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# **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



## Stakeholders

### Client



Beijing-Zhangjiakou  
Intercity Railway Co., Ltd.

### Contractors



China Railway No. 5  
Group Co., Ltd

### Designer



China Railway Engineering  
Consulting Group Co.,Ltd

### Other stakeholders



Beijing Zhongtie Chengye Engineering  
Construction Supervision Co.,Ltd.





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# OUTLINE

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Overview of the Project



The Construction Difficulties of the Project

**2**

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Innovations in the Project



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**4**



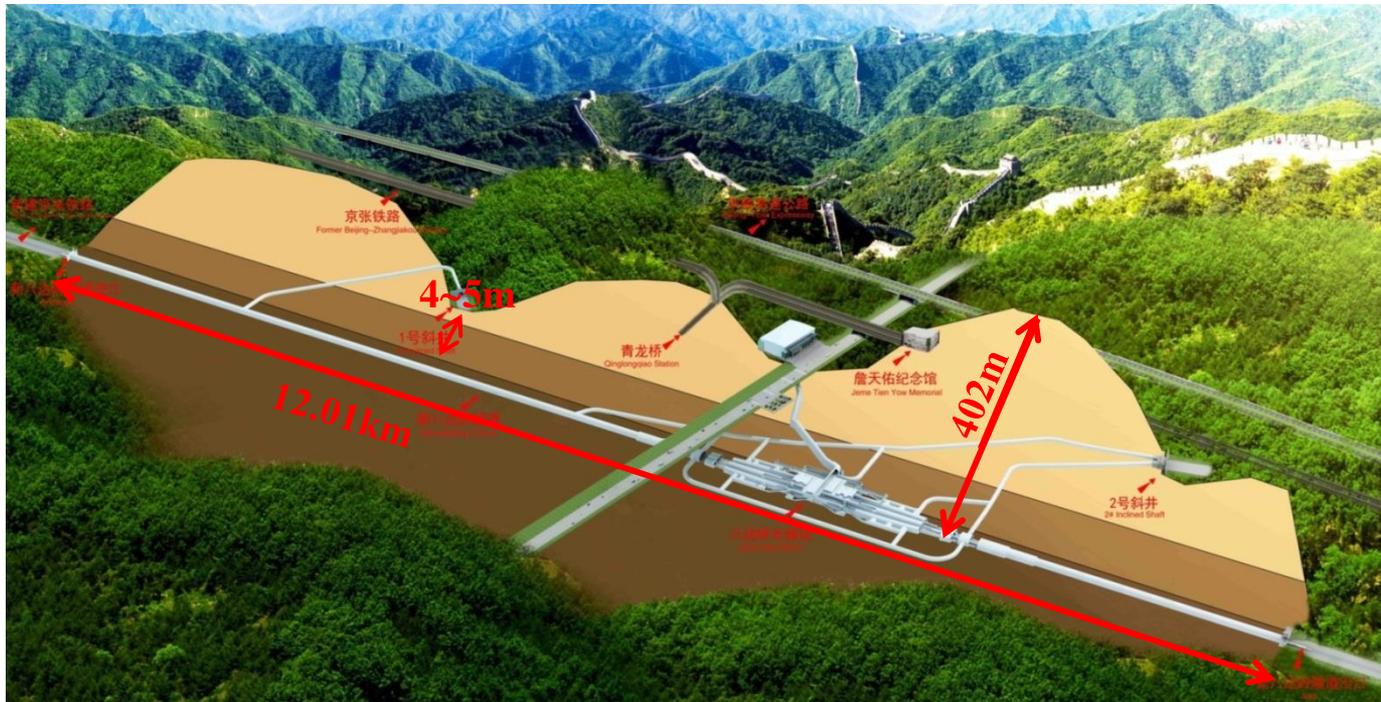




## 1 Overview of the Project

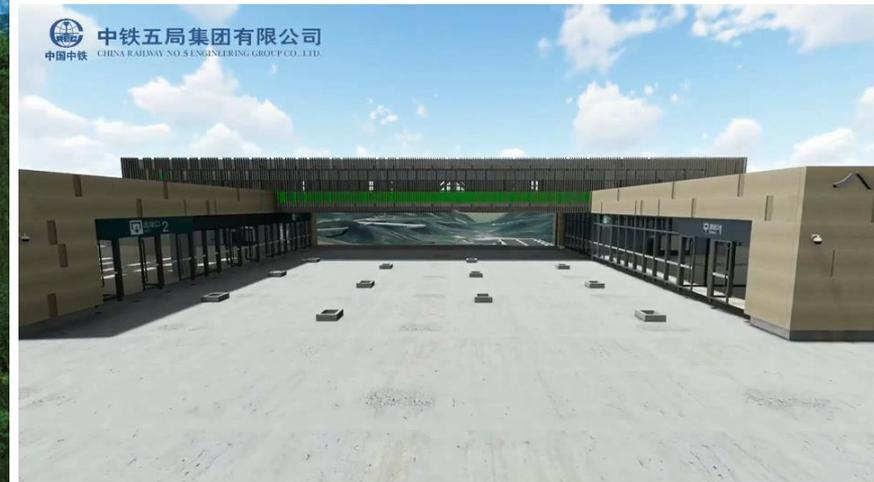
### 1.2 The new Badaling tunnel

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<sup>2</sup>**, 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

