with "three floors and three tunnels". The designed peak hour passenger flow in this station is 4,400 people per hour. The station is 470m long and 80m width with the underground building area of 39850 m^2, which is the most underground complex for high-speed railway station.

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2 The Construction Difficulties of the Project

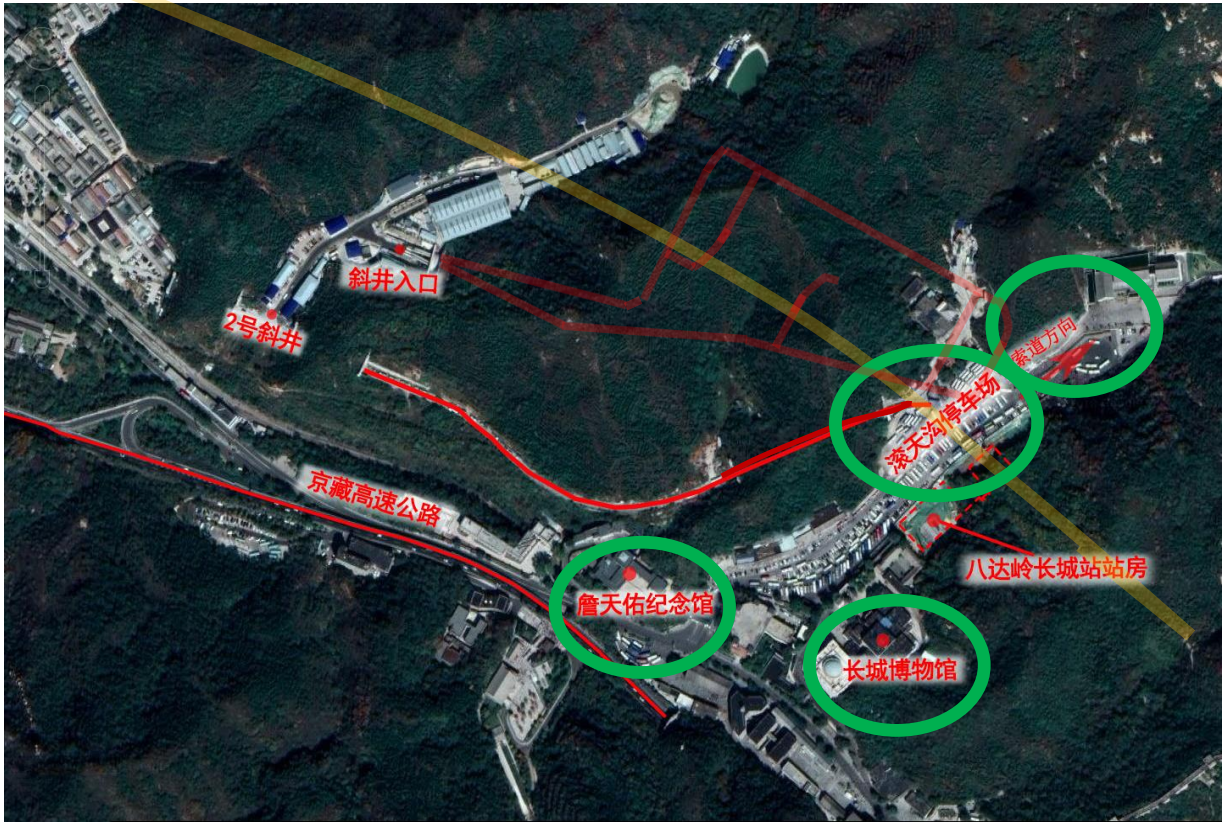
2.1 Stringent environmental requirements in Badaling Core Scenic Area

Sewage drainage：
Achieving Class I Water Quality (disinfection and filtration for drinking)

Vibration control：< 0.1cm/s

P M 2.5 ：< 150μg/m³

Noise control：< 55dB



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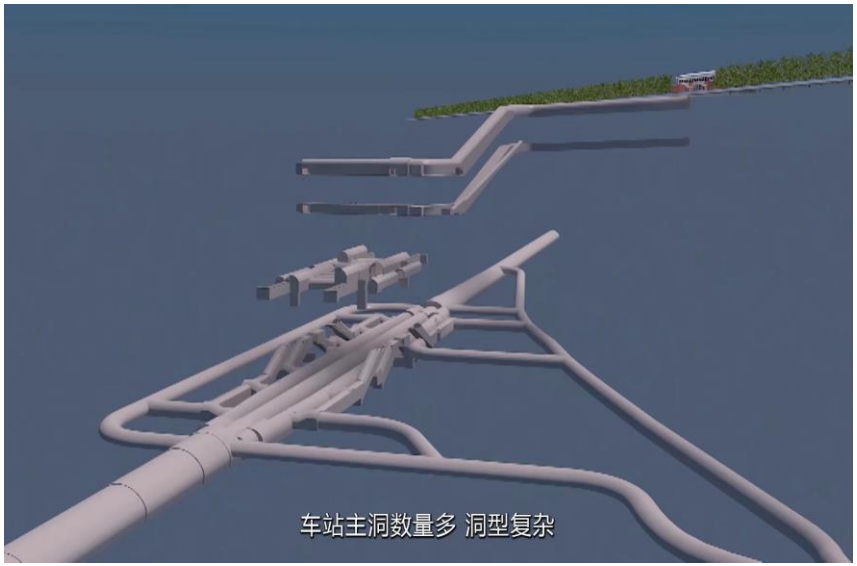
2 The Construction Difficulties of the Project

