Pandrol and the Railways in China

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The high-speed railway network in China is now developing at a rapid pace. The Chinese Ministry of Railways (MOR) has a very ambitious plan to develop its railway network from the current route length of 80,000km to a route length of 120,000km by 2020. Out of this additional 40,000km of track, 12,000km will be dedicated high-speed passenger lines (PDL lines), with maximum speeds of 350km/hr.

All of the following are currently being prepared for high speed rail services. Most of the lines will open with a line speed of 200 km/h, limited by the trainsets and national law. Over time the permitted speeds will be increased up to the maximum allowed for by the track design.

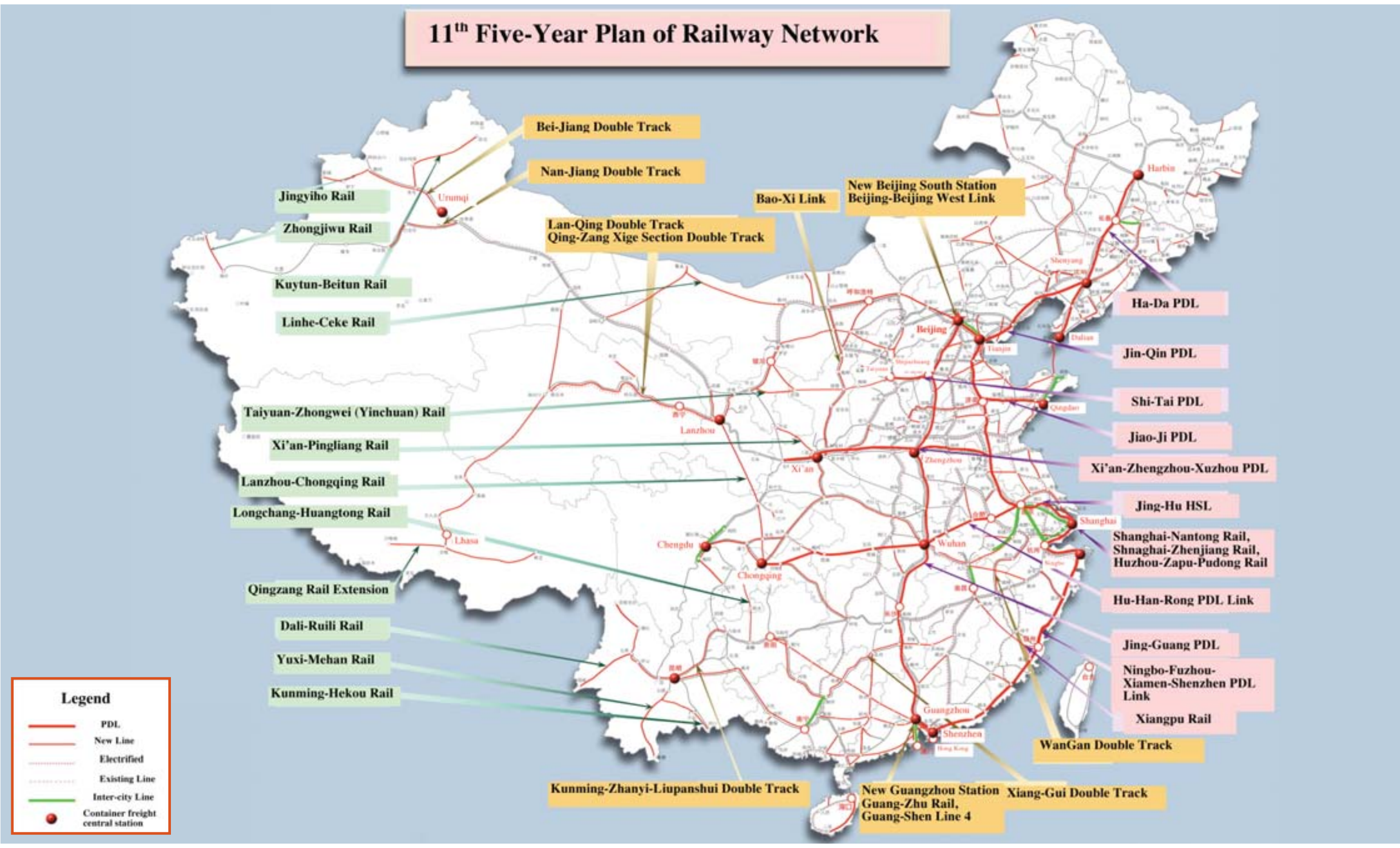
Four north-south lines: (PDL)