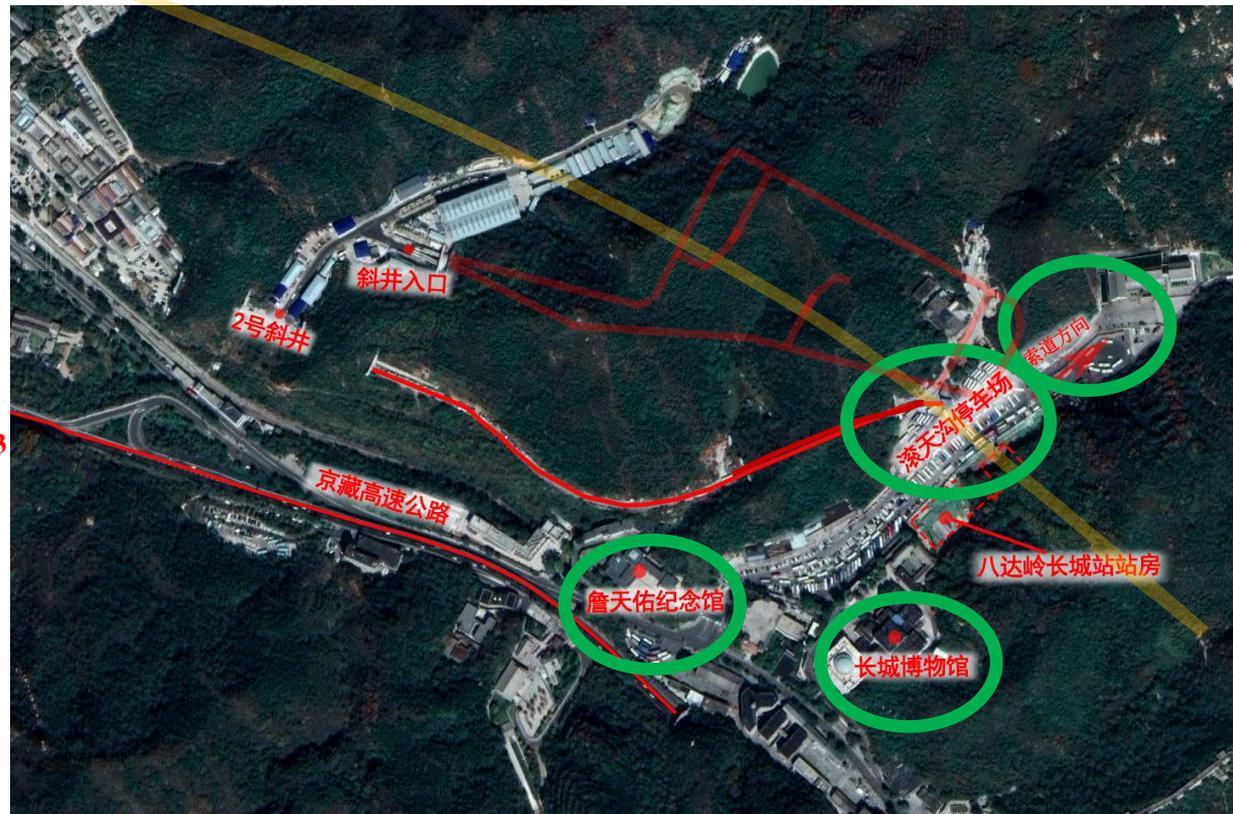
**Sewage drainage :**

**Achieving Class I Water Quality  
(disinfection and filtration for  
drinking)**

**Vibration control : < 0.1cm/s**

**PM 2.5 : < 150µg/m<sup>3</sup>**

**Noise control : < 55dB**





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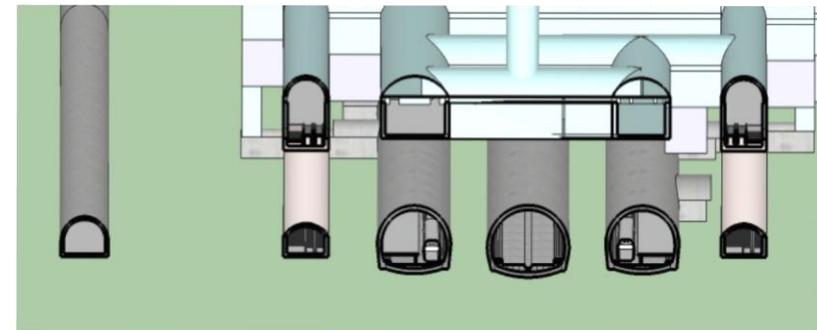
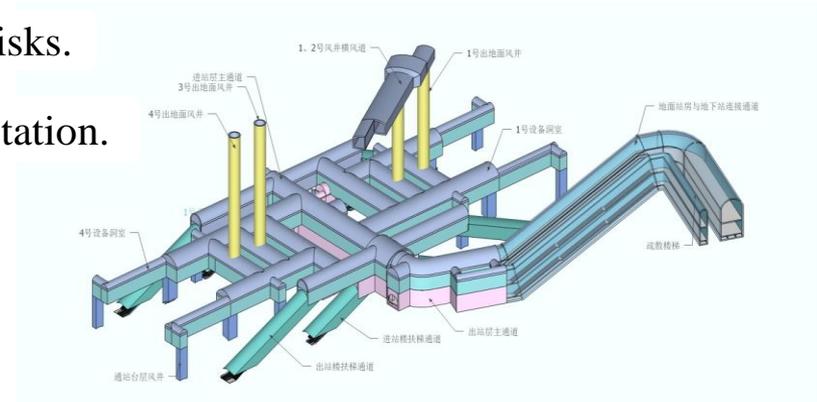
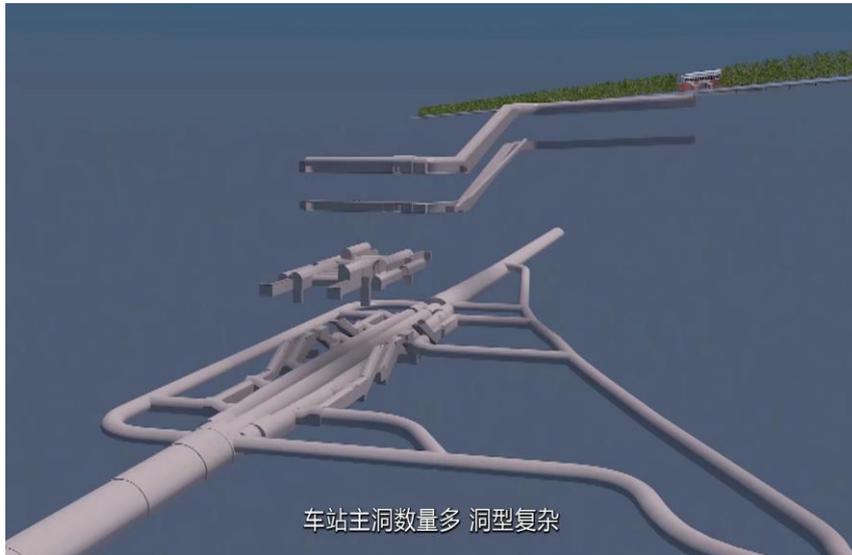
## 2 The Construction Difficulties of the Project