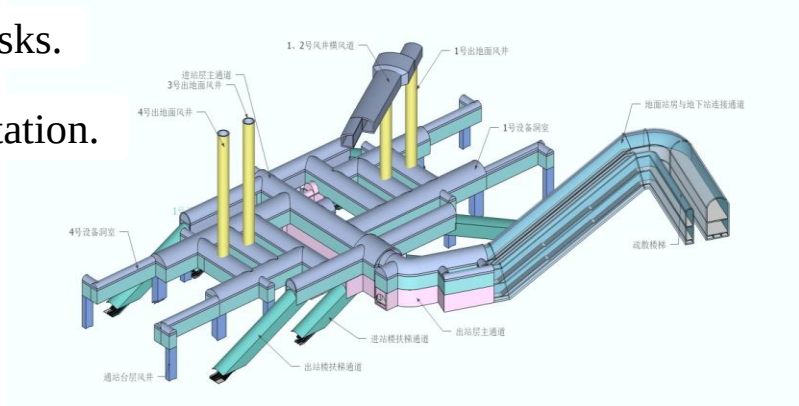
2.2 Multiple caverns distributed, complex underground structures and cross-interference

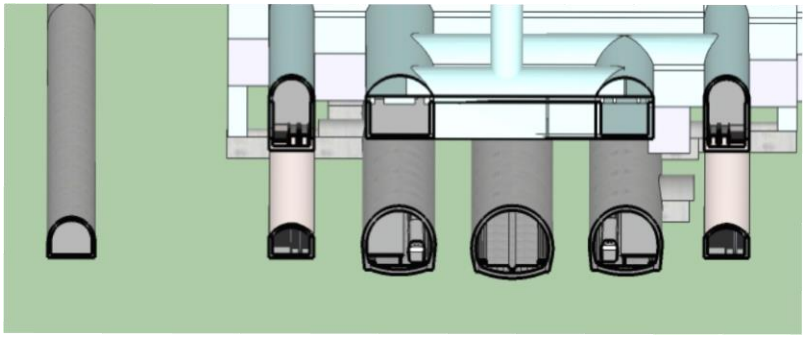
Caverns : 78 complex underground structure with multiple joints.

Section forms : 88 difficult construction regions with high risks.

The most complex underground excavated caverns cluster station.