- Beijing-Harbin Line via Tianjin, Qinhuangdao, Shenyang. Branch: Shenyang-Dalian.
- Beijing-Shanghai Line via Tianjin, Jinan, Xuzhou, Bengbu, Nanjing. 350 km/h.
- Beijing-Hong Kong Line via Shijiazhuang, Zhengzhou, Wuhan, Changsha, Guangzhou, Shenzhen, infrastructure designed for future operations at 350 km/h.
- Shanghai-Shenzhen Line via Hangzhou, Ningbo, Wenzhou, Fuzhou, Xiamen; Shanghai-Hangzhou-Ningbo part is designed for 350 km/h, rest is designed for 200~250 km/h for both passengers and freight.

Four east-west lines (PDL)

- Qingdao-Taiyuan Line via Jinan, Shijiazhuang, Taiyuan line is designed for 200~250 km/h for both passengers and freight, others are designed for 200~250 km/h for passengers.
- Xuzhou-Lanzhou via Zhengzhou, Xi'an, Baoji, 350 km/h.
- Shanghai-Chengdu Line, via Nanjing, Hefei, Wuhan, Chongqing; Shanghai-Nanjing section is part of Beijing-Shanghai line with 350 km/h tracks, Nanjing-Chengdu line is designed for 200~250 km/h for both passengers and freight; Chongqing-Chengdu section is designed for 350 km/h.
- Hangzhou-Kunming via Nanchang, Changsha, Guiyang, Track 350 km/h.

These 8 Lines total 12000 km.



The blueprint of Chinese Railway Network by the year of 2010

Construction Schedule

Route	Short name	Length (km)	Design Speed (km/h)	Construction Start Date	Open Date
Qinhuangdao-Shenyang	Qin-Shen	404	200	8/16/1999	10/12/2003
Hefei-Nanjing		166	200	6/11/2005	4/18/2008
Beijing-Tianjin	Jing-Jin	115	350	7/4/2005	7/1/2008
Jinnan-Qingdao		364	200	1/28/2007	12/20/2008
Shijiazhuang-Taiyuan	Shi-Tai	190	200	6/11/2005	4/1/2009
Hefei-Wuhan	He-Wu	351	200	8/1/2005	4/1/2009
Wenzhou-Fuzhou		298	200	10/1/2005	6/30/2009
Ningbo-Wenzhou		268	200	12/1/2004	8/1/2009
Wuhan-Guangzhou	Wu-Guang	989	350	9/1/2005	12/1/2009
Fuzhou-Xiamen		273	200	9/1/2005	12/3/2009
Zhengzhou-Xian	Zheng-Xi	455	300	9/1/2005	12/28/2009
Guanzhou-Shenzhen		105	350	12/18/2005	1/1/2010
Longyan-Xiamen		171	200	12/25/2006	1/1/2010
Shanghai-Nanjing		296	200	7/1/2008	5/1/2010
Nanchang-Jiujiang		131	200	6/28/2007	6/1/2010
Guangzhou-Zhuhai		364	200	1/8/2007	11/1/2010
Wuhan-Jiujiang		258	200	12/16/2008	12/16/2010
Xiamen-Shenzhen		502	200	11/23/2007	1/1/2011
Changchun-Jinlin		96	200	5/13/2007	5/1/2011
Hainan East Ring		308	200	9/29/2007	9/1/2011
Wuhan-Yichang		293	200	9/17/2008	1/1/2012
Hefei-Bengbu		131	300	1/8/2009	6/1/2012
Guiyang-Guangzhou	Gui-Guang	857	200	10/13/2008	10/1/2012
Beijing-Shijiazhuang	Jing-Shi	281	300	10/8/2008	10/1/2012
Shijiazhuang-Wuhan		838	300	10/15/2008	10/1/2012
Tianjin-Qinhuangdao	Jin-Qin	261	350	11/8/2008	11/8/2012
Harbin-Qiqihar		285	200	11/20/2008	11/20/2012
Nanjin-Hangzhou		251	200	12/28/2008	12/28/2012
Ningbo-Hangzhou		150	200	12/28/2008	12/28/2012
Harbin-Dalian	Har-Da	904	350	8/23/2007	2/1/2013
Beijing-Shanghai	Jing-Hu	1318	300	4/18/2008	3/1/2013