### 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.

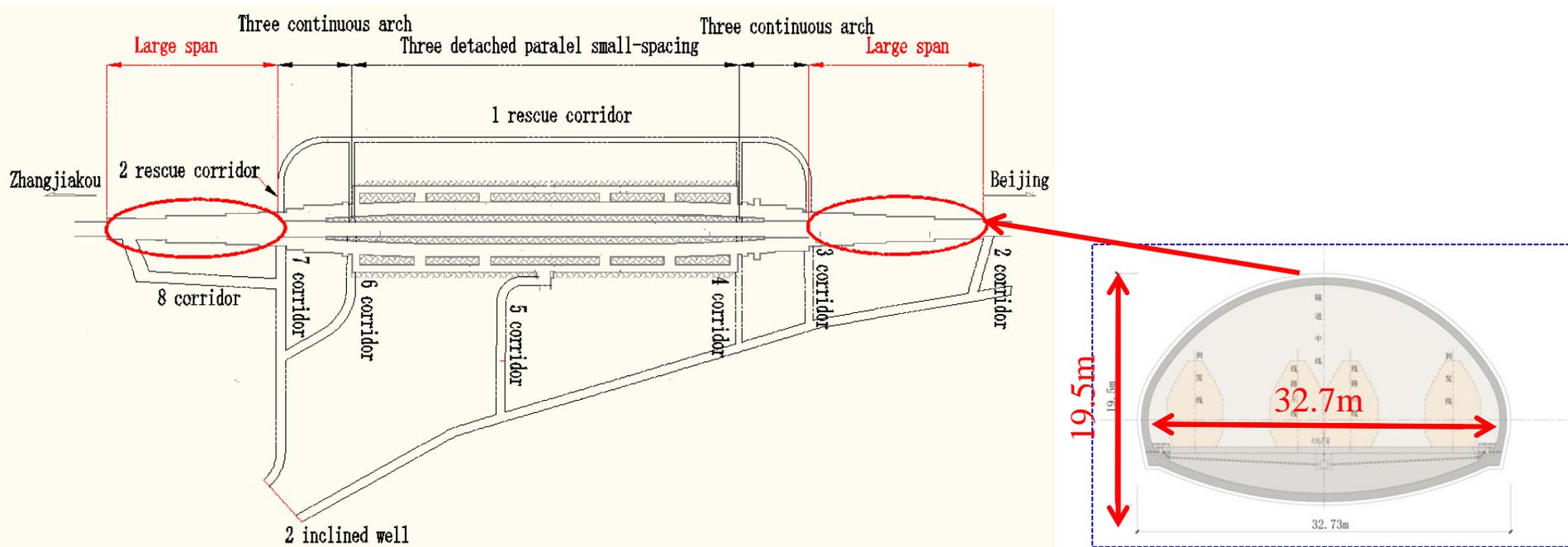




## 2 The Construction Difficulties of the Project

### 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<sup>2</sup>.

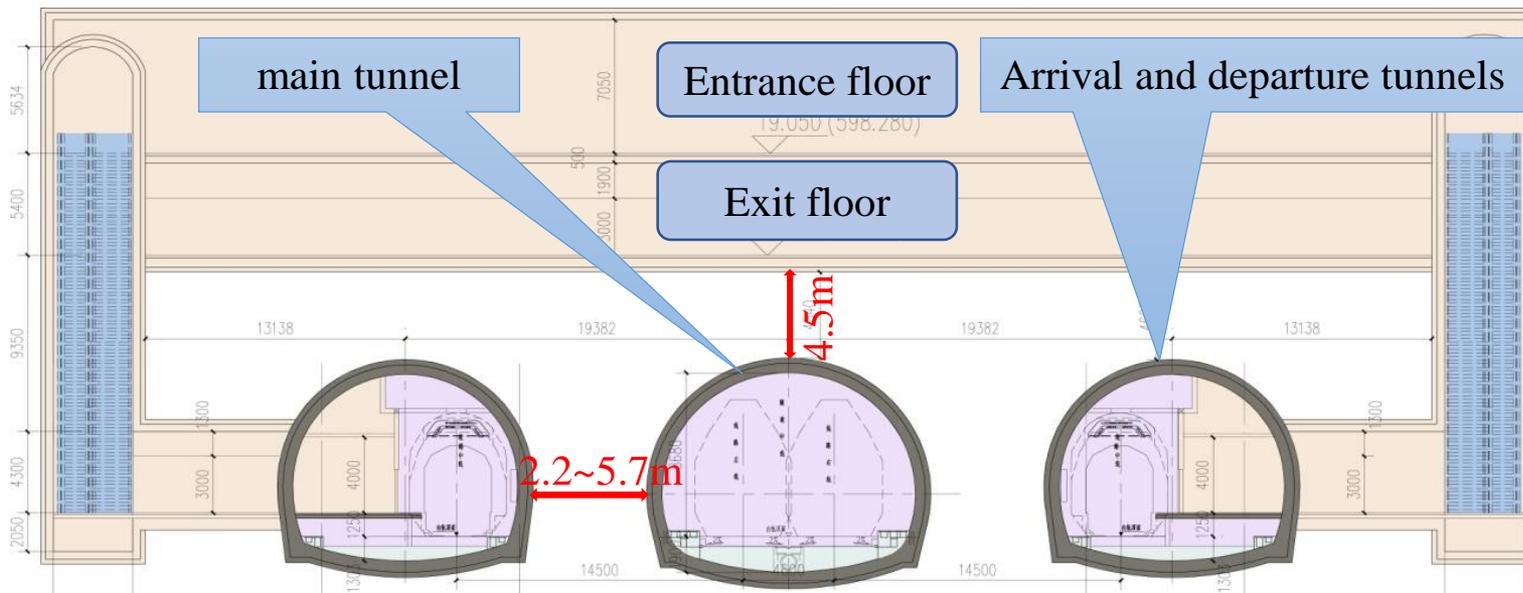




## 2 The Construction Difficulties of the Project

### 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

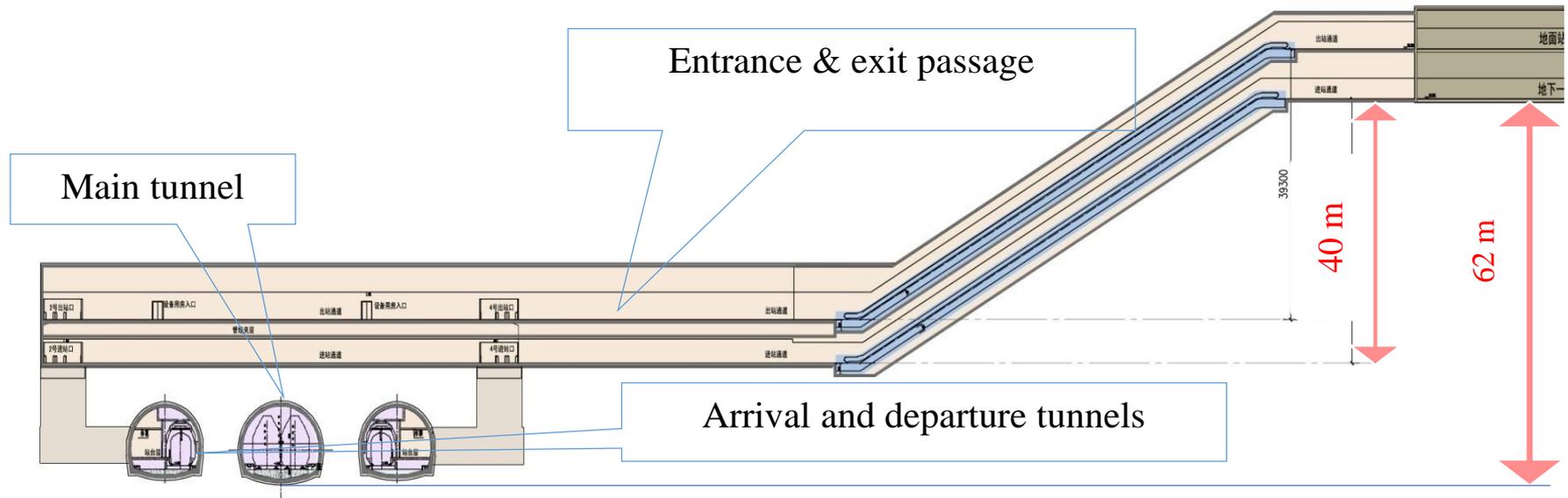