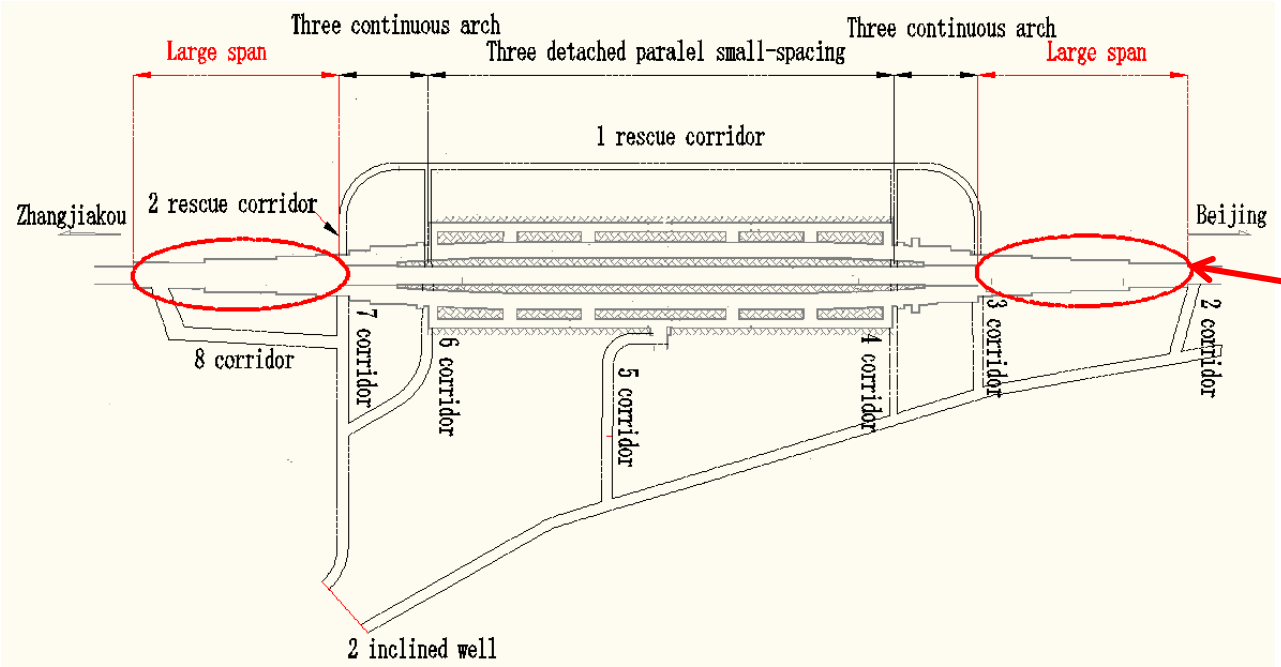


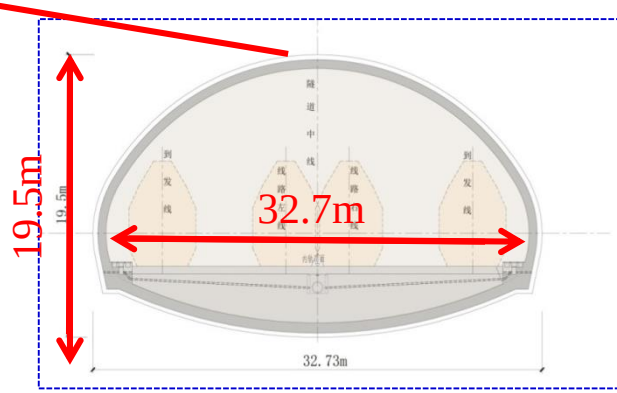


2 The Construction Difficulties of the Project

2.3 Large span, complex support design and excavation challenging

The maximum width and height of the large span the transition section is 32.7m and 19.5m,respectively. Section area is 497m^2.

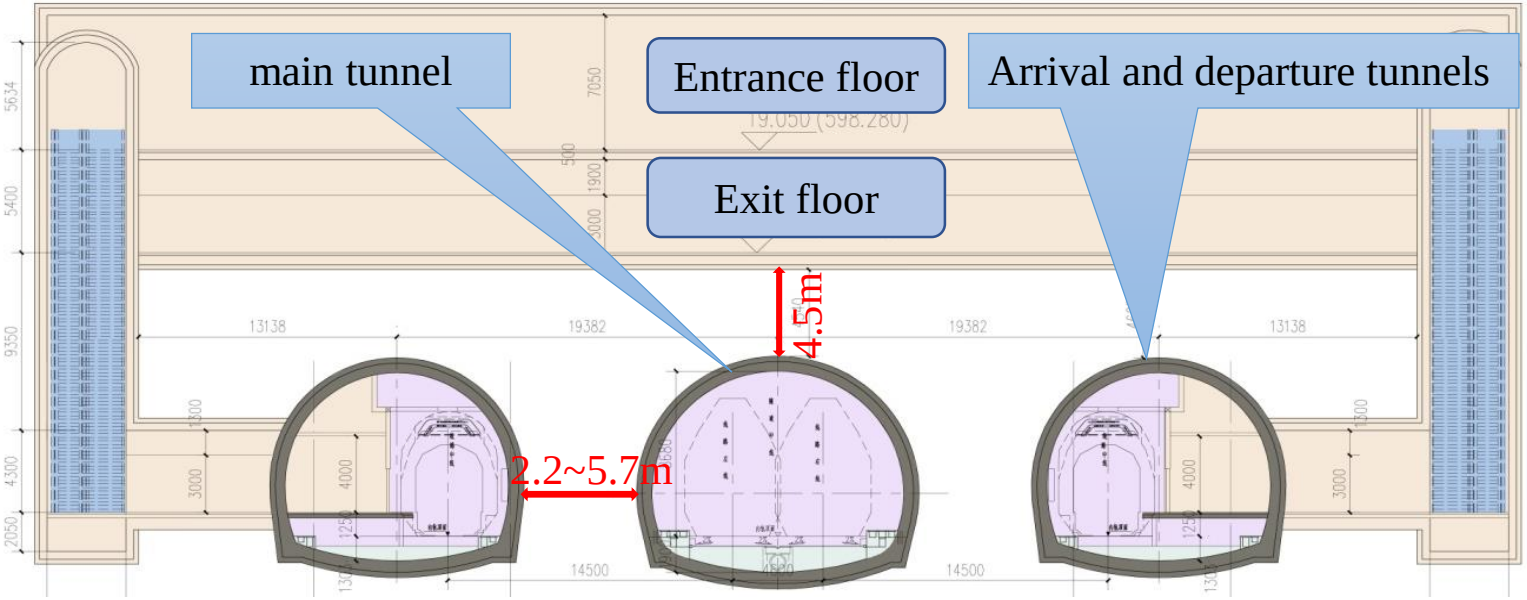




2 The Construction Difficulties of the Project

2.4 The horizontal spacing of the three separate tunnels is small

The platform level is consisted of 3 separate tunnels, with the main tunnel in the middle and the arrival and departure tunnels on both sides. The horizontal spacing between the middle tunnel and the left and right arrival and departure tunnels is 2.2m ~ 5.7 m.

