



THE WEST QINLING TUNNEL ON LANZHOU-CHONGQING RAILWAY China

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1. Overview of The West Qinling Tunnel



The West Qinling Tunnel is a key project of the Lanzhou-Chongqing Railway with a total length of 28.236km. The construction purpose of the railway, as a part of the national strategy of "the Belt and Road Initiative", is to serves as a bridge linking the two watersheds (the Yellow River basin and the Yangtze River basin) and the two western economic belts (the Longhai-Lanxin Economic Belt and the Sichuan-Chongqing Economic Belt) of China.

The key section of the Lanzhou-Chongqing Railway, the West Qinling Tunnel (located in Wudu district, Longnan city, Gansu province) is apparently a landmark project for its significance.







2. The construction difficulties of the West Qinling tunnel



Fig1. Geological profile

The tunnel site crossing a regional great fault and four secondary faults is at the tectonic extrusion region of Qinghai-Tibet plate, the Yangtze plate and North China plate, with extremely complicated geological conditions and sensitive environment.







2.The construction difficulties of the West Qinling tunnel







Fig2. Crush and lamellate phyllite

Tunneling faced with serious geologic conditions (complex and uneven lithology).







2. The construction difficulties of the West Qinling tunnel







No reference for the super long distance (drillingblasting method for the 8km section at the north portal, TBM method for the 20km section at the south portal) ventilation, evacuation and rescue, etc..



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- (1) TBM system including machine adaptability, boring index and synchronized lining with continuous belt conveyor mucking
 - ① Adaptability:

TBM type, key parameters on cutterhead, cutters, thrust force, torque are well adapted to the lithologic conditions of the tunnel.









① Adaptability:

The rock mass	key parameters				Secondary/refined)	
cuttability classification	Rc/MPa	α /°	kv	seepage / (L/min . 10m)	classification	(m · h ⁻¹)
I	30-60	45-65	< 0.55	-	I a	3.60-3.72
	30-60	45-65	> 0.55	-	I _b	3.40-3.60
	30-60	< 45	-	-	I _c	3.00-3.40
	30-60	> 65	-	-	I _c	3.00-3.40
Ш	60-75	45~65	_	< 10	Π _	2.60-3.00
	60-75	< 45or > 65	-	10~20	П	2.30-2.60
	60-75	_	_	> 20	П с	2.00-2.30
Ш	> 75或 < 30	_	0.45-0.75	< 10	III_a	1.80-2.00
	> 75或 < 30	_	0.45-0.75	> 10	Ш _ь	1.65-1.80
	> 75或 < 30	_	0.35-0.45或	-	Π	1 65-1 80
			0.75-0.80		ш _b	1.05 1.00
	> 75或 < 30	_	< 0.35or >	-	Ш _с	1.60-1.65
			0.80			





② Boring index:



Fig5. Synchronized lining trolley



Fig6. TBM ventilation

Boring Record: Large Diameter 10.32m **Daily boring** 42m Weekly boring 235m Monthly boring 842m **Monthly lining** 860m **Continuous boring distance** 15.6km









③ synchronized lining with continuous belt conveyor mucking



The belt conveyer mucking system have reduced the exhaust emission and the cost of ventilation.

The developed devices including the redundant belt keeper, the continuous mucking separator, and the nondestructive rapid belt extender have played a key role to keep high efficiency of the 14km belt conveyor mucking system, ensuring 15.6km continuous TBM boring.







(2) Construction ventilation system

The phased ventilation mode adopted in the construction has solved the world problem of the 20km super long distance ventilation in the TBM tunneling.



Fig7. Construction ventilation







(3) Emergency evacuation and rescue system

In this super long tunnel, two tubes are connected by cross passages for rescue and evacuation purposes. With overpressure ventilation from safe tubes and fume exhausting through inclined shaft, a complete disaster prevention and rescue system has been set up, improving the tunnel evacuation and rescue system in China.



Fig8. IDA simulation







4. Project evaluation and description

新建铁路兰州至重庆线 西秦岭特长隧道工程评价意见

新建铁路兰州至重庆线途经甘、陕、川、渝三省一市 22 个县(区), 兰州至重庆段正线线路长度为 855.331km,设计时速 200km/h,桥隧比为 76.99%。全线控制性工程西秦岭特长隧道位于甘肃省陇南市武都区境内。

西秦岭特长隧道长 28236m,设计为两座单线隧道,线间距 40m。隧道 走行于秦岭高中山区,地势总体趋势西高东低,山体陡峻,沟谷深切多呈 "V"字形。高程多在 1000~2400m,相对高差约 1400m,隧道最大埋深约 1400m。西秦岭特长隧道工程设计进口采用钻爆法施工,出口采用两台大直 径开敞式 TBM 施工,TBM 独头施工长度超过 15km,TBM 洞外拼装,洞 内拆卸,拆卸洞断面积 347m²。该工程是国内目前采用 TBM 与钻爆法结合 施工最长的铁路隧道。