## 2 The Construction Difficulties of the Project

### 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**.



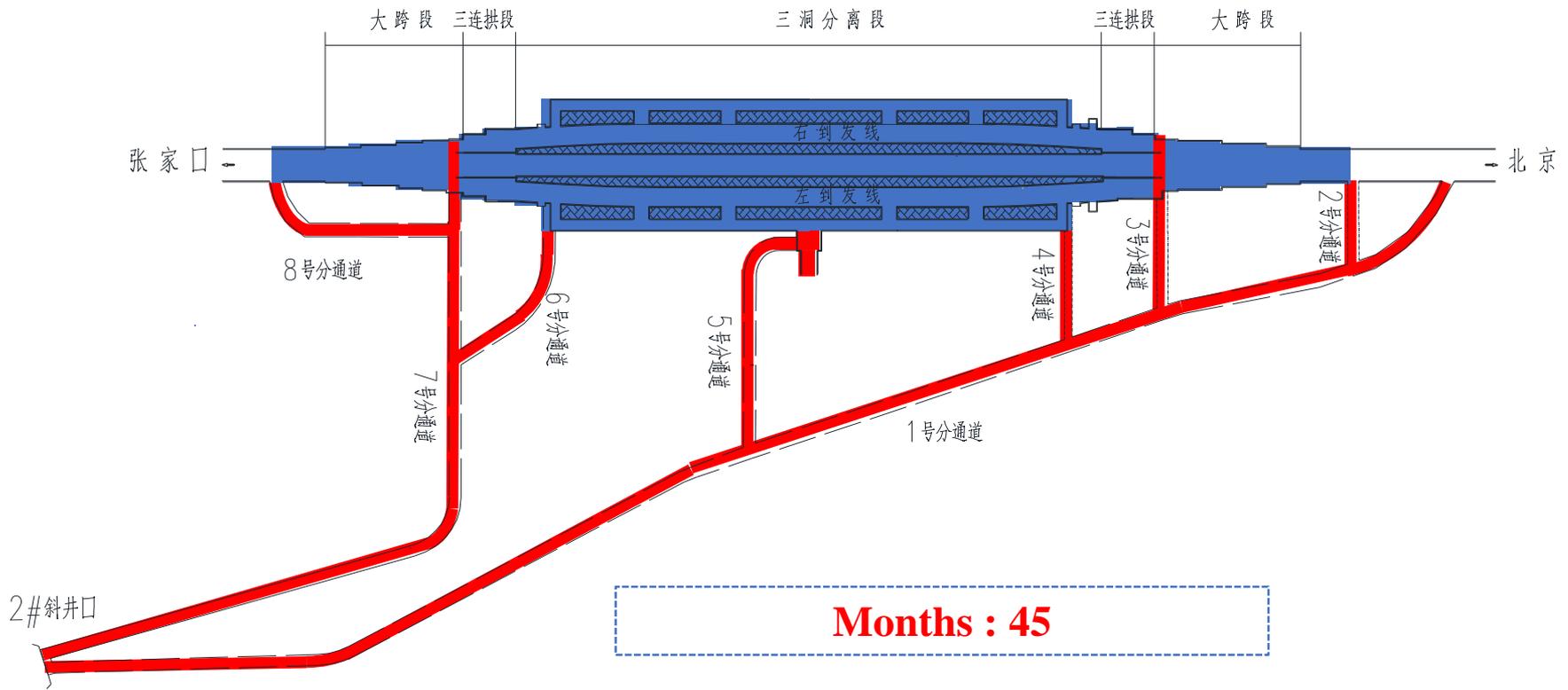


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## 2 The Construction Difficulties of the Project

### 2.6 Tight schedule and complex construction scheme





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## 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