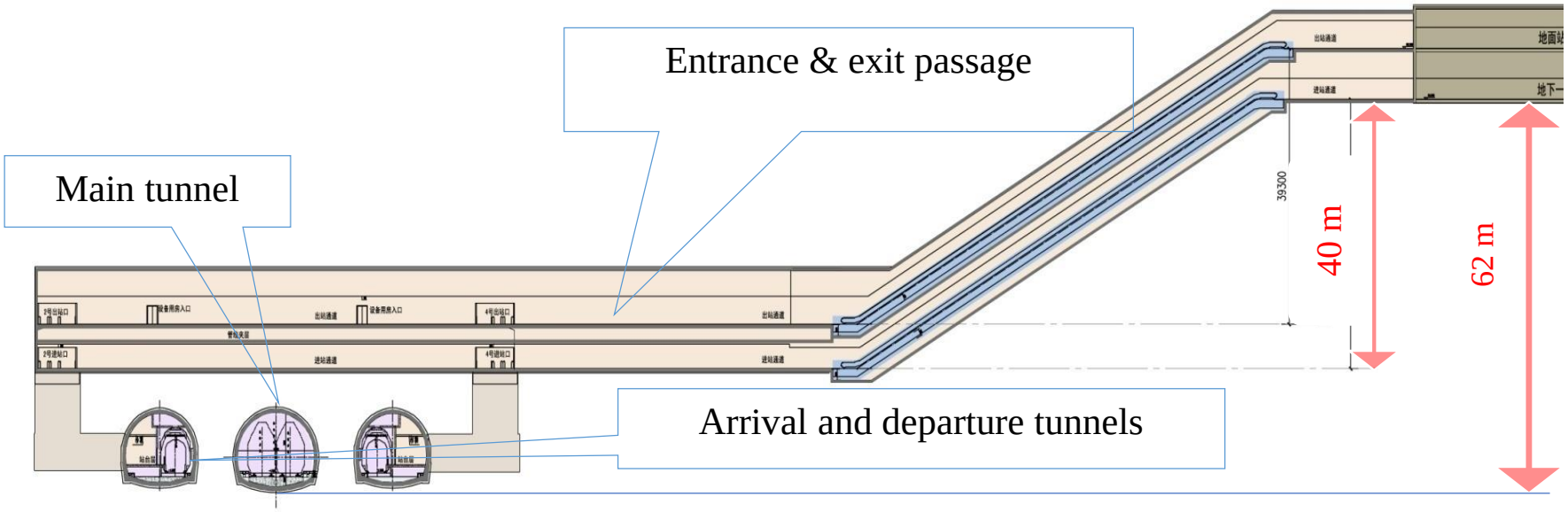


Cross section of the station

2 The Construction Difficulties of the Project

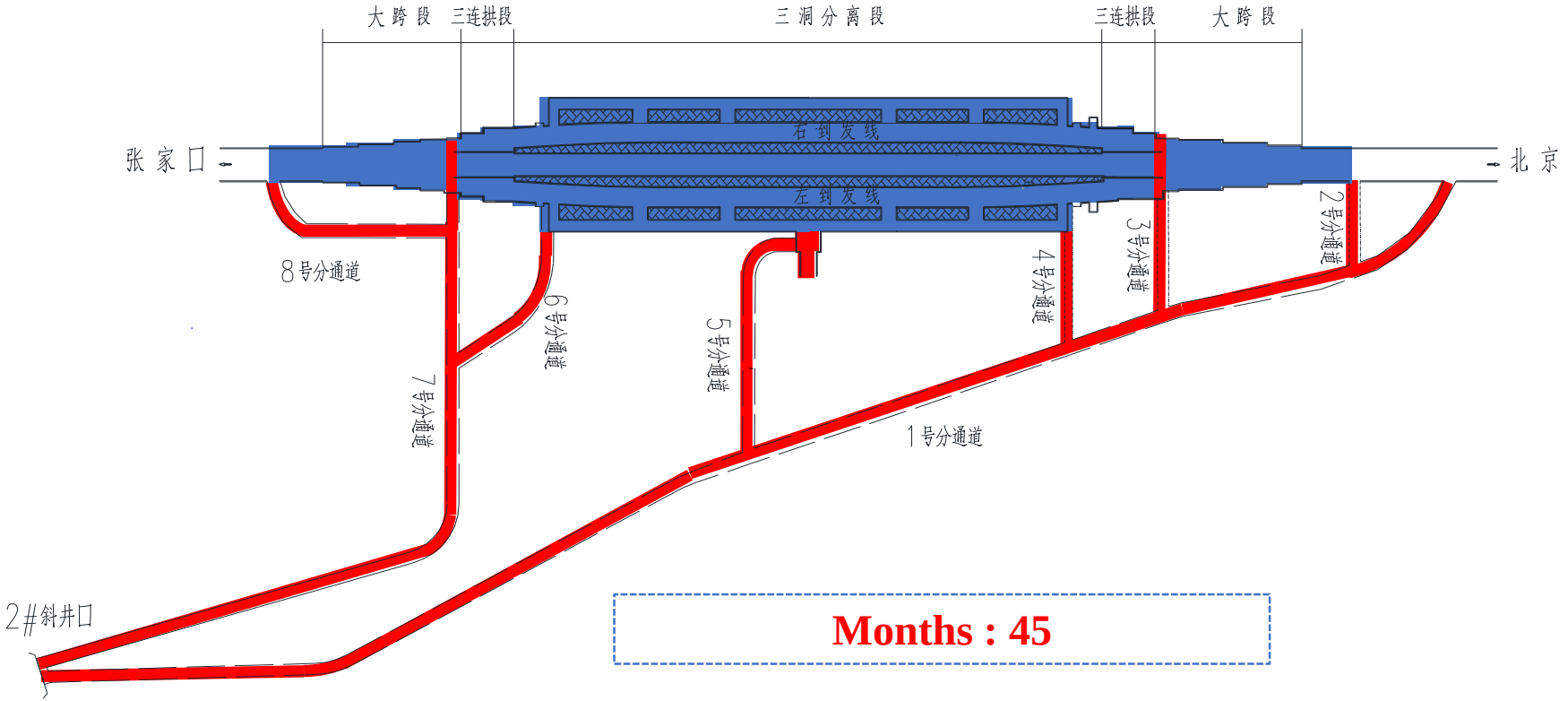
2.5 Large burial depth, brings challenge to passenger elevation, rescue and evacuation

Platform to ground structures has a elevation of 62 m, entrance & exit passage connected to ground structures, with an elevation of 40 m.



2 The Construction Difficulties of the Project

2.6 Tight schedule and complex construction scheme



Months : 45

3 Innovations in the Project

3.1 Green tunnel construction technology in scenic areas

the green environmental protection construction technology of tunnel slag dust control with the largest power machine and sewage purification is adopted to strictly protect the ecological environment of scenic spots. Therefore , optimizing transportation routes and adjusting transportation time can further reduce the construction for environment.