Pandrol has been very much a part of MOR's plans, with involvement in a number of PDL and metro lines.

Shijiazhuang to Taiyuan (S-T) PDL

Classification	Application Standard	Remarks
Maximum design speed	250 km/hr	
Minimum radius	5,000 m	
Maximum Gradient	13.5%o (Up Track) 18%o (down Track)	
Effective length of platform	1,050m	
Track Gauge	1,435mm	
Distance between adjacent tracks	4.6m	
Rail	CHn60	60kg/m
Electricity	AC25KV	
Temperature	-25°C ~ +40°C	

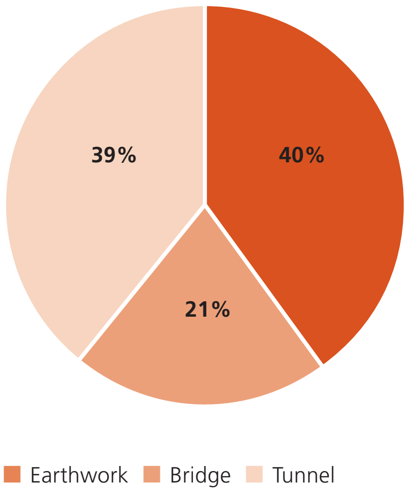
Construction of the new Passenger Dedicated Link (PDL) from Shijiazhuang to Taiyuan began in 2005. This PDL has been designed for an initial operating speed of 250km/h, which will be increased to 300km/hr after several years' operation. Unusually for a PDL, some freight traffic will also be allowed on the line, and it has a maximum allowable axle load of 25 tonnes.

The line has a total route length of 190km. This is comprised of 76km of plain tracks, 39km of bridges, and 75km of tunnels. The ballasted tracks are equipped throughout with PANDROL FASTCLIP rail fastenings.

There are three main tunnels: The Taihangshan tunnel (27.848km); Nanliang tunnel (11.53km) and the Shibanshan tunnel (7.505km), all three forming 39% of the total route length. These tunnels are fitted with CRTS1 concrete track slab, a prefabricated slab system similar to that which has been in use in Japan for many years.

The PANDROL Offset SFC (Single FASTCLIP) baseplate system is used throughout the tunnel sections. These baseplates, incorporating the FASTCLIP fastening, feature lateral adjustment of up to ±12mm and vertical adjustment of +30/-2mm, which makes it an ideal product for slab track where the speed and ease of installation and alignment, both in the initial construction and subsequent realignment, is critical.

Main Line Length: 190km



Earthwork
Length: 76km
Ratio: 40%

Bridge
Length: 39km
Ratio: 21%

Tunnel
Length: 75km
Ratio: 39%

Track Construction on the S-T PDL

A test installation was carried out at the depot at Shijiazhuang in March 2008. The contractor wanted a quick installation and adjustment of the line and level, in order that materials trains could be run through the tunnels to the other areas of construction as quickly as possible.

1. 5m long prefabricated slabs were laid and adjusted to approximately the correct level by injecting grout into a large bag attached to the underside of the slab.