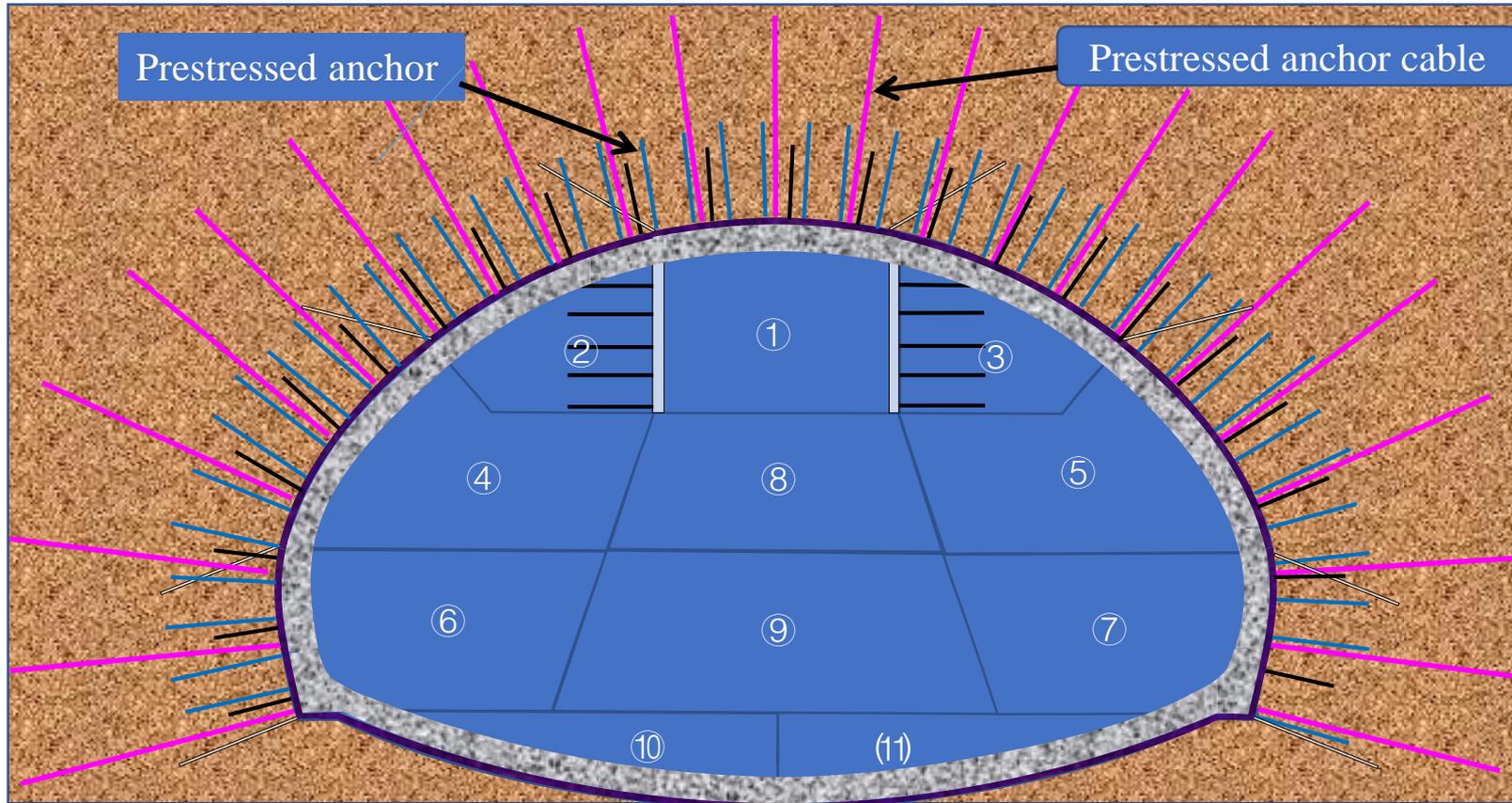


## 3 Innovations in the Project



### 3.2 The large span tunnel construction technology

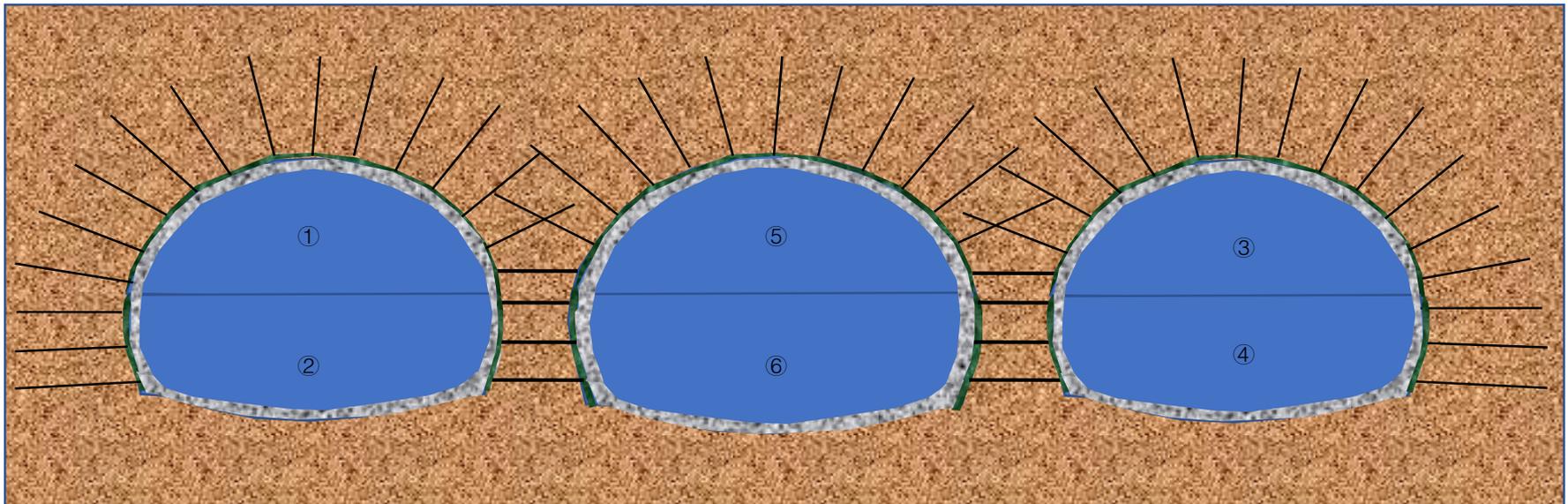
Excavation method: advance excavation of top small pilot tunnel, top-down excavation in layers, reserving core soil and reinforced by prestressed anchor rod and cable. Developing high-strength and fast-setting grouting technology. Creating a new type of large span second-lining trolley.