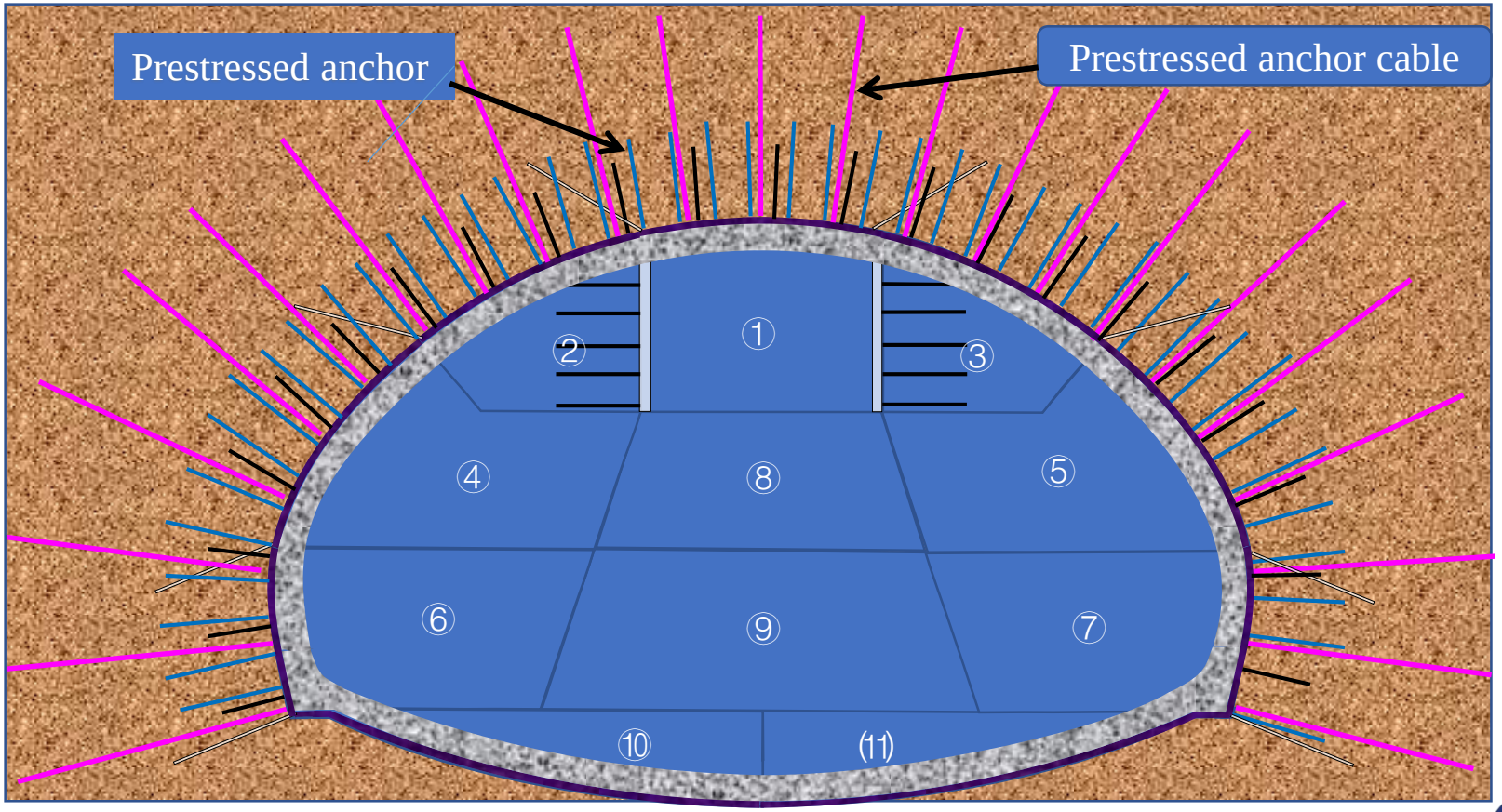
tunnel slag dust control

sewage purification

3 Innovations in the Project

3.2The large span tunnel construction technology

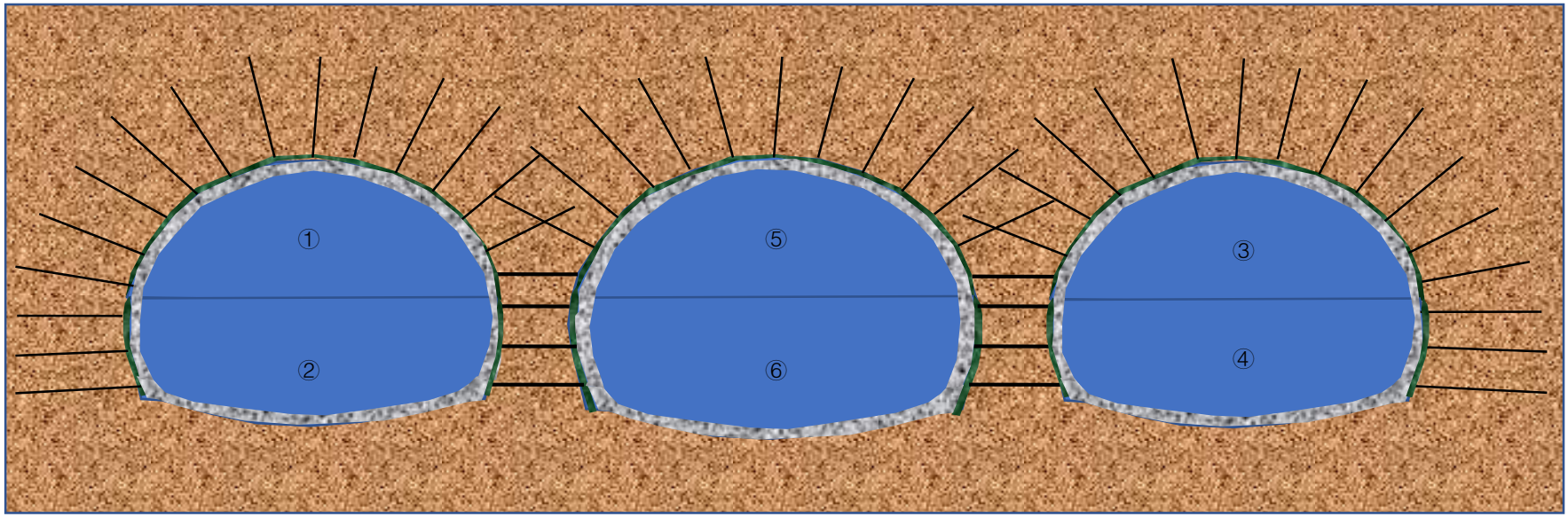
Excavation method:advance excavation of top small pilot tunnel, top-down excavation in layers, reserving core soil and reinforced by prestressed anchor rod and cable. Developing high-strength and fast-setting grouting technology. Creating a new type of large span second-lining trolley.