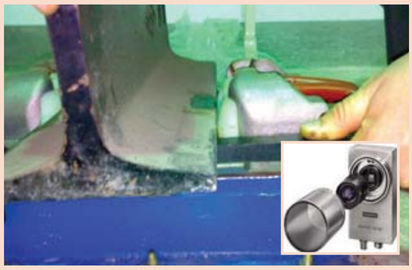
2. The baseplates were fitted to the slabs in the 'neutral' position.

3. Rails were installed and clipped up.
4. Due to the accuracy of the slab laying, materials trains could be run through the tunnel immediately.

5. In between materials trains, a full line and level survey of the rails was undertaken using very accurate rail mounted laser based equipment.

6. The installed position of the track was compared to the design position and lifts and slues marked onto the rail.

7. An adjustment team followed behind. A series of colour coded LDPE, HDPE and steel shims were provided, which allowed the track height to be very accurately set. Baseplate bolts could be loosened, the rail lifted with crowbars, and the correct shims slid into place.



8. In case of any suspensions of rail base in some rail seat areas it's also important to check the gap between the datum surface of baseplate and the bottom of the rail base, using a simple 'gap gauge' to measure the gaps. An alternative way can be a measurement using a laser measuring device.
9. The actual measured gap is compared with the designed standard gap value and the difference marked in the related baseplates.
10. Follow the procedure stated in step 7 to insert shims with the correct thickness.

11. Lateral adjustment then took place. After loosening the baseplate bolts on the datum rail, engineers could crowbar the rail to the amount required and make the adjustment using the slots in the baseplate and the serrated washer. The datum rail baseplates were then tightened and the gauge set on the other rail in the same manner.

Completed Track

Track geometry tolerances for S-T PDL (static track irregularity)

Item	200 km/h	200<v<=350km/h	Mark
Track Gauge	+1/-2mm	+1/-1mm	1435mm
Vertical irregularity	2mm	2mm	10m long chord
Lateral irregularity	2mm	2mm	10m long chord
Twist	3mm	-	Base on 6.25m
Track Cross Level	2mm	1mm	

The track opened in April 2009, and track geometry quality has been first class

Heifei to Wuhan (H-W PDL)

A further new PDL line, linking Heifei to Wuhan, has been constructed, with a total route length of 356km.

Heifei to Wuhan Passenger Dedicated Line

There are four main tunnels in this PDL, Dabieshan Tunnel (13.256km); Jinzhai Tunnel (10.7km); Hongshiyan Tunnel (7.857km) and Hongshigent Tunnel (5.108km). Pandrol In-line SFC fastenings were selected to be installed in the tunnels in this project, once again selected for the lateral (up to ±12mm) and vertical (+30/-0mm) adjustment they offered.

The difference between Pandrol Offset SFC and In-line SFC relates to the bolt positions - Offset SFC baseplates are designed for slab track applications where a lightweight baseplate is required. In-Line SFC Baseplates are designed for use on Concrete sleepers embedded in slab track, such as the Rheda 2000 system, where anchor bolts must be 'In Line' to avoid the steel reinforcement.

On the Heifei to Wuhan PDL, the baseplates were bolted to twin-block sleepers, which were then encased in reinforced concrete to form a concrete slab track - a process commonly referred to as 'Top Down' Construction. Pandrol In-Line SFC baseplates attached to twin-block sleepers had previously been used on the KTX high-speed lines in Korea, with great success, which provided a good reference for the Chinese MOR.

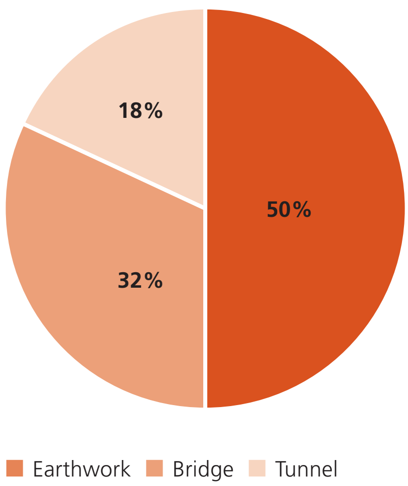
As with the S-T PDL, the initial line speed will be 250km/hr, increasing to 300km/hr, with a maximum axle load of 25 tonnes.