## 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.





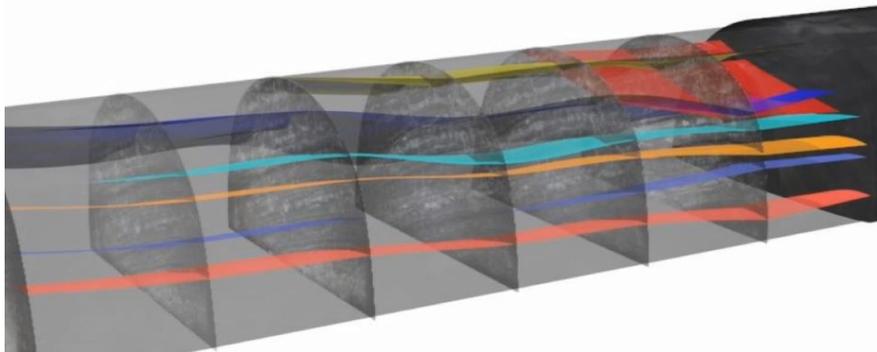
## 3 Innovations in the Project

### 3.5 Information technology of tunnel construction

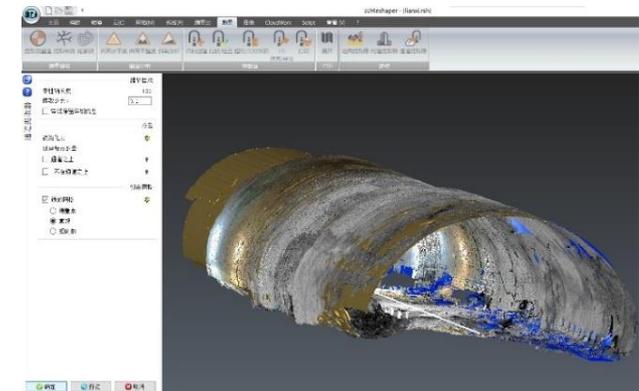
Based on BIM technology, digital image, 3D points cloud and tunnel monitoring, the information construction management of “**people-machine-rock-tunnel**” is realized. Applying **tunnel face geological DC auto-identification technology**, we could forecast short-distance geological condition. Applying **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