3 Innovations in the Project

3.3 Triple-detached cavern small-spacing tunnel excavation method

The underground station adopted the structural design of three-floors and three-parallel-tunnels. The construction sequence of "from bottom to top, from side to middle, with advancing adjacent excavation" and the precise micro damage control blasting technology were adopted to ensure the safety of rock pillars and the tunnel structure that have been constructed.



3 Innovations in the Project

3.4 **Durable concrete production and construction technology of tunnel lining structure**

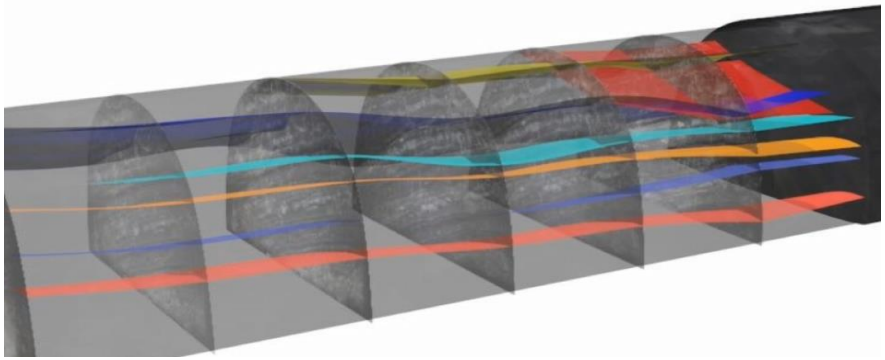
The key technologies for durable concrete construction are developed, including aggregate shaping technology, long-life concrete design, concrete form production and construction technology, and durable concrete maintenance. The durable concrete technique improves the internal compactness of concrete and prevents the cracking of concrete and the corrosion of steel bar. Curing measures, quality rapid detection and monitoring are proposed to achieve the durability of concrete.

3 Innovations in the Project

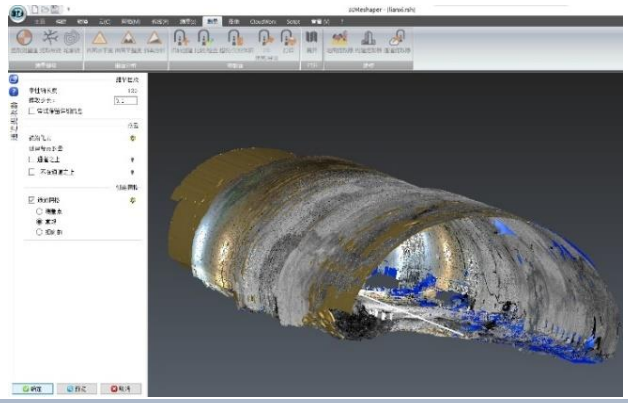
3.5Information technology of tunnel construction

Based on BIM technology, digital image, 3D points cloud and tunnel monitoring, the information construction management of “pepole-machine-rock-tunnel" is realized. Applying tunnel face geological DC auto-identification technology, we could forecast short-distance geological condition. Applying 3D laser scan technology, we could analysis the tunnel back break and review the concrete quantity of tunnel lining.

