The New Guanjiao Tunnel on Qinghai-Tibet Railway

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Stakeholders

Client: Qinghai-Tibet Railway Company
Engineer: China Railway First Survey & Design Institute Group Co., Ltd (FSDI)
Contractors: China Railway Tunnel Group
China Railway 16th Bureau Group Co., Ltd
China Railway 22th Bureau Group Co., Ltd
China CREC Railway Electrification Bureau Group Co., Ltd
Main suppliers: Shangyu Yucai Fan Industry Co., Ltd.
Zhejiang Jindun Fans Holding Co. ,Ltd
Chengdu Mei Anchor Bolting Inc.
Other Stakeholders: Beijing Tiecheng Construction Supervision Co., Ltd
Sichuan Tieke Construction Supervision Co., Ltd
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1. Overview of the new Guanjiao tunnel

The New Guanjiao Tunnel is a key project of the second line of Xining-Golmud section of Qinghai-Tibet Railway, with a total length of 32.690 km. The purpose of the new Guanjiao tunnel is to address the problems of difficult operation and low efficiency of the existing railway when climbing over Mount Qinghai Nanshan.
2. The construction difficulties of the new Guanjiao tunnel

An average elevation of 3400 m, an annual average temperature of -0.5°C, the atmospheric pressure of 60 kPa and Low oxygen content. We had to confront several severe challenges:

- Low labor and mechanical efficiency,
- Heavy construction mechanical exhaust emission,
- Serious labor sanitation security problem,
- Difficult construction ventilation.
During the construction of the new Guanjiao Tunnel, large deformations occurred in several sections.
2. The construction difficulties of the new Guanjiao tunnel (cont’d)

Water inrush occurred when tunneling beneath valleys.
3. Innovation of the new Guanjiao tunnel

(1) Construction ventilation system

AS a distinct solution for low oxygen content condition in high altitude tunneling site, quite effective measures is adopted.

① Multi simultaneous excavation faces are developed for each inclined shaft, instead of two faces in common practice, to expedite tunneling process.

② The oxygen bags are provided at each working face, and a hyperbaric oxygen chamber at each portal.
(2) Construction ventilation system

③ The method of increasing the amount of air supply is adopted.
④ A diaphragm is installed in the inclined shafts to form a tight separated air supply passage. Then jet fans are installed to supply for air chambers at the bottom of inclined shafts, then sufficient air supply is achieved with axial flow fan to four working faces.
3. Innovation of the new Guanjiao tunnel (cont’d)

(2) Belt conveyor transport in inclined shaft

Since heavy duty trucks for tunneling spoil transport will produce heavy exhaust emission, bring worse occupational heath problem and constrain the comprehensive tunneling efficiency, a belt conveyer system for tunnel spoil transportation is installed in the long inclined shaft, which consists of transport system outside the portal, shaft belt conveyor and bottom crushing station.
3. Innovation of the new Guanjiao tunnel (cont’d)

The key technology of belt conveyor system is the of bottom crushing station.

If a mobile crushing station is set near the excavation face, the belt conveyor with restrictions of tunnel space will affect the other tunneling processes when the belt conveyor passes through the lining work template trolley and multifunctional construction platform. Finally, the scheme of a fixed crushing station located in the inclined bottom was adopted.
3. Innovation of the new Guanjiao tunnel (cont’d)

(3) Operation ventilation system

The ventilation method of using train piston wind is adopted in normal operation condition in China’s longest tunnel with high altitude. Two-years operation practice indicates that air quality in the tunnel is satisfactory.
The non-incident tube and the cross passages are pressurized by the jet fans to meet the demand of personnel evacuation; the evenly distributed shafts are used for smoke discharge from the top of the tunnels.

Separated track systems and ventilation & smoke exhaust systems, as well as independent controlling systems, are equipped for two tubes at the evacuation and rescue station.
4. Project evaluation and description

A number of technologies with low carbon, energy conservation and reduced cost, such as moderate gradient slope, construction ventilation, belt conveyer system and operational ventilation have been development.

With design tunnel technologies and construction plans, the tunnel construction has been completed on schedule and the tunnel has been put into operation in December, 2014. With high satisfaction for technologies employed, the client is happy to make this entry recommendation.
4. Project evaluation and description (cont’d)

The tunnel has been given due attention by the local government for the short distance between the tunnel portal and the close-by tourist attractions. Therefore, landscape design has been included in the design of the tunnel portal.

![tunnel portal Xining](image1.jpg)

![tunnel portal Golmud](image2.jpg)
4. Project evaluation and description (cont’d)

The sewage discharge has not posed any threat to the survival of the national second-class protected scaleless carp and its number has steadily been rising.

No negative impact has been inflicted on the local climate and environment, nor has the tunnel construction changed the trend of annual water level rise of Qinghai Lake in the construction area.

Scaleless carp in Buha river

Bird Island of Qinghai Lake
Thank you!