自 2008 年 8 月西秦岭隧道开工建设以来,经过建设、设计、监理、施 工等单位的联合攻关,系统研究并成功实现连续皮带机出碴条件下,开敞 式 TBM 掘进与二次模筑混凝土衬砌同步施工技术、连续皮带机出碴技术、 长距离独头通风技术、TBM 施工 HSP 超前地质预报技术、超大断面 TBM 拆卸洞成洞技术、高低压供配电技术等,形成西秦岭特长隧道成套建设技 术,有效的提高了特长隧道工程 TBM 施工综合成洞效率。

西秦岭隧道设计内容全面、细致,充分利用了开敞式 TBM 这种先进设 备在隧道施工中的机械化优势,并在建设中实现了多项技术的重大突破, 是我国隧道技术的巨大进步,同意推荐西秦岭隧道参加有关优秀工程设计 和科学技术奖的评选。 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 developed.

The tunnel construction has been completed on schedule and the tunnel was put into operation in December, 2016. With high satisfaction for technologies employed, the client is happy to make this entry recommendation.



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4. Project evaluation and description



The record-breaking West Qinling TBM holed through into an adit in May 2011, following landmark advances of 235 m (771 ft) per week and 841.8 m (2,751 ft) per month.

CHENNAI METRO EPB FITTED FOR MIXED **GROUND CONDITIONS**

In 2012, a new 6.65 m (21.8 ft) Robbins EPB will tackle mixed ground conditions in densely urban Chennai. The southeastern Indian city is a rapidly growing technological and industrial center with a population of more than 8.2 million people. Owner Chennai Metro Rail Limited (CMRL) ommissioned two new rail line

WORLD RECORD WINS FOR WEST **QINLING MAIN BEAMS**

1 up to 1,400 m (4,600 ft) of cover and more than 10 hours from the nearest airport. China's West Qinling Mountains may not seem like an ideal site to set tunneling records. Two Robbins TBMs are proving that mark rates in difficult conditions.

The first of two 10.2 m (33.5 ft) Main Beam Machines advanced 235 m tion before being re-launched. (771 ft) in one week, and 841.8 m (2,761 ft) in one month during April 2011-rates higher than any ever recorded for TBMs in the 10 to 11 m (33 to 36 ft) diameter range. The previous long-standing rates, from a Robbins machine at Chicago, USA's TARP project, were for 185 m (607 ft) in one week and 685 m (2,247 ft) in one month.

"The Robbins machines have a good performance, we are very happy with the weekly rates, and hope for even better monthly rates," said Mr. Xu, project, an extensive 820 km (500 mi) Chief Engineer & Vice Project Manager for contractor China Railway Tunnel Group Co. Ltd. (CRTG). The 18th Bureau of CRTG is managing the Left Line hours and enable an annual freight ca-Tunnel, while China Railway Construc-

tion Corporation (CRCC) is managing the Right Line Tunnel. The two parallel 16.6 km (10.3 mi) routes are just 40 m (130 ft) apart.

The record-breaking Left Line machine also broke through into an assumption wrong, however, with land- intermediate adit on May 28, 2011 at the 5.5 km (3.4 mi) mark, where it underwent planned maintenance and inspec-

> Ground has consisted mainly of phyllite and limestone with some sections of high quartz content. Crews have also encountered fault zones of breccias and clay, as well as a 600 m (2,000 ft) long section of broken rock. Despite the conditions, only about 100 cutters have been changed on the Left Line machine so far. The Right Line machine, launched a month later, is also experiencing good cutter life.

The West Qinling tunnels are part of the Lanzhou to Chongging Railway long scheme that will open to traffic in 2014. The new railway will shorten transport times from 17.5 hours to 6.5 pacity of 100 million metric tons.

The tunnel create many world records boosted and the development of TBM technology. The West Qinling tunnel are part of Lanzhou to Chongqing Railway project. The railway will shorten new transport times from 17.5 hours to 6.5 hours and enable an annual freight capacity of 100 million metric tons.

MAJOR PROJECT OF THE YEAR

(quote:http://www.therobbinscom pany.com/projects/west-qinling-railtunnels/)







4. Project evaluation and description

The project obtained 5 patents for invention and 20 patents for utility models, won a second prize of provincial level Science and Technology Progress Award and a special prize of Technical Innovation of China Association of Construction Enterprise Management, and developed a provincial level Construction Method. 25 papers were published in Chinese core journals.



Special Prize of Technological Innovation, Science and Technology Award 2012 by China Association of Construction Enterprise Management







Thank you!