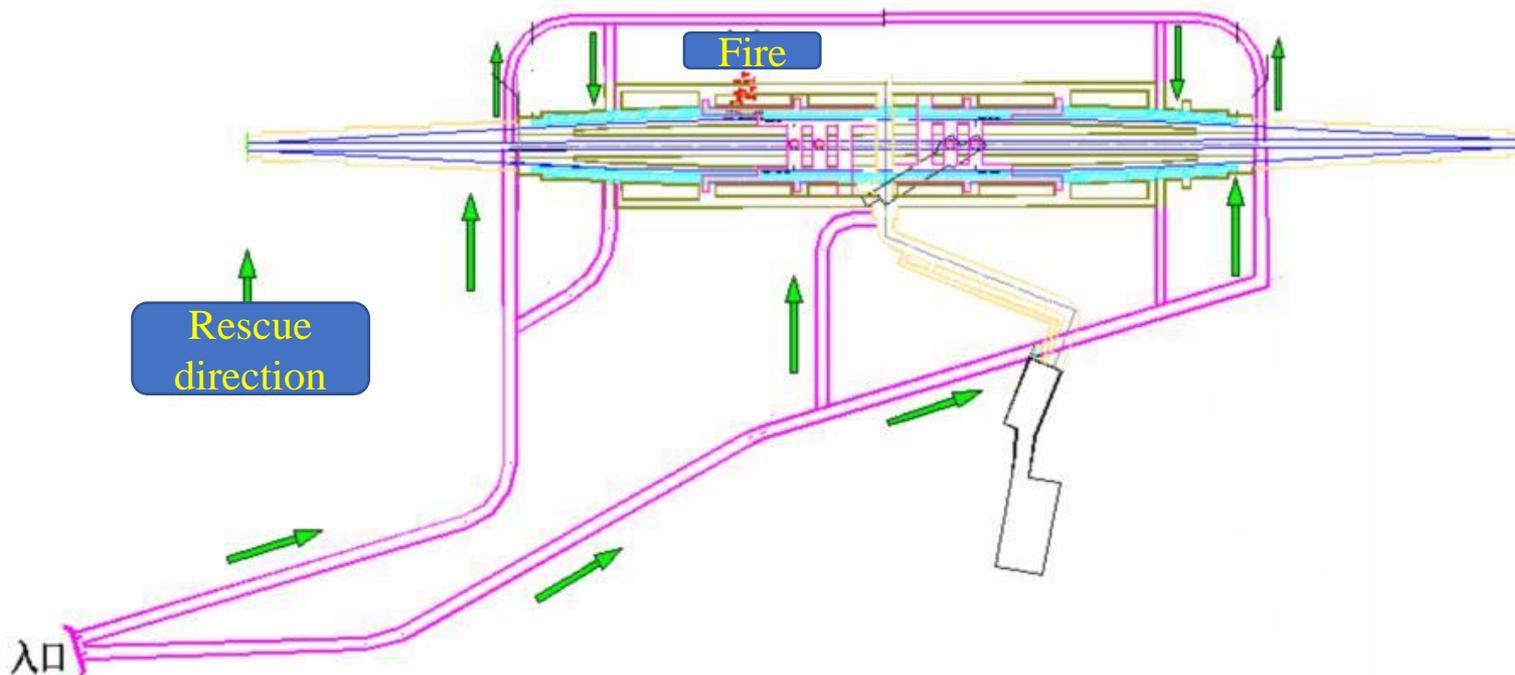




## 3 Innovations in the Project

### 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.





## 4 Project Evaluation and Description

### Globe Times

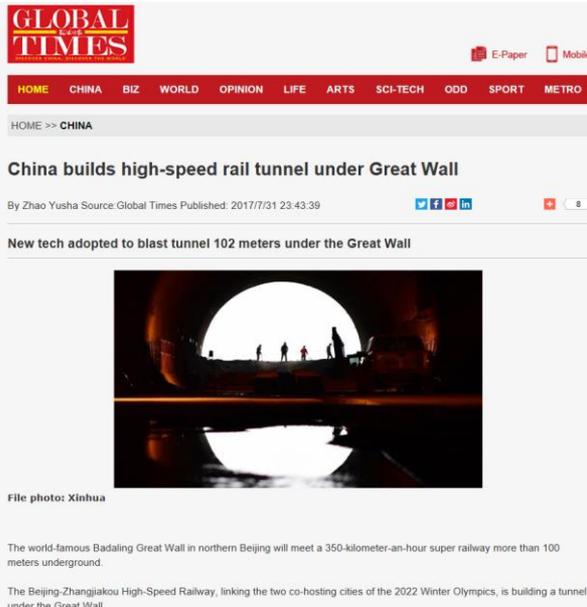
China builds high-speed rail tunnel under Great Wall. ...

### Asian Rail News

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

### China Daily

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



**GLOBAL TIMES**

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### China builds high-speed rail tunnel under Great Wall

By Zhao Yusha Source: Global Times Published: 2017/7/31 23:43:39

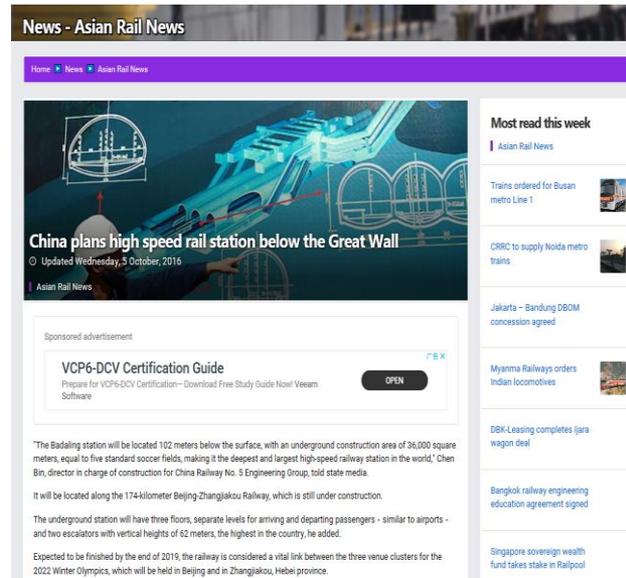
New tech adopted to blast tunnel 102 meters under the Great Wall



File photo: Xinhua

The world-famous Badaling Great Wall in northern Beijing will meet a 350-kilometer-an-hour super railway more than 100 meters underground.

The Beijing-Zhangjiakou High-Speed Railway, linking the two co-hosting cities of the 2022 Winter Olympics, is building a tunnel under the Great Wall.



News - Asian Rail News

Home > News > Asian Rail News

### China plans high speed rail station below the Great Wall

Updated Wednesday, 5 October, 2016

Sponsored advertisement: VCP6-DCV Certification Guide

"The Badaling station will be located 102 meters below the surface, with an underground construction area of 36,000 square meters, equal to five standard soccer fields, making it the deepest and largest high-speed railway station in the world," Chen Bin, director in charge of construction for China Railway No. 5 Engineering Group, told state media.

It will be located along the 174-kilometer Beijing-Zhangjiakou Railway, which is still under construction.

The underground station will have three floors, separate levels for arriving and departing passengers - similar to airports - and two escalators with vertical heights of 62 meters, the highest in the country, he added.

Expected to be finished by the end of 2019, the railway is considered a vital link between the three venue clusters for the 2022 Winter Olympics, which will be held in Beijing and in Zhangjiakou, Hebei province.



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### China is building deepest high-speed railway station under Great Wall

By Guo Kai | chinadaily.com.cn | Updated: 2017-07-31 13:58



Workers are digging a tunnel of the Beijing-Zhangjiakou high-speed railway line's branch linking Chengde county, Zhangjiakou, Hebei province, on June 30, 2017. (Photo:Xinhua)

Chinese workers are building the world's deepest and Asia's largest underground high-speed railway station beneath the Great Wall at the Badaling section in Beijing.

The station under construction will be 3-story high and have a 36,000 square meters floor area, including platform, entrance and exit. The railway tracks will be 102 meters underground.





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