Information Platform



Tunnel face geological DC auto-identification technology

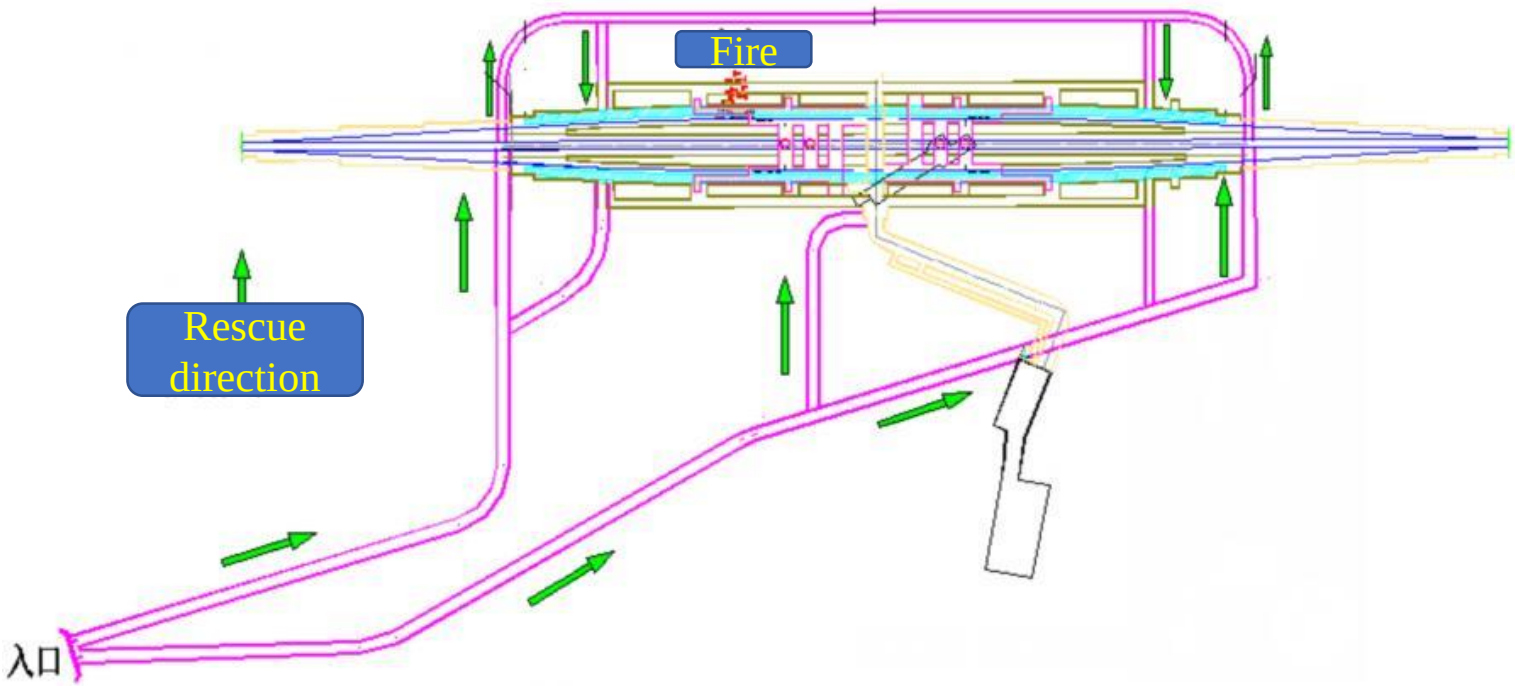


3D laser scan technology of tunnel section

3 Innovations in the Project

3.6 Disaster prevention and rescue

A 3D circular evacuation corridor provides full coverage in emergencies. which can be accessed no more than 50 meters from any position on the platform floor. Based on BIM, 3D GIS, Internet+ technologies to enable 3D visualized disaster prevention, rescue and smart command system, achieving smart smoke control, evacuation command, joint emergency planning. Fire prevention training center use VR to simulate more realistic scenarios for training.



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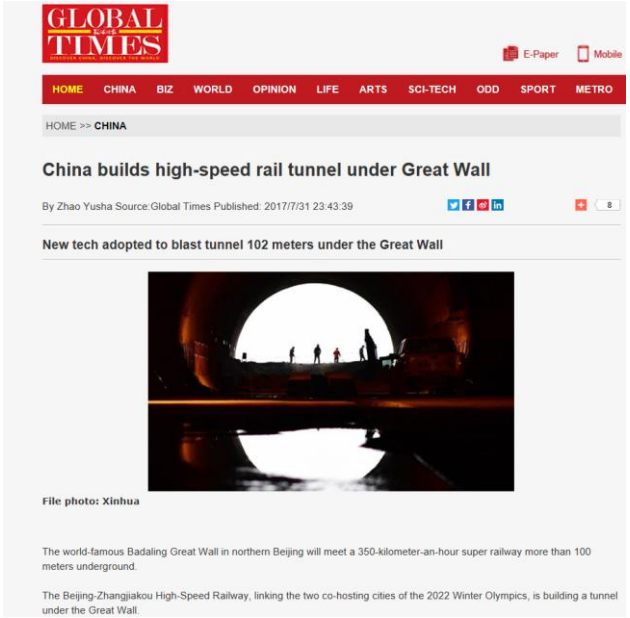
4 Project Evaluation and Description

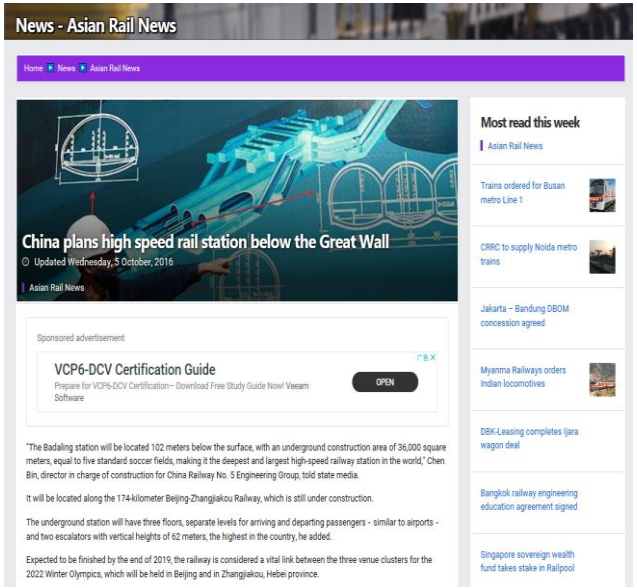
Globle Times

China builds high-speed rail tunnel under Great Wall. …



Asian Rail News

China high-speed rail station below the Great Wall. …



China Daily

China is building high-speed railway station under Great Wall. …

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