This PDL opened to operation in April 2009 and forms an important part of the proposed new high speed railway between Shanghai and western China.

Heifei to Wuhan Passenger Dedicated Line

Classification	Application Standard	Remarks
Maximum design speed	250 km/hr	
Minimum radius	4,500 m	
Maximum Gradient	6‰	
Effective length of platform	850m	
Track Gauge	1,435mm	
Distance between adjacent tracks	4.6m	
Rail	CHn60	60kg/m
Electricity	AC25KV	
Temperature	-25°C ~ +40°C	

Main Line Length: 356km



Earthwork
Length: 179km
Ratio: 50%

Bridge
Length: 113km
Ratio: 32%

Tunnel
Length: 64km
Ratio: 18%

Track Construction on the H-W PDL

1. All fastening components were pre-assembled on the baseplate.

2. The pre-assembled baseplate was bolted to the twin-block sleeper, with a conforming pad beneath the baseplate.

3. The twin-block sleepers complete with fastenings were laid onto the tunnel base slab and top slab base reinforcement.

4. The rails were threaded into the rail seats, and the clips applied.

5. Spindle jacks were fitted to the rails and the rails were lifted, lined and levelled. The rails were fitted with Gauge Bars to prevent the rail gauge decreasing due to bending of the twin-block sleepers.

6. Once the track had been precisely adjusted, concrete was poured to form the final track.
7. After the slab concrete was cured, the alignment of the track was checked.
8. If the vertical adjustment was out of the specified tolerance, vertical adjustment using height adjustment shims was carried out.
9. If the measured track gauge was out of tolerance (+/-1mm), lateral adjustments were made by simply loosening the bolts and moving the baseplates laterally via the slot in the baseplate and the serrated washer.

Track geometry tolerances for H-W PDL (static track irregularity)

Item	250 km/h	Mark
Track Gauge	+1/-1mm	1435mm
Vertical irregularity	2mm	10m long chord
Lateral irregularity	1mm	10m long chord
Twist	3mm	Base on 6.25m
Track Cross Level	+1/-1mm	

PANDROL VANGUARD in China

The first Chinese installation of PANDROL VANGUARD, the revolutionary rail fastening for the reduction of noise and vibration from railway tracks, was made in Guangzhou Metro in 2004, comprising of 700 assemblies on their lines 4 and 5. Further installations have followed every year and the Metro now has over 47,000 VANGUARD assemblies along its route length.

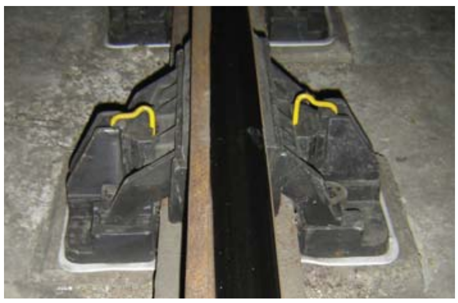
Pandrol's VANGUARD system delivers an assembly with both very low vertical stiffness and minimal rail roll and delivers exceptional vibration reduction performance at a much lower cost than floating slab.

In a VANGUARD assembly, the rail is supported under the head and in the web with large rubber wedges, leaving the foot of the rail suspended. The rubber wedges are held in place by cast-iron side brackets which are either fastened to a concrete sleeper, concrete block or slab, or to a baseplate fixed to the track base using either bolts or screwspikes.

Following the success of the Guangzhou Metro installations, Beijing Metro decided to introduce VANGUARD on its Line 5, and a successful site performance of ground vibration reduction with the system met the requirement for the 2008 Olympic Games in Beijing.

Planned installations on Beijing Metro will be double those installed in 2008, and there are further projects proposed for other Chinese metro systems in 2010/11. ■

Completed Track



VANGUARD installed on the Beijing